THE NAVAL ARCHITECT

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September 2014

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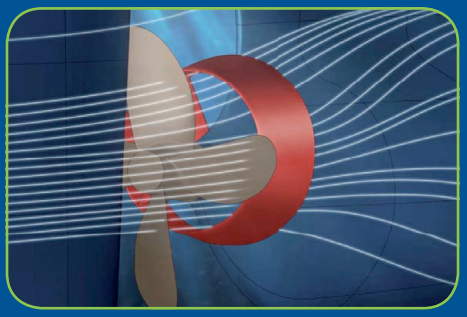

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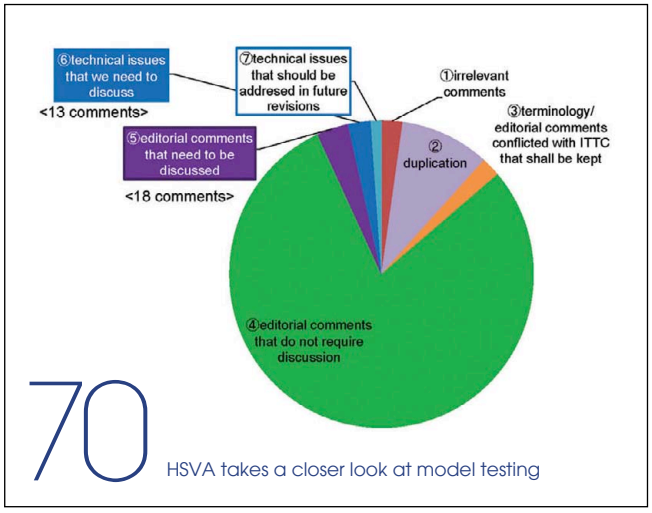

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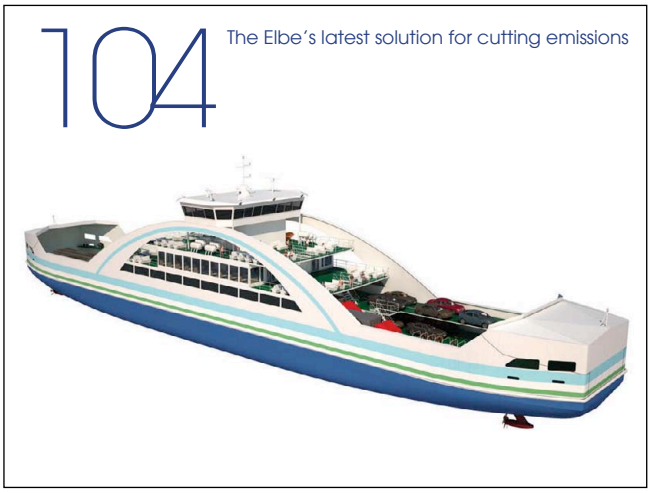

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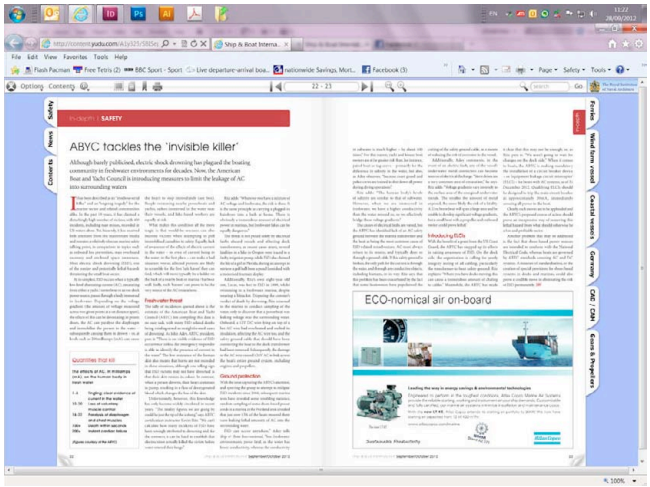

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Modernise or bust

China takes proactive action to the problems faced in the shipbuilding industry

There is a realignment of the shipping industry taking place as the full extent of the sustained recession becomes clearer and the dust settles around the shipbuilding industry the view from the parapet is one where investment and knowhow will triumph over stagnation.

The new model will see the evolution of a leaner slower growing industry whose main base, for the time being at least, will be in China. Japan and South Korea will maintain smaller industries and will, on the whole, attempt to maintain a technological advantage over China, whose cheap labour workforce provides an attractive draw for ship operators looking to build new ships.

China has tried to address the problems that its shipbuilding industry is suffering the difficulties caused by the glut of capacity that exists in China, still more than 1,600 yards operating in the country by issuing directives that would, if enforced, certainly see a significant number of yards close down.

Enforcement is an issue in China (see page 42 Beijing yard reforms slow to take hold) and the government has a problem, if yards do shut down then unemployment will rise, presenting the authorities with another headache. So although Issue 55 has been passed and the yards are meant to operate more efficiently, offer permanent jobs and training to staff, invest in R&D, etc. the reality on the ground is that little of these reforms have been realised as a consequence of Issue 55.

Effectively market forces are forcing the hands of Chinese yards. Owners now have an abundance of capacity to choose from as orders collapsed so they are demanding better facilities, more and better trained staff, better quality work, higher quality design and better quality components. In short market forces will decide which yards will get the work and which ones will not and those that have not modernised are facing the grim realities of market forces.

Those grim realities are stark. In 2013, the Chinese shipbuilding industry apparently experienced something of a renaissance, with yards seeing a near 15% increase in export orders at Chinese yards to the end of May this year, when compared to the same period last year. Sadly for the yards all these orders went to just 4% of the 1,600 plus yards available in China.

This is now a recognised trend as 2013 saw 80% of the US$37 billion in new orders placed at just 20 yards. Such a trend will certainly lead to yard closures, but it will also spur those still competing in the market to improve their services.

On that score Chinese shipbuilders have definitely got the message. Yards and designers in China are now looking to enter into the high end sectors that Japan and Korea and even the Europeans were hoping to preserve for themselves. Chinese yards are already exploring the possibility of building cruise ships, previously the exclusive reserve of a few European yards. Another group of yards in China has either developed or is in the process of developing, the technological ability to build LNG carriers.

Many yards in China are now looking at competing for sophisticated vessels used in the offshore trades too, and this in turn will squeeze Japanese and Korean builders who have sought refuge from the ravages of recession by developing their offshore client base.

Enforcement of regulations may become less complicated when the country approaches a full employment situation, that situation remains a focus for the future in China. At the moment the recovery, such as it is, remains in its embryonic stages. In shipbuilding the green shoots of recovery have been nurtured by a group of owners that have preserved cash with which to order when the market reached rock bottom. Those orders are now being disseminated by these prudent owners.

However, these owners often buy cheap and sell at the top of the market and it may take a while for them to be able to realise their profits as the recovery in other parts of the economy remains sluggish, making the demand for ships and ship capacity also sluggish.

The market will return to growth at some point, however, and those owners will eventually reap the rewards of their prudence. The challenge for the yards is to follow in the owners' footsteps, show similar prudence and invest in the technology and knowledge that will meet the demands of quality owners. The message is clear; modernise or go bust. *NA*

Scrubbers

Approved scrubber secures orders

Finnish joint venture DeltaLangh, a partnership between Deltamarine and Oy Langh, is celebrating the class approval of its scrubber system with the announcement of a four ship deal.

The scrubber system has been installed on Langh Ship's 6,410dwt general cargo vessel *Laura* and the system has been given the final approval by DNV GL. Four other Langh ships will be fitted with the scrubber system before January 2015 when the Sulphur Emission Control Area (SECA) comes into force, says the company.

DeltaLangh was established in June this year in an effort to offer ship operators in the European and North American SECA regions a way of meeting the new sulphur regulations.

"DeltaLangh provides shipping companies with a unique environmentally friendly closed loop scrubber solution, which also efficiently cleans the scrubber's washing water. The system uses caustic soda to clean the exhaust gas. The water content of the residual sludge from the patented water treatment process is very low and therefore minimises the amount of waste. The scrubber can alternatively be used in an open loop mode with sea water," says the company.

Fuel savings

Dutch foil saves fuel

Hull Vane BV has launched its fuel saving attachment, the Hull Vane, which it says is suitable for a variety of vessel types and can be used for new ships or retrofitted to existing vessels.

Fuel savings of up to 15% are claimed by Hull Vane, which is a foil shaped attachment designed to be fitted to the stern of a vessel and to generate forward thrust. The company says the attachment also reduces the stern wave and the running trim of the vessel.

The company claims: "Sea trial comparison tests of a 55m Fast Supply Intervention Vessel with and without Hull Vane confirmed what was earlier found in Computational Fluid Dynamics (CFD) calculations: a reduction in required shaft power ranging from 10% at 12knots to 15% at 21knots for this application."

However, the company adds that the reduction in fuel consumption is dependent on the length of the ship, its speed and hull form.

MOU

GE & LR sign GT deal

Marine propulsion manufacturer GE Marine and class society Lloyd's Register have signed a Memorandum of Understanding (MOU) to develop commercial projects using gas turbine power.

The two companies will first identify which sectors are most suitable for them to target. GE gas turbines are already operational on cruise ships, fast ferries and yachts and GE says that the systems "offer power density", that means they are light weight and high power says the company.

Moreover, the GE system offers "fuel flexibility, and an optional, highly reliable Dry Low NOx emissions (DLE) combustion system technology". It can also meet Tier III IMO/Tier IV United States Environmental Protection Agency regulations.

The Hull Vane can be installed on newbuild vessels or retrofitted to existing vessels

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According to the company: "GE's industrial LM2500 family fleet has logged nearly 70 million hours operating on natural gas, of which 20 million hours were dual fuel applications. In addition, the 585 industrial applications that use the DLE combustion system have logged more than 12 million hours. Separately land-based operators report a 99.9% reliability rate across the gas turbine fleet."

Eco-ships

Kisekae sets sale

The Maritime Innovation Japan Corporation or MIJAC has announced that its new design 'Kisekae' will provide a new means to improve ship fuel efficiency.

The company is confident that it has helped create a solution that it has included 'Kisekae' in its basic design of the concept bulk carrier *Flex Ultramax 2014* that it has been developing.

The advance comes very soon after MIJAC announced its 10 research themes at the end of last year, which included the development of a 30% energy saving ship.

In November 2013 Kazuichi Masuda, MIJAC director, explained: "The general plan [for the ECO-SMART ship] spans four or five years, but some items in the plan may reach their goals earlier, by one or two years, so that adoption becomes possible from the second to third years."

And in just under a year MIJAC is already heading towards its goals, the company says: "While fuel efficiency has already been increased by 5% on 63,000dwt bulk carriers compared to *Supramax* of 56,000-58,000dwt, we expect an additional 3% in fuel efficiency on the *Flex Ultramax 2014* by applying the concept on 'Kisekae'."

MIJAC added: "Slow-steaming operations are currently the norm, and the movement of environmental regulations and fuel prices suggests that slow-steaming operations will continue in the future.

"But, because many operators think that the shipping market is facing an economic boom and that they will again want to operate ships at increased speeds, *Flex Ultramax 2014* has been designed for those usual bulk carrier speeds."

However, MIJAC is not the only company that is in the race to produce its own fuel efficient vessels. The Chinese company, Qingshan Shipyard, combined with a modified version of a design by the Finnish company, Deltamarin Ltd, have managed to develop a new bulk carrier that promises extremely low fuel use.

Hamburg Bulk Carriers (HBC) is confident of the new fuel efficient vessels, being built by Qingshan Shipyard, that they have ordered three vessels that, according to the company, will use less than 20tonnes of fuel per day.

Yards

Meyer Werft acquires STX Finland shares

Germany's Meyer Werft and STX Finland shipyard have combined forces in Turku.

The two companies set to merge in Turku, have signed a share purchase agreement after the current owner, STX Europe, was refused a loan from the Finnish Government for the Turku shipyard, located in southern Finland, back in 2012.

The latest purchase from Meyer Werft has given it a 70/30 split of shares, along with industrial leadership in the new company, set to rename itself Meyer Turku Shipyard Oy once the acquisition has been cleared by the antitrust authorities and banks.

Dr Jan Meyer, managing partner of Meyer Werft, said: "This acquisition will strengthen the yards in Papenburg, Turku and Rostock: With joining forces with Turku we can offer more flexibility to our customers."

Meyer Werft's latest purchase can be considered a big step in the right direction for the company as it will give Meyer Werft the ability to build larger ships than its German shipyards can currently handle.

"Both shipyards respect each other for their high level of professionalism and thus can learn a lot from each other in order to improve their working processes or to join forces on research and development", the company says.

At present some 1,300 employees and a specialised supplier network are involved in the construction of the cruise ship *Mein Schiff 4* for the German cruise operator TUI Cruises from Hamburg. TUI Cruises just announced to order another two ships of this class in Turku to expand its fleet to six ships by 2017. *NA*

The *Mein Schiff 3* has been built at STX Finland Oy in Turku in 2013

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Newbuilds, are they accidents waiting to happen?

Seafarers need to be extra vigilent to guard against possible defects in newbuidings which may become apparent after delivery, North P&I Club has warned, while seafarers union Nautilus has reacted angrily to what it says are moves by the UK government to revoke certain shipping regulations enacted in the wake of the *Herald of Free Enterprise* ferry disaster, *writes Sandra Speares*.

Many seafarers or superintendents who have been present around the time of a newbuilding being built, or delivered to its new owner, have witnessed that vessels may not be free of gremlins and in the busy months after the new ship comes into service, build defects may become apparent.

The North P&I club has warned its members to check their new ships very carefully before accepting delivery. In the latest issue of its loss prevention newsletter 'Signals', the club says it has become aware of several of instances of potentially dangerous poor construction in the newbuilding market.

According to Tony Baker, head of North's loss prevention department: "We have been made aware of instances recently where newly constructed bulk carriers and general cargo ships have been delivered from the shipbuilder with partly completed or poorly constructed ladders in the cargo holds, for example."

The club reports that ships are being delivered with cargo hold access ladders, platforms and their cages constructed and secured to the bulkheads only by tack welds, rather than being fully welded.

"When subject to a load or any other applied stress, such as vessel movement, the tack welds have failed and resulted in an unsafe access to and from the cargo hold. This introduces a very high risk of injury to crew members, stevedores and any third parties entering or leaving the cargo hold," says Baker.

In addition to accidents, North warns that defects can also result in costly delays and port state control problems. While the cost of repairs for defects that fall within a newbuilding's warranty period will often be recoverable from the shipbuilder, the club says any costs incurred through consequential losses, as a result of such a defect, are unlikely to be recoverable.

"Shipowners and their superintendents taking delivery of newbuildings in the current market need to be extra vigilant to ensure that all parts of the ship - including hold access ladders - are defect free," says Baker. "The first few months that a vessel enters service are amongst some of the busiest, during which time hidden or previously unnoticed build defects will soon become apparent, potentially resulting in serious accidents and delays.

"From a loss prevention perspective, we would recommend that the owner's representative standing by the newbuild, be it a project manager or superintendent, remains vigilant to these types of problems and ensure that work is carried out to an acceptable standard before signing off. If taking delivery of a newbuild without having a representative on site during construction, then ensure a high level of scrutiny before acceptance."

Herald outcry

Meanwhile, an angry response has come from seafarers union Nautilus over what it says are UK government plans to revoke four shipping safety regulations, introduced in response to recommendations made by the formal investigation into the 1987 *Herald of Free Enterprise* ferry disaster.

The union accuses the government of putting costs before safety in its 'repugnant' plan to scrap the requirements for ro-ro passenger ships to be fitted with on-deck emergency equipment lockers containing axes, crowbars, lifting gear and ladders.

In its response to a public consultation on the proposals, Nautilus argues that they are being 'driven by deregulatory dogma' and that it is wholly unacceptable to

Anger as regulators introduced following the loss of *Herald of Free Enterprise* are to be recinded

consider removing equipment that could help to save lives in an emergency.

The Union says the proposals have been built on a 'dangerously complacent' assumption that the root causes of the *Herald* disaster have been addressed by subsequent safety measures.

Emergency equipment lockers are in fact more important than ever because of the increasing size of ferries, it points out. "The importance of such equipment — or the lack of it — was demonstrated in the recent *Sewol* ferry disaster in South Korea," it adds.

The Union also warns against the proposed scrapping of an associated requirement for goods vehicles and items of cargo over 7.5tonnes to be weighed in ports before loading.

"These essential measures are an integral part of a safety package drawn up in response to the *Herald* disaster and we must continue to learn from such accidents," said Nautilus senior national secretary Allan Graveson. "We believe these proposals have been driven by commercial pressures and by those who have little regard for the lessons of history."

The four regulations in question were:

- The Merchant Shipping (Weighing of Goods Vehicles and other Cargo) Regulations 1988 (S.I. 1988/1275)
- The Merchant Shipping (Weighing of Goods Vehicles and other Cargo) (Amendment) Regulations 1989 (S.I. 1989/270)
- The Merchant Shipping (Weighing of Goods Vehicles and other Cargo) (Application to non-UK Ships) Regulations 1989 (S.I. 1989/568); and
- The Merchant Shipping (Emergency Equipment Lockers for Ro/Ro Passenger Ships) Regulations 1988 (S.I. 1988/2272).

In a consultation document released in June, the Government outlined a number of changes that had been made since the *Herald of Free Enterprise* disaster on 6 March 1987 and concluded that the Government's Red Tape Challenge Initiative identified the four sets of regulations as suitable for revocation and said that with higher standards introduced following the disaster and subsequent accidents like *Estonia,* the MCA safety experts consider that the four Regulations proposed for revocation now add very little additional meaningful safety. *NA*

Ballast water treatment

Hyde Marine offers validation service

Hyde Marine, Inc., has announced it will begin using a new ballast water test system, B-box, recently made available from the Royal Netherlands Institute for Sea Research (NIOZ) to help ballast water treatment (BWT) technology companies conduct accurate analysis regarding the concentrations of chemicals or organisms present in ballast water.

The B-box testing service was designed by NIOZ to help BWT companies and shipowners test the BWT system operations and the physical and chemical variables that may be present in the ships' ballast water, the company said. NIOZ has extensively tested the B-box system with Hyde Marine over the past two years to determine its efficacy for maritime use.

B-box is a "ballast water sampling box," which contains sample bottles that can be filled with treated ballast water, mixed with provided test chemicals, and sent to NIOZ for validation. NIOZ professionals will perform a number of tests on physical-chemical variables and concentrations of organisms as requested by Hyde Marine and provide analysis regarding what chemicals and organisms are present in the water.

www.hydemarine.com

CAD/CAM

Dassault Systemes gets SIMPACK

Dassault Systèmes has announced its acquisition of SIMPACK, the multi-body simulation technologies and solutions provider. With the acquisition of SIMPACK, based near Munich, Germany, Dassault Systèmes is expanding its SIMULIA realistic multi-physics simulation technology portfolio to include multi-body mechatronic systems, from virtual concept validation to the real-time experience.

Dassault has said that SIMPACK has demonstrated strong technology leadership, in particular through complex models, non-linear effects such as friction and flexible structures, efficient numerical algorithms, and real-time capabilities.

With SIMPACK technologies enhancing the 3DEXPERIENCE platform, Dassault Systèmes will provide the leading integrated solution for end-to-end development of advanced systems, combining realistic multi-physics simulation, accurate real-time simulation of mechatronic assemblies, and control of smart systems.

www.3ds.com

Lifesaving & ship safety

Viking inks multi-million dollar deal

Marine and fire safety equipment provider Viking-Life-Saving Equipment and Topaz Energy and Marine have jointly announced the signing of a USD multi-million, 10-year combined fixed price and exchange service agreement for liferafts. Under the terms of the contract, Viking will upgrade all of Topaz's current liferafts and manage the ongoing servicing and certification of Topaz's liferaft fleet. Topaz has said that the new agreement further strengthens the company's health and safety credentials, raising the bar in an increasingly competitive market.

www.viking-life.com

Ancillary equipment

Classified sealing from IHC

IHC Sealing Solutions has said that it has received third-party verification from DNV GL,. This means that the company's SUPREME Ventus and SUPREME Athmos seals, that it claims guarantees zero oil emissions, are now compatible with mineral oils that are used in US waters in compliance with the Vessel General Permit (VGP).

On 19 December 2013, the revised VGP, issued by the US Environmental Protection Agency, came into force. This new permit mandates the use of environmentally acceptable lubricants for all oil-to-water interfaces, such as stern tube and thruster seals, on all merchant vessels that are 79 feet or longer and sailing in US coastal and inland waters.

"The verification by DNV GL shows that under normal operating conditions, the oil-to-water interface is eliminated," says IHC Sealing Solutions, marketing manager, Dustin van Horik. "Both systems prevent emissions to the surrounding environment. We are delighted that the DNV GL's verification means that it is now possible to sail in US waters with mineral oils in combination with IHC Sealing Solutions' SUPREME Ventus and SUPREME Athmos seals."

www.ihcsealingsolutions.com

Propulsion

Engine monitoring from Actisense

Actisense, the marine electronics brand from Active Research Limited, based in Poole, UK, has upgraded

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its Engine Monitoring Unit (EMU-1) with advanced new firmware. The device, which acts as a specialised Analogue to the NMEA 2000 Interface, will offer greater flexibility by allowing monitoring of dual engines or multiple tanks, Actisense has said.

Alternatively, the EMU-1 can be used to monitor fluid levels in up to six tanks at any one time. The addition of a configurable 'instance' for each tank allows the user to identify which tank the data is coming from, making the monitoring of fluid levels easier.

The EMU-1 was designed to simplify the conversion of analogue engine parameters (of temperature, pressure, Tach / RPM, etc.) into the corresponding NMEA 2000 engine parameter group number (PGNs). The EMU-1 can handle six gauge / parameter inputs (these can be instead of the gauge or in parallel with the gauge), four alarm inputs, two Tach inputs and two additional auxiliary inputs, which are flexible to suit each installation. Most notably, the device is also backwards compatible with older engines.
www.actisense.com

Paints & coatings

I-Tech to supply CMP

I-Tech has entered into a non-exclusive supply agreement with Chugoku Marine Paints Ltd (CMP) for use of I-Tech's proprietary product, Selektope, in commercial antifouling paints. Selektope is to be used as the principle biocide in future CMP products.

CMP have said that due to the low concentration needed, Selektope does not compromise the paint's chemical structure, colour or other cooperative biocides involved.

"We are pleased to start commercialising on our dedicated efforts in developing formulations using Selektope as principal biocide. It is well aligned with our core values and we look forward to be able to introduce this technology to our customers", says CMP's, managing director, Masashi Ono.
www.cmp.com

CAD/CAM

AVEVA links up with ETAP

AVEVA and ETAP have signed a partnership agreement under which both companies will jointly develop a software interface between AVEVA Electrical and ETAP's enterprise solution for electrical power systems. The new interface will provide for the first time electrical engineers with a single round-tripping environment for complete data validation from design and network validation to 3D visualisation. The interface will deliver capabilities for efficient design, development and production for the most complex electrical installations in all types of process and power plants, ships and offshore facilities, AVEVA has said.

The collaboration means that engineers will be able to introduce an iterative approach to electrical data changes. They can now seamlessly round-trip data between AVEVA Electrical and ETAP as many times as necessary and can use shared data to visualise and perform accurate cable routing in AVEVA Everything3D through an unbroken workflow.
www.aveva.com

Actisense launches its latest solution for engine monitoring

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Propulsion

Siemens equips UASC eco ships

The Siemens Drive Technologies Division is equipping 17 container ships owned by the United Arab Shipping Company (UASC) with an environmentally friendly drive and power generation system (Siship SGM) under contract from Hyundai Heavy Industries. Using a waste heat recovery system (WHRS), exhaust gas from the propulsion main engine is utilised to produce additional electrical power from the ship's exhaust gas in a clean and efficient manner. This enables power to be generated with a lower overall fuel consumption while simultaneously reducing CO_2 emissions by up to 12%, Siemens claim. The drive system is a shaft generator, which operates both as motor or generator and is automatically adapted to suit the requirements in hand by a higher-level power management system. This enhances the efficiency and flexibility of the power generation process as well as reducing wear on the main drive and the auxiliary generators.

The class A-14 and A-18 UASC container ships have a carrying capacity of 14,500 and 18,800TEU. Due to the loaded cargo, the ships have significant power requirements, which can be optimised with highly-efficient drive solutions and an intelligent power management concept.

www.siemens.com

Vessel monitoring

Getting good vibes from Dyena

Dyena has launched its latest Dyena PRO, which is set to simplify long term recording of vessel structural accelerations, providing scientific data. When an event occurs above the programmable threshold, raw data from before and after the event is stored in a single file alongside the daily overview spreadsheet and a Google Earth 3D map trace.

The Dyena PRO unit constantly monitors the shock and vibrations received by the vessel's structure and stores the data to the onboard solid state memory, alongside position, speed, heading and time. Sampling at 1,200Hz, recording the peak and RMS averages every second and storing individual daily records stored alongside a Google Earth 3D map trace, provides the user with a concise and easy to interpret overview of vessel operations, the company said.

Raw data is continuously buffered and when a significant event is observed Dyena PRO records the accelerations leading up to the event as well as those afterwards at 1,200Hz providing the user with the complete record of the relevant acceleration data.

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Dyena launches latest shock and vibrations solution

Ancillary equipment

WTS secures Inert Gas System orders

Wilhelmsen Technical Solutions has secured multiple orders to supply its Maritime Protection Dry Inert Gas Generator (DIGG) systems for installation on LNG carriers under construction at Japan Marine United's, Tsu shipyard.

Two DIGG units will be installed on two gas carriers under construction for Japanese owners Tokyo LNG Tanker Co., Ltd./Mitsui O.S.K. Lines Ltd (first vessel) and Tokyo LNG Tanker Co., Ltd./NYK Line (second vessel).

The MP DIGG system comprises an inert gas generator, refrigeration unit and a combined cooler/dryer and will be delivered to the yard in 2016. Among the reasons for the selection of the system is that it occupies much less space and volume in the engine room compared with competitive units.

WTS is also fulfilling orders for Maritime Protection DIGG systems for VLGC/LPG carriers built by Hyundai Heavy Industries, Hyundai Mipo Dockyard, Hyundai Samho Shipyard and Daewoo Shipbuilding & Marine Engineering.

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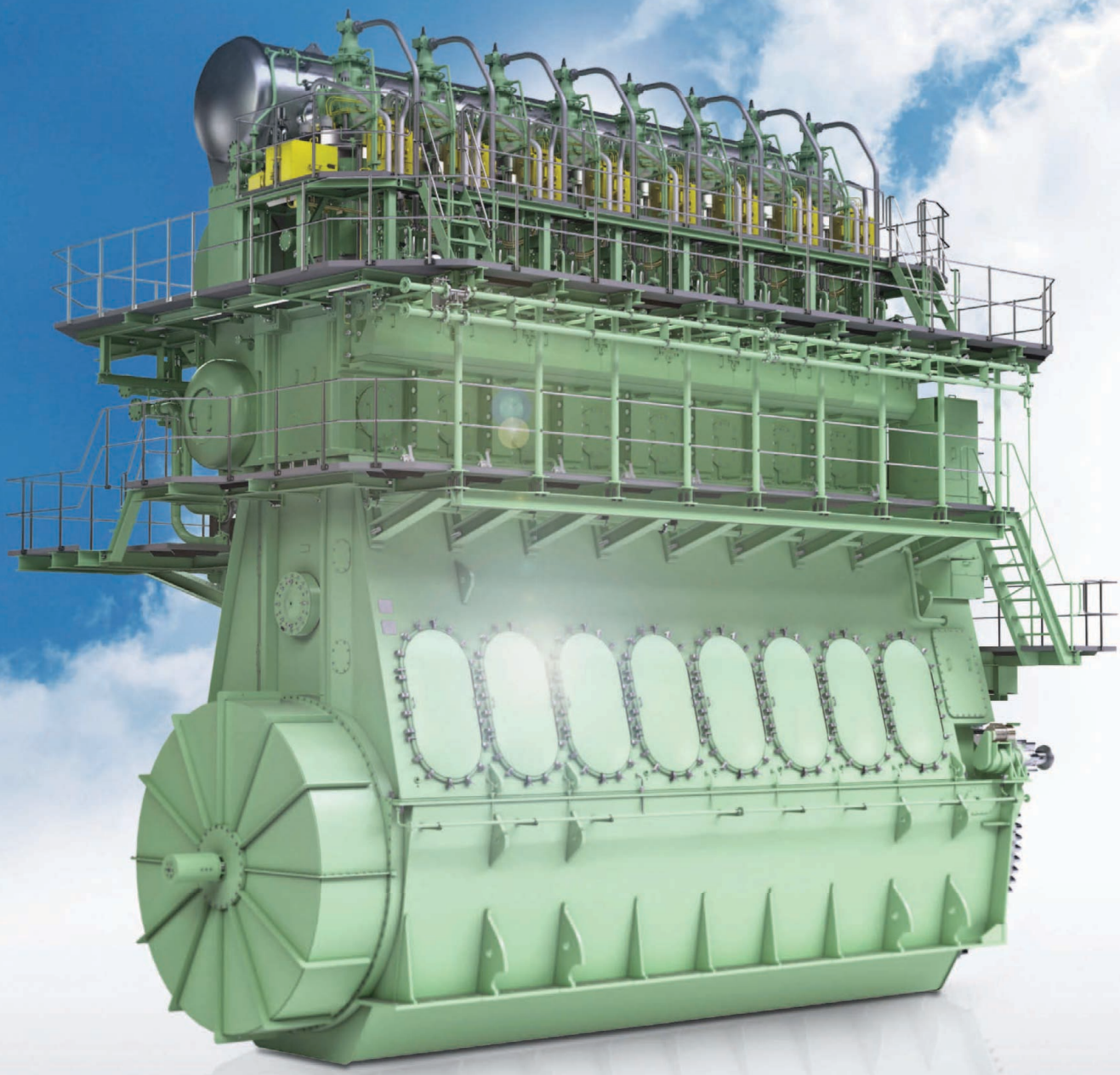

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Exciting times for Marelli's hybrid motor

Marelli's hybrid synchronous motor-alternator with a dual AC/DC excitation system is an innovative marine solution in which the same electric machine operates as a conventional shaft generator and variable speed propulsion motor

Over the last decades a steady trend has developed towards more-electric ships. In fact, the use of electric power in the shipboard environment brings large advantages in terms of flexibility, dynamics, comfort and efficiency.

Large electric machines are being more and more frequently introduced not only for onboard electric power generation, but also for electric propulsion, including both main and auxiliary propellers.

In normal conditions, the internal combustion engine generates the overall power needed for both propulsion and other shipboard electric loads and the electric machine is required to operate as a fixed-speed fixed-voltage conventional alternator subject to Automatic Voltage Regulator (AVR) control.

However, the same machine is also required to operate as an inverter-fed variable-frequency motor to drive the main propeller. Such an operating mode is essential to guarantee uninterrupted driving torque to the propeller in case of a failure on the internal combustion engine. Moreover, the motoring mode is required when the propeller is to be driven at low variable speed during ship manoeuvring.

These requirements have inspired the electromagnetic design for the motor-generator, which has been equipped with a novel double-excitation system mounted on its shaft. More precisely, the electric machine has two rotating exciters (with relevant rotating rectifiers), of which one features an AC-fed three-phase stator and the other a more conventional DC-fed stator.

Both exciters are used to energise the main rotor field. More precisely, the DC-fed one is used during generator operation under conventional AVR control, the AC-fed one is used during motor operation mode under variable-frequency converter supply.

	Motor mode	Generator mode
Power	1500-3000 kW	Up to 4,5MVA
Voltage	LV or MV	LV or MV
Frequency	Up to 72 Hz	50 or 60 Hz
Speed	0-1500 rpm	750 to 1800
Power factor	Approx. 1.0	0.8
Efficiency at full load	Approx. 97%	96 to 98%

Table I: Machine ratings

The advantage of using an AC exciter during motoring operation mode is that the main field can be energised even at stand-still and at very low speeds, which makes the synchronous motor capable of a large starting torques with no need for oversized rotor cage circuits to be dimensioned for asynchronous starting.

System layout and operating modes

The system layout in which the electric machine is included is shown in Figure 1. Includes a large internal combustion engine connected, via a triple-shaft gear-box, to the main propeller and to the electric machine as well.

The normal operating mode for the system is depicted in Figure 2, under these conditions, the internal combustion engine develops the entire power PDE (DE standing for diesel engine), which is partly used to provide the mechanical torque to the propeller (mechanical power quota PM) and partly used to drive the electric machine as an alternator that supplies the shipboard grid (electric power quota PE).

In case of failures, the internal combustion engine is disconnected from the gearbox and the propeller torque is to be delivered using the electric machine, which is then switched into motor operating mode.

Under these conditions (Figure 3), the electric machine is fed by a variable-frequency Voltage Source Inverter (VSI) supplied by the shipboard grid thanks to the power produced by other onboard generation groups. The same motoring mode is entered by the electric machine when the propeller needs to be driven at low variable speed for example during manoeuvring and station keeping.

The electric machine ratings are given in Table I. The required mechanical performance for the machine in its motoring mode is represented in Figure 4a in terms of power versus speed curve. The same performance is indicated in Figure 4b, where the torque output is plotted as a function of the speed. What does not appear in Figure 4 is the break-away torque that the motor is demanded to develop to start the propeller from stand-still. This torque value is difficult to predict and strongly depends on friction, bearing characteristics and ship attitude and speed at the motor start-up.

In order to meet the operating requirements the technology used consists of a double rotating excitation system (Figure 5).

An overall scheme of the rotor excitation system is shown in Figure 6. Here we can note that the field circuit F, protected by a capacitor C and a varistor V against possible over-voltage supply, is supplied

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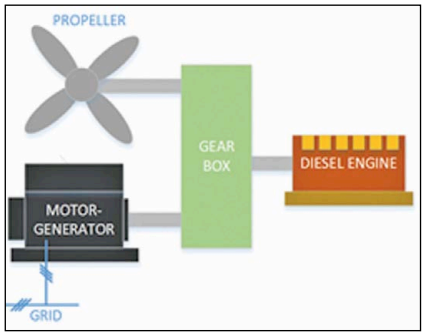

Figure 1: Overall system layout

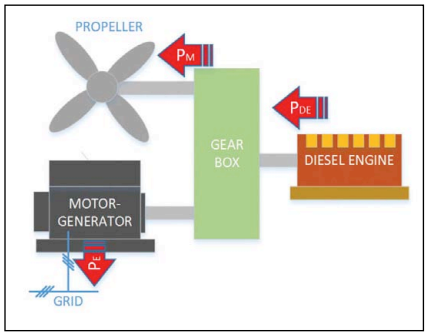

Figure 2: Electric machine operation as a generator driven by the internal combustion engine

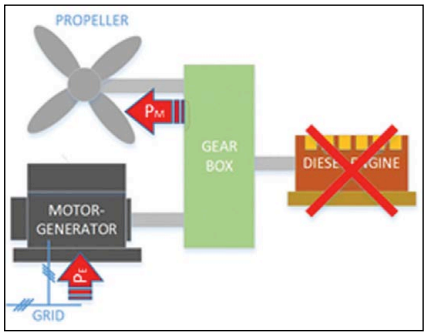

Figure 3: Electric machine operation as a motor driving the propeller

by two shunt connected rotating rectifier bridges, DC-B and AC-B. These are respectively supplied by the three-phase rotor windings of two rotating exciters, named DC-E and AC-E respectively. The former is a conventional exciter with a DC-fed stator winding (DC-S), while the latter is a special exciter featuring a three-phase stator winding (AC-S).

A schematic of system implementation from a construction viewpoint is illustrated in Figure 7. Here we can note that both exciter rotors are coaxially mounted on the same machine shaft, where also a Permanent Magnet Generator (PMG) and an encoder (E) are assembled. The two exciter stators are, instead, fixed on the main machine frame.

The excitation system operation for the generating and motoring modes is illustrated in Figure 8 and Figure 9, respectively. In generating mode (Figure 8), the machine shaft is supposed to be turning near the rated speed under driven by the internal combustion engine (Figure 2). In these conditions, the voltage produced by the PMG is used to supply a static excitation system which feeds the stator of the DC-fed exciter through a conventional AVR.

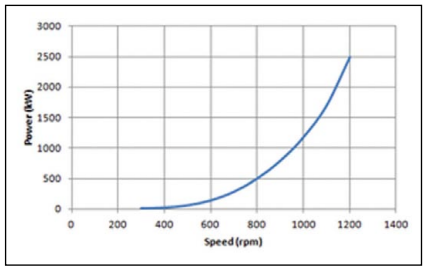

Figure 4a: Output power demand versus speed in machine motoring operation

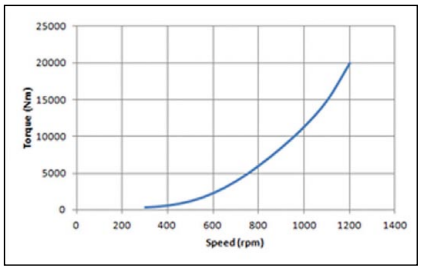

Figure 4b: Output torque demand versus speed in machine motoring operation

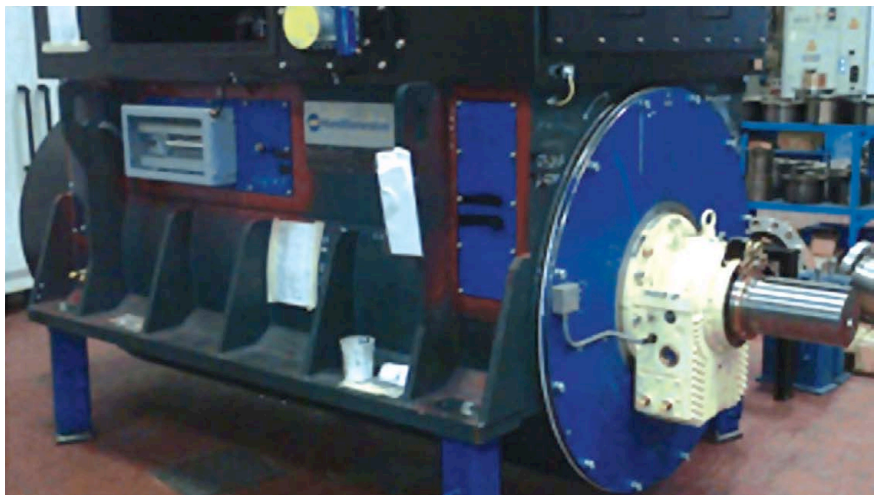

Figure 5: Machine design solution

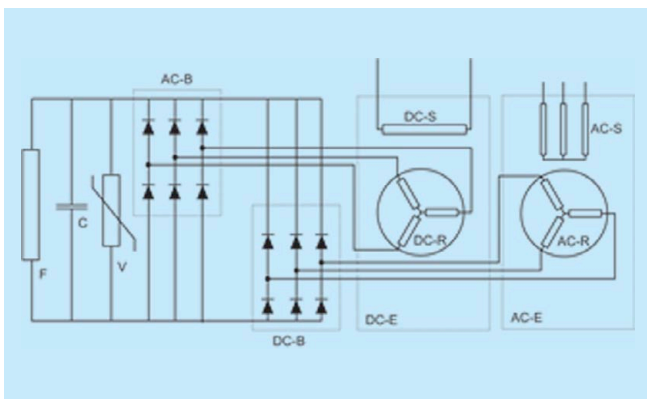

Figure 6. Block scheme of the overal rotor excitation system. Field circuit (F); protection capacitor (C); varistor (V); DC-fed exciter (DC-E) with relevant rotating rectifier bridge (DC-B), three-phase rotor (DC-R) and DC stator (DC-S); AC-fed exciter (AC-E) with relevant rotating rectifier bridge (AC-B), three-phase rotor (AC-R) and three-phase stator (AC-S)

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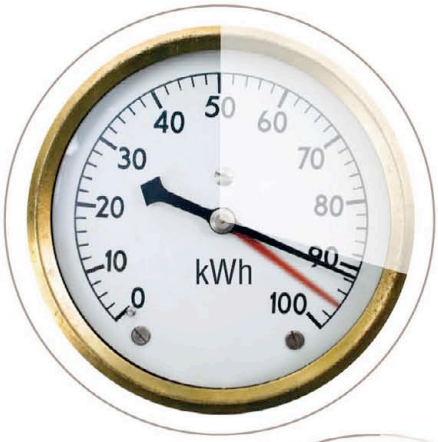

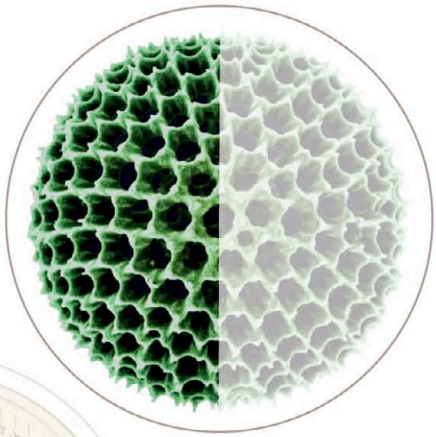

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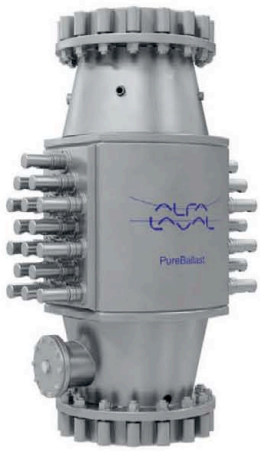

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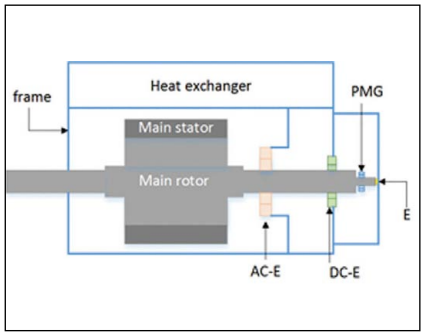

Figure 7. Machine lateral section drawing. AC-exciter (AC-E) and DC-exciter (DC-E) mounted on the shaft along with a PMG and an encoder E

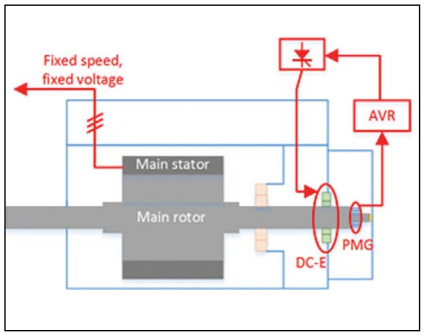

Figure 8. Schematic of machine operation as a generator

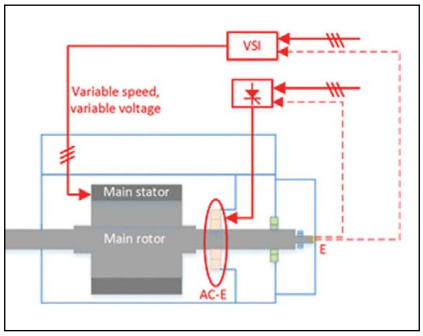

Figure 9. Schematic of machine operation as a motor

In motoring mode (Figure 9), the machine shaft can be either at stand-still or turn at whatever speed, between the zero and the maximum. A VSI feeds the main stator terminals based on a speed control that employs the encoder output for the feedback loop. The VSI also encompasses a power module that supplies the AC-fed exciter with fixed-frequency three-phase voltages of variable amplitude so as to control the rotor excitation current and, consequently, the machine flux.

Design advantages

The AC-fed exciter substantially differs from the DC-fed one because it includes a three-phase stator. By supplying such an exciter stator with a three-phase system of currents at a fixed frequency f, it is possible to obtain a rotating magnetic field that revolves at a mechanical speed equal to $2\pi f/p$ rad/s, where p is the number of AC-fed exciter pole pairs. By suitable selection of exciter supply phase sequence, it is possible to generate a rotating field that revolves in the opposite direction compared to the main shaft. Hence, calling π the shaft mechanical speed, a slip s arises between the AC-exciter rotor and its stator-generated field. Such slip is:

$$s = \frac{2\pi f / p + \omega}{2\pi f / p} \quad (1)$$

In particular, the slip is equal to 1 when the shaft is at stand-still (π=0) and increases as the rotor speed grows. Thanks to this slip (which is always greater than 1), the three-phase winding mounted on the AC-fed exciter rotor is subject to induced EMF's (electromotive forces) each time the exciter stator is supplied, regardless of rotor speed. The AC-fed exciter is thereby capable of energising the main field circuit at any rotor speed (even at stand-still), which would not be possible with a conventional DC-fed exciter, where rotor induced EMF are null at stand-still speed and grow proportionally to rotor speed for a given DC stator current supply.

The use of an AC-fed exciter, therefore, makes it possible to operate the machine as an inverter-fed variable-speed motor having a field excitation (and hence a torque production capability) guaranteed at any rotor speed. This constitutes a significant advantage with respect to conventional Direct-On-Line (DOL) operated synchronous motors, where the starting torque originates due to the currents induced in the damper windings under asynchronous operating conditions. With respect to such a conventional solution, the proposed design makes it possible not to oversize the ammortisseur cage, that can be measured as in a normal synchronous generator. Furthermore, the adoption of a VSI to feed the synchronous motor makes it possible to vary its speed depending on the present needs, which would not be possible with a traditional DOL solution.

Finally, an objection can be made observing that the AC-fed exciter could be employed not only for the motoring mode, but also for the generating mode. Other prototype motor-generator realisations are equipped with a single AC-exciter, which serves the purpose of energising the field circuit in any operating conditions. However, it should be noted that shipboard generators are subject to very strict qualification criteria, based on shipping registers, which pose quite strict constraints on such tasks as voltage regulation. As a consequence, the need to comply with shipping register qualification criteria can make it virtually inevitable that the machine is operated with a standard excitation system (based on a qualified AVR and relevant DC-fed exciter) when it acts in generating mode.

Machine fault tolerance assessments

The use of a rotor double excitation system gives rise to some issues as concerns the possible electromagnetic interactions between the AC-fed and DC-fed excitation system sections, in both normal and abnormal operating conditions.

In normal operation, an essential operating requirement imposed on machine service is that the two exciters cannot be supplied simultaneously. As a consequence, when one of the two exciters is not supplied, no EMF is induced in its rotor phases and the relevant rotating rectifier diodes are naturally blocked, preventing any current from flowing into the unfed exciter rotor.

The situation has been reproduced by means of a numerical simulation in the Matlab-Simulink environment. The model of a synchronous machine including the two exciters, rectifier bridges and field protection devices has been used as described in Alberto Tessarolo, "A numeric simulation approach to

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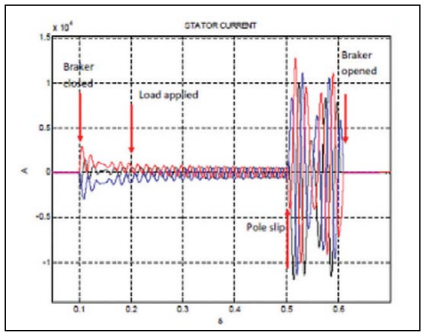


Figure 10. Stator current (phase a)

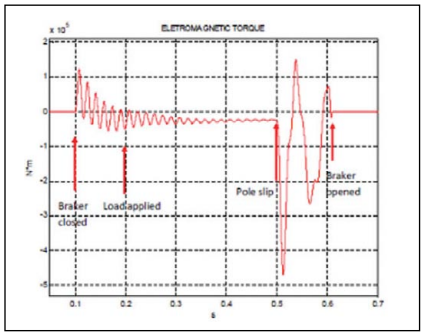


Figure 11. Electromagnetic torque

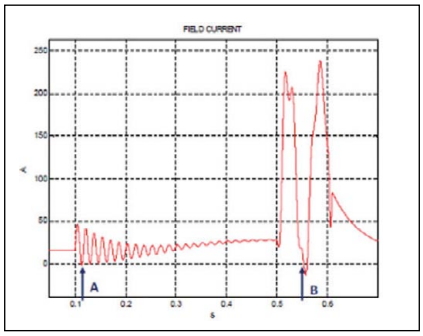


Figure 12. Field current

field protection design in wound-rotor brushless synchronous machines", 4th IET Conference on Power Electronics, Machines and Drives, 2008. PEMD 2008, pp.139-143, 2-4 April 2008.

Using such a model, the machine operation has been simulated starting from no load conditions followed by the sequence of events listed below:

- at t = 0 the machine is at no load with the rotor spinning at rated speed and no-load voltage equal to the grid voltage
- at t = 0.1 s the breaker is closed and the machine synchronises with the grid remaining at no load
- at t = 0.2 s the rated load is applied and the excitation supplied is raised at the value required to have the full-load field current
- at t = 0.5 s, while the machine is in quasi-steady-state conditions, a pole slip event is forced by reducing the grid frequency from 60Hz to 40Hz in a stepwise manner. At the same time, the exciter supply is removed
- at t = 0.6 s the generator output breaker is opened.

The transients associated with the mentioned sequence of actions are represented by the diagrams shown in Figures 10, 11 and 12. The first two figures show the transients occurring in a stator phase and in the electromagnetic torque, while Figure 12 shows the diagram of the field circuit current. It should be noted that the pole slip event causes the field current to increase in the first instance and then to abruptly decay to zero. In particular, at instant B (Figure 12) the field current becomes zero and would naturally tend to reverse.

However, current reversal is stopped due to the blocking action of the (unidirectional) rectifiers. This causes a sudden voltage overload across the field circuit (Figure 13), which is clamped by field protection devices (capacitor and varistor, Figure 6). After excitation cut-off at t=0.5 s, the rectifier diodes connected to the DC-fed excited continue conducting until their current become zero, i.e. during the interval D after excitation cut-off at t=0.5 s (Figure 14). After the voltage overload event (B, Figure 13) both rectifiers are not supplied and they are seen as identical parallel-connected paths for the field current which is still flowing through the field circuit (Figure 12). Hence, such residual field current flows half in one rectifier and half in the other (Figure 15) over the interval indicated with letter E. When the machine breaker is opened at t = 0.6 s, the equally-shared field current starts to decay asymptotically tending to zero (Figures 12, 14, 15).

In conclusion, simulations have proved that, under some severe transient conditions where field currents tend to reverse and exciter supply is removed, the possibility may arise that some of the field current flows, not only into the rectifier connected to the exciter presently supplied, but also into the other rectifier. However, these conditions are proved to last for very short periods and to involve so little heating energy that no possible failures or dangerous consequences are expected to occur as a consequence.

The electromagnetic interactions between the two sections of the rotor dual excitation system have, therefore, been investigated and shown not to constitute an issue for machine operation in either steady-state and transient conditions.

In some shipboard applications, high- and medium-power electric machines are often required to operate both as

Figure 13. Field voltage

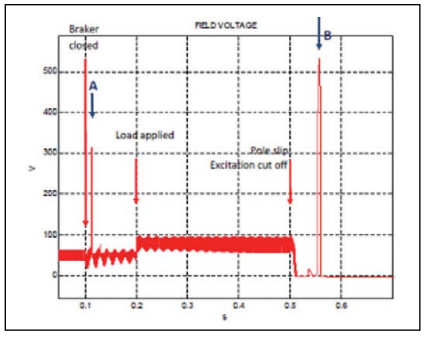


Figure 14. Currents in rectifier connected to the DC-fed exciter

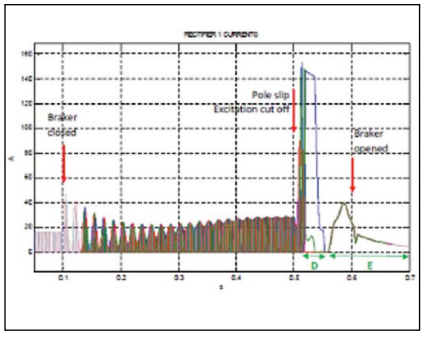
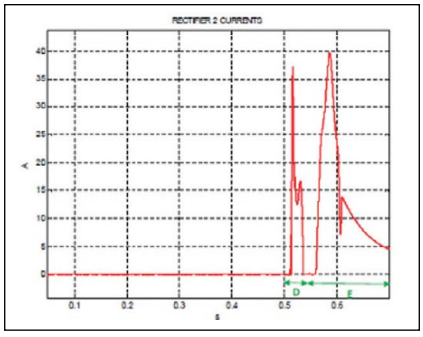


Figure 15. Currents in rectifier connected to the AC-fed exciter



motors and generators. With this design implementation has been presented for a medium-voltage motor-generators suitable for operating both as a traditional alternator subject to conventional AVR control and as a variable-speed propulsion motor under inverter supply.

The latter operating mode is, in particular, activated in case of a fault in the internal combustion engine normally used as a main propeller drive. The design provision implemented consists of equipping the machine rotor with a dual excitation system, including an AC-fed and DC-fed rotating exciters, capable of energising the main field through parallel-connected rectifier bridges. The two exciters are used when the machine operates as a motor and as a generator.

The adoption of the additional AC exciter for motor operation enables the system to provide field current even at stand still and at low rotational speeds with no need for oversized rotor cage circuits to be used for asynchronous starting. To assess the fault tolerance of the design solution implemented, possible interactions between the AC-fed and DC-fed sections of the rotor excitation system have been investigated through numerical simulations. These proved that possible interactions between the two sections may arise only in cases of very severe transient conditions and, in any case, do not introduce any additional failure source.

On board performance

After the detailed technical analyses, the assistance of the University of Trieste and team work among players, commissioning and performance on board were expected to be easy and so was it.

Given that the checks and verification were earlier conducted, the first vessel was successfully commissioned and has now been in operation since May 2014.

Other units are being commissioned and the team work with all the players continues to measure operational benefits and determine the enhanced operational flexibility and fuel savings.

Conclusions

Hybrid electrical machines can be used to as conventional shaft generators and variable speed propulsion motors to enhance vessel operations and manoeuvring, save fuel as the main engines can be switched off and offer redundancy since the operational modes are totally independent.

The core technology is the hybrid synchronous machines provided with two exciters each of these are designed to meet the specific operational mode, motor or alternator.

In house tests have validated design expectations and provide a footprint for the next phase onboard.

Based on operational requirements - the captain will determine whether or not to command the vessel via the main engine which will also drive the shaft generator or stop it and use the variable speed electrical propulsion system (which will also be used in case of main engine unexpected failures).

When compared with other fuel saving arrangements, this solution can be both installed in new constructions, but also retrofitted in existing units as no major re-layout or electrical connections are required.

Given that first vessel was commissioned in May 2014 and two additional units are in the pipeline, the hybrid concept fuel saving and operational flexibility are now being measured. *NA*

Acknowledgement

The authors wish to thank the University of Trieste and particularly Dr. Alberto Tessarolo for his technical assistance in the electromagnetic design and verification of the Marelli machine.

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Mitigating human error by design

Now in its second year, FAROS is an EC FP7 funded, three year project aimed at incorporating human factors into the Risk-Based Design of Ships. The 12 member consortium includes representatives from industry, academia and research institutes

The ultimate technical objective of the FAROS project is to quantify and integrate the human error into risk-based ship design. This is responsible for some 90% of maritime accidents.

Risk-based design is a design process supported by systematic risk assessment so that all significant design decisions are risk-informed. This project builds on previous research and development of Risk-Based Design for ships, which began with SAFEDOR, and now encompasses damage stability, fire safety, flooding control and environmental impact.

The FAROS project focuses on the concept design stage and adopts a systemic approach to human error. The basic assumptions of this systemic approach are that the crew are fallible and errors are to be expected. Such errors are seen as consequences rather than causes; with their origins rooted in ship design on both the meso (i.e. deck layout, arrangement of equipment and accessibility) and macro levels (i.e. hull and structural arrangement determining levels of ship motions, whole body vibration, and noise). Hence the broader operational aim of the project is to improve the conditions under which the crew works, thereby reducing the occurrence of human error and mitigating its consequences.

The FAROS project consists of eight Work Packages (WPs), addressing performance studies, risk models, design optimisation, and validation (see Figure 1). The technical work packages being; WP3: Crew performance studies, WP4: Risk models with crew performance, WP5: Risk-based design implementation, WP6: Design optimisation studies and WP7: Validation.

The first project period, which ran from October 2012 to March 2014, was dedicated to the quantification and the integration of the human error into risk models and design. It resulted in a design assessment toolbox to be used for performance optimisation of preselected ro-pax and oil tanker ships in the second half of the project.

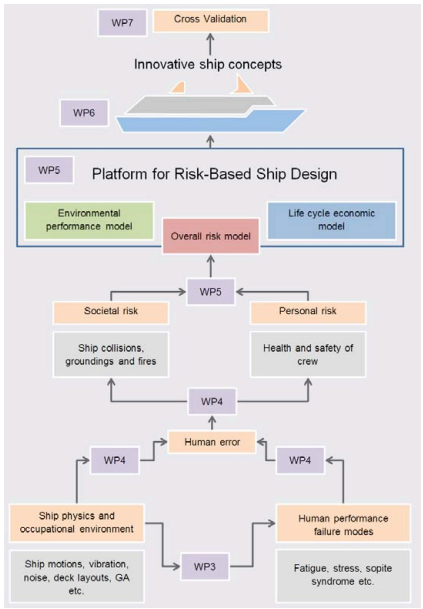


Figure 1: The overall structure of the FAROS project with five technical work packages (WPs)

Figure 2: Engineer in CAVE performing WTD scenario (courtesy of University of Strathclyde)

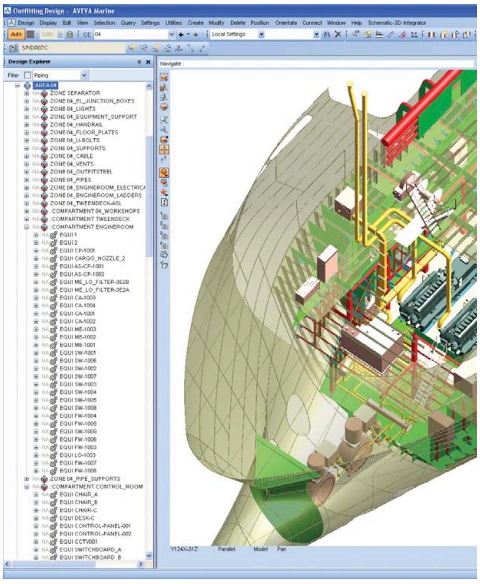
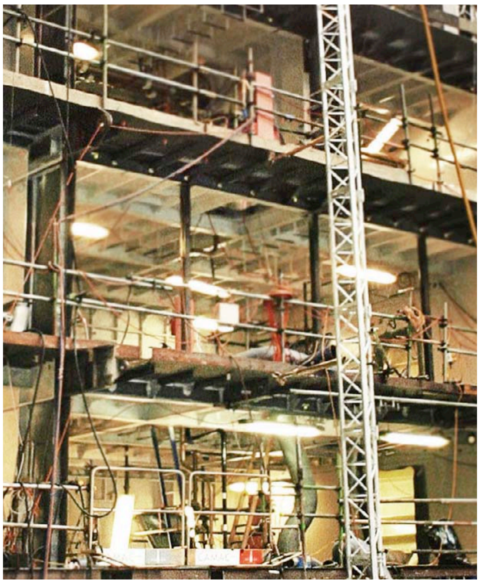
Figure 3: Deck officer wearing the Dikablis wireless mobile eye-tracking system (courtesy of University of Strathclyde)

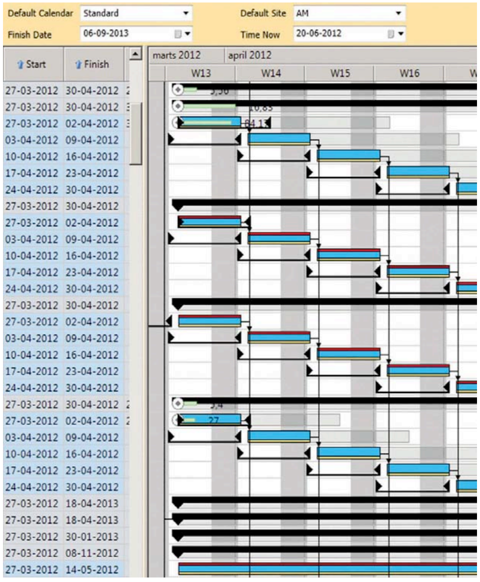
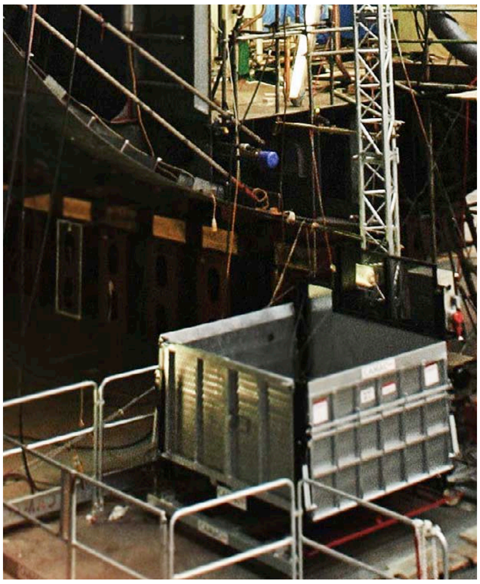
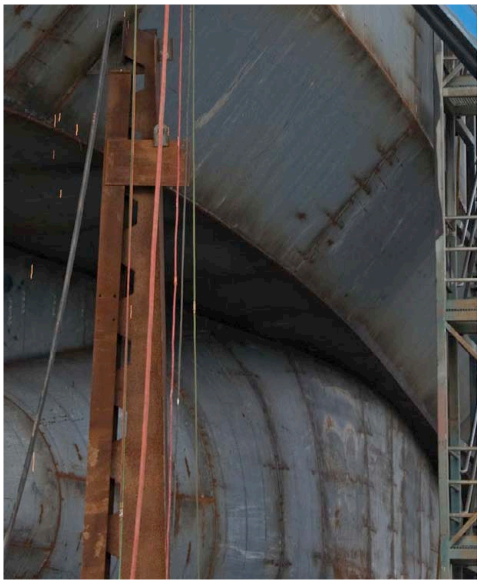
Reviewing models and rules

In order to integrate the human error into risk models to be applied in the risk assessment, the causal link between Global Design Factors (GDFs) and human performance had to be quantified. GDFs denotes the characteristics of the ship design that can be used to quantify its effect on the performance of the crew. The GDFs examined in FAROS concerned; ship motions; whole body vibration; noise; deck layout; arrangement of equipment and accessibility. Although the extensive literature review suggested that exposure to noise, vibration and ship motions degrades the crew's attention management capability, which in turn may lead to human error, no quantitative models to represent the causalities were found.

To rectify this, a high-level, scientifically justified framework was proposed by human factor specialists from Lloyd's Register. This framework bridges the knowledge gap and consequently enables design evaluation in terms of its effect on human performance. The framework specifically combines the principles behind three existing models of human performance: the Dynamic Adaptability Model, the Cognitive Control Model, and the Malleable Attentional Resources Theory. Taken together these theories describe a mechanism that accounts for the impact of a 'trinity of stress' on human performance, based on the principles of attention management. A specific implementation of the framework can be validated by Human Reliability Analysis (HRA) techniques.

The literature review on the effect of GDFs on human performance at sea also found that the current design rules and

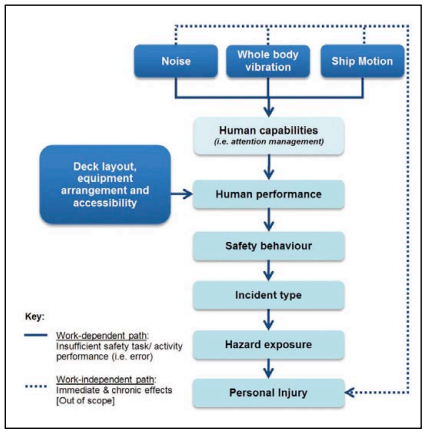


Figure 4: Identified work-dependent and work-independent causal paths describing the effect of Global Design Factors on human performance, safety behaviour, and the occurrence of personal injury (Courtesy of Lloyd's Register)

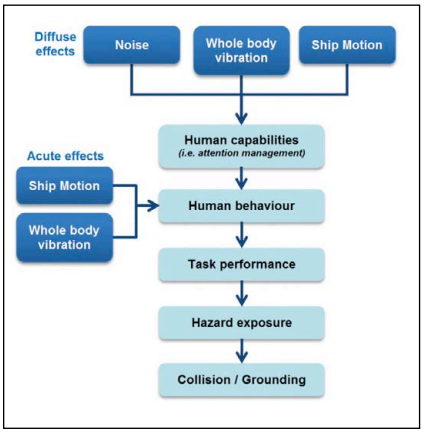


Figure 5: Causal chain developed to describe the relationship between crew exposure to Global Design Factors and the unwanted outcomes of collision or grounding (probability of collision per encounter) (Courtesy of AALTO University)

standards use a binary approach with maximum allowable GDF limits. These have the assumption that exceedance of the limits would have detrimental effects on human performance, but that no degradation would occur below these levels. Although some standards were indeed found to be linked to physiological functions (e.g., limits on ship motions), there was insufficient evidence to claim these links apply to all standards, and there was no evidence at all to support a link to crew cognitive functions.

As deficiencies in cognitive functions (e.g., situational awareness and decision-making) have been found to be the primary causes of human errors behind serious maritime accidents, the binary model and current limits on GDF values may not provide for some safety critical tasks performed by the crew being affected. Thus the limits are arbitrary with respect to operational safety. This observation is further reinforced by the fact that maximum limits on noise and whole body vibration vary significantly from class society to class society (e.g., noise limits in the wheelhouse range from 55 to 65dB, according to ABS and LR respectively).

Virtual reality and simulations

Virtual Reality experiments were conducted by University of Strathclyde and CIS Galicia (which later became part of the Galician Innovation Agency), involving 12 engineers from Tallink Group. The experiments conducted in simulations of ro-pax machinery spaces showed how deck layout may affect crew behaviour. It was observed that the propensity to keep watertight doors open - and thus significantly compromise the watertight integrity of the vessel - may be directly proportional to the frequency of passing through them. Additionally, it was noticed that a bigger engine room, or any other compartment with hazardous equipment inside, may be safer than smaller spaces because the crew would utilise the extra space to keep further away from hazardous objects. However, both observations were inconclusive as the experimental data was insufficient to make a comprehensive statistical inference. As this subject is of great interest, future research - outside project FAROS - should involve experiments to a much greater extent to be fully confident about such phenomena.

The effect of GDFs was also studied on bridge simulators provided by Hochschule Wismar, University of Applied Sciences, Technology, Business and Design. Experiments in these facilities were conducted by University of Strathclyde on tanker and ro-pax simulations (see Figures 2 and 3). The deck officers were provided by operators Tallink Group and Arcadia. The aim of the experiments was to test the effects of noise and ship motions on collision/grounding avoidance, which was quantified as the mean value of the closest point of approach (CPA). Whilst the mariners in almost all cases violated the safe navigation distance of 1nm from a collision threat or grounding line, no evidence of an influence of GDFs on navigation performance emerged for any of the measures.

Task difficulty may have been too extreme in the experimental scenarios to enable a clear pattern to emerge regarding the influence of GDFs. However, there were clear findings regarding the effect of sleep restriction from the ro-pax scenarios. Mariners, when sleep restricted, were found to steer courses significantly further away from target vessels than when fully rested.

This pattern was interpreted as reflecting effort on the part of the mariners to compensate for tiredness. On the whole, this experimental study was useful and it contributed to the subject of safe navigation, expanding the previous work in FP7 project Horizon (2012) in which collision avoidance was measured independently of the effect of ship motions and noise.

Development of risk models

The accumulated knowledge regarding the causal links affecting crew performance allowed the development of risk models incorporating human error. Three risk models suitable for ro-pax and tanker vessels have been developed in the FAROS project by consultancies, classification societies, and operators. These cover personal risk, collision and grounding, and fire risk. These models were designed to account for the existing causal links between GDFs and crew performance. They were developed using a range of technical expertise and analysis methods then integrated into a single overall approach to Risk-Based Design.

Personal risk model

A significant development in the FAROS project is the proposal of a personal risk model by Lloyd's Register, Deep Blue srl, and Brookes Bell R&D. Prior to the project, no personal risk model that linked design characteristics (GDFs)


IF WE
need room to breathe,
could we live under the sea?
Underwater skyscrapers –
a dream our software could bring to life.
Innovative thinkers everywhere use INDUSTRY SOLUTION EXPERIENCES from Dassault Systèmes to explore the true impact of their ideas. Insights from the 3D virtual world are helping to blur the boundaries between architecture and marine engineering and may one day help us create new cities at sea. How long before everyone can have a sea view?
3D
V+R
3DEXPERIENCE
It takes a special kind of compass to understand the present and navigate the future.
3DS.COM/MARINE
DASSAULT SYSTEMES | The 3DEXPERIENCE Company

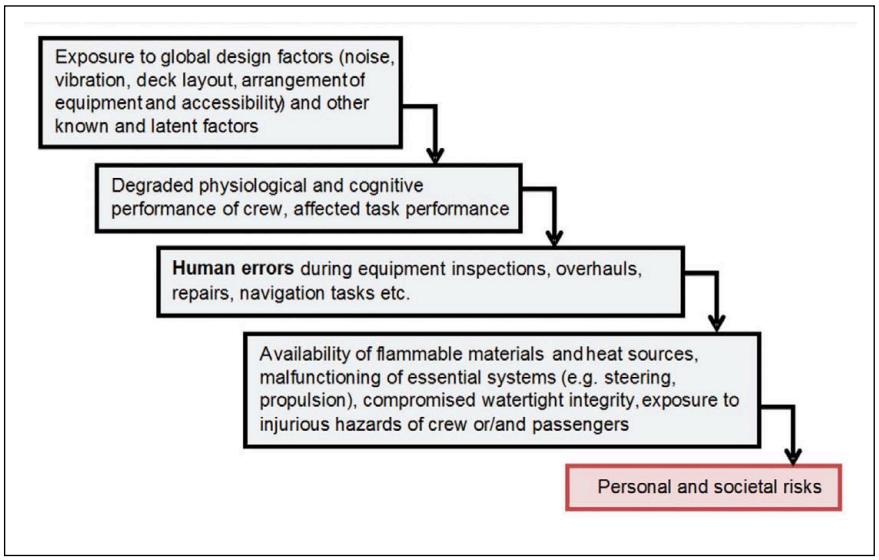
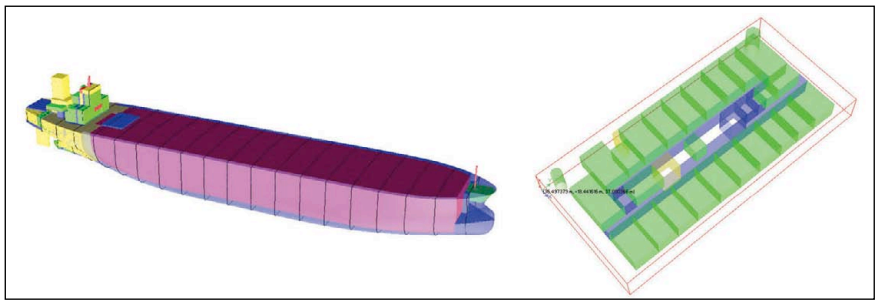


Figure 6: The causal chain that was integrated in the FAROS risk models



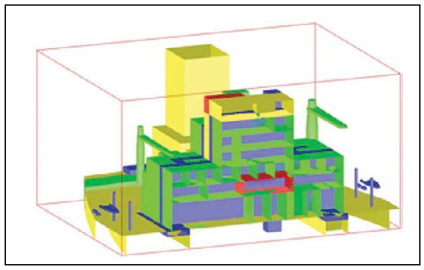


Figure 7: Parametric VLCC model showing detail of the accommodation spaces (courtesy of UCL)

with probability of injury and death had been available. The model focuses on such incident types as slips, trips, falls, falls from height and impact by moving objects. It also considers unsafe behaviour as the main antecedent condition for personal injuries and fatalities during normal operation.

Collision & grounding

The collision and grounding risk model developed by AALTO University, VTT Technical Research Centre of Finland, and Brookes Bell R&D consists of two parts: the probability of a collision/grounding event occurring, and its subsequent consequences. The model is based on the most recent casualty statistics from the Sea-web database and expert estimates of collision and grounding encounters on preselected routes. The consequence part of the model is underpinned by research work on damage stability recently funded by the European Maritime Safety Agency and European Commission (such as the FP7 project GOALDS).

Fire risk model

Brookes Bell R&D, Tallink Group, and Alpha Marine Consulting developed a fire risk model, work on which was chiefly focused on the fire inception probability in different onboard spaces. The development was based on statistics from the Sea-web database, fire accident investigation reports, empirical data elicited from tanker and ro-pax engineers, and other sources. The work resulted in:

- Probabilistic ignition models for the engine room, galley, Ro-Ro deck, cargo tanks, and cabins (both crew and passenger).
- Ignition scenarios for smoking, arson, and electrical fault caused ignitions.
- Statistically estimated ignition probabilities for other onboard spaces.

Based on statistical analysis and modelling, the main cause of fire inception was found to be human error, as opposed to insufficient equipment reliability or other technological factors. Thus in general, a strict adherence to safety procedures (e.g. ISM Code) and best practices is essential to avoiding fire inception opportunities.

Integration of the risk models

To apply the risk models in design, they were integrated into an overall risk model (a.k.a. a holistic or total risk model) to be used in the risk assessment process of ship design alternatives. The overall risk model integrates hazards that may occur in both normal and emergency situations. This makes the risk assessment comprehensive. This property is useful at the concept design stage, where distinct design alternatives are assessed on the overall ship level, as opposed to the system level assessment. This way such a holistic risk assessment becomes commensurate with economic and environmental assessments, and is of interest to ship operators and consequently to ship designers.

Ship modelling and parameterisation

In addition to the development of the risk models, the first project period has also seen extensive work on the modelling and parameterisation of ro-pax (140 and 200m in length) and oil tanker ships (VLCC and Aframax sizes). Using reference design data provided by the design office Naval Architecture Progress, state of the art methods, such as the Design Building Block Approach developed by University College London, and the NAPA Parametric Modeller by Brookes Bell R&D were utilised for this purpose.

Both these methods make use of commercially available ship design software, indicating that the risk models developed in FAROS should be applicable to industry beyond the

project consortium. In total, four parametric ship models have been developed, which will be optimised with respect to the overall risk, commercial viability (NPV, RFR etc.), and energy efficiency (EEDI). The selected routes of operation are Baltic and North seas and the Indian Ocean. The design optimisation is expected to result in improvements of the hull, propulsion, and general arrangement.

Summary of achievements

In the first 18 months, the FAROS project has delivered in four main technical areas:

- The undertaking of a comprehensive literature review on human (crew) performance as affected by ship motions, noise, whole body vibration, deck layout and arrangement of equipment and accessibility. The summary report is publically available on the project website
- The development of a high-level, scientifically backed framework that enables quantification of affected human performance and consequently human error
- The development of personal and societal risk models with the human error integrated. The risk models can be used for tasks such as risk-based design, cost-benefit analysis of risk control options, inference of prescriptive design guidelines
- The generation of parametric models of oil tanker and ro-pax vessels, compatible with the risk models and design exploration and optimisation processes with the aim of obtaining low overall risk, high economic performance and good energy efficiency.

Future research objectives

The project findings and deliverables can already be used to enhance the training of crew members, upgrade internal safety procedures (as a part of continuous improvement under the International Safety Management (ISM) Code), implement revisions and changes to plan approval processes, and improve ship design practices.

The second half of the project will focus on a process of exploration and optimisation of the four vessel designs, to improve their human factors performance and reduce the overall risk. This optimisation process will also be subjected to validation against the measurements taken in the early stages of the project. Dissemination and communication with external stakeholders is a vital part of this research and two further FAROS Public Workshops are scheduled for the remainder of the project: in September of 2014/2015.

The findings of the FAROS project so far have identified potentially fundamental flaws in the current ship design requirements and their effect on safe human performance, highlighting the need for more research beyond the project scope. This future research has to involve large scale experiments on bridge simulators, virtual reality environments simulating engine and other rooms, as well as onboard measurements (field research). The ultimate objective would be to determine optimal conditions for human performance in normal operations, and compare them to corresponding design rules and guidelines. *NA*

Authors

Dr. Rachel Pawling, University College London, Leader of Design optimisation studies and Dr. Romanas Puisa, Brookes Bell R&D, Project Coordinator

Further information

The project website, www.faros-project.eu, contains a public area with access to all public project deliverables. The availability of new public reports is also announced on the social media network LinkedIn (http://www.linkedin.com/company/3194994). A public workshop was held in London in September 2013 and the papers and presentations are available for download from the FAROS website, along with details of future events.

Acknowledgements

The support provided by the European Commission to this research in shipping safety and risk-based design is gratefully acknowledged. The FAROS project is funded by the European Commission under Grant Agreement 314817 as part of the Seventh Framework Surface Transport Programme.

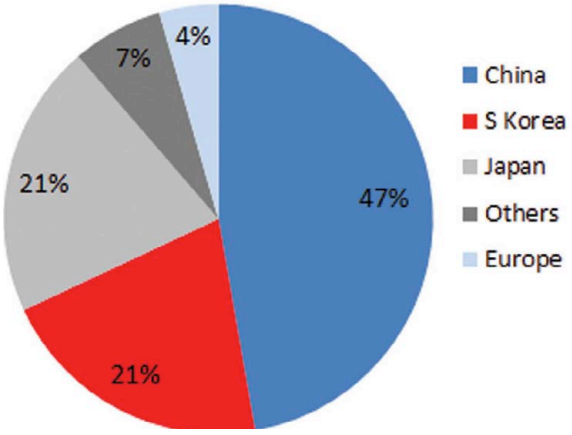
In addition the authors would like to acknowledge the support from the project's Advisory Board which includes European shipyards Meyer Werft (Germany), STX Finland and Western Baltija Shipbuilding (Lithuania).

Clarkson Research Services: Historic and Scheduled Delivery

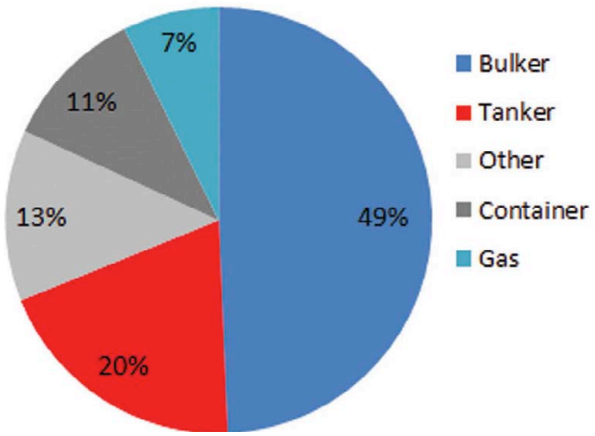
Data extract from World Fleet Register available at www.clarksons.net/wfr

Vessel Type	2004		2005		2006		2007		2008		2009		2010	
	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	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	10	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	26	12	15	16
Products 30-60,000	58	60	51	48	59	56	68	66	73	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 65-80,000	35	39	41	35	36	26	22	22	23	20	18	15	18	33
Handymax 40-65,000	37	43	52	48	53	40	50	50	66	59	86	100	168	168
Handysize 10-40,000	30	35	32	38	33	33	43	54	65	60	89	117	142	156
Combos > 10,000	0	0	0	0	0	0	0	0	0	0	0	0	3	2
LNG Carriers	11	9	7	11	12	16	16	16	25	26	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	40	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	109	69	51	56	25
Offshore	7	4	5	6	4	5	3	18	14	14	13	14	24	26
Cruise Vessels	7	3	2	2	5	1	7	3	6	3	3	6	9	4
Ro-Ro Ferries	9	6	13	6	8	6	5	8	16	5	9	7	10	8
Other	70	61	74	77	102	123	148	133	150	148	143	151	163	177
TOTAL	**523**	**494**	**579**	**610**	**692**	**717**	**798**	**823**	**951**	**993**	**1,035**	**966**	**1,214**	**1,116**

Orderbook by builder region (number of vessels)



Orderbook by sector (number of vessels)



2011		2012		2013		2014	Scheduled Orderbook		
1st Half	2nd Half	1st Half	2nd Half	1st Half	2nd Half	1st Half	2014	2015	2016
35	27	27	22	21	9	13	24	20	45
23	19	31	16	25	6	4	13	14	14
27	32	29	14	13	5	4	22	58	37
19	7	8	6	6	4	3	7	10	21
46	22	25	30	49	27	46	108	156	89
3	7	7	0	1	2	2	9	2	0
52	46	39	12	11	16	13	40	56	65
44	41	58	25	22	20	15	43	13	0
128	123	149	64	63	40	57	102	144	157
82	97	140	95	100	68	61	122	155	108
39	47	53	39	34	43	41	98	57	3
195	198	226	146	147	118	95	223	387	201
158	170	209	113	110	74	83	197	237	103
3	0	0	0	0	0	0	0	0	0
5	10	1	2	4	13	13	30	49	35
15	14	13	7	23	16	13	31	78	72
46	25	50	28	51	32	58	92	124	68
33	26	40	19	46	29	26	48	41	7
32	29	33	34	28	16	18	47	71	41
29	25	33	16	15	19	29	71	76	54
4	2	6	1	6	0	3	5	7	12
10	5	6	4	4	4	11	17	11	4
173	168	189	94	98	85	63	142	137	54
1,140	**1,372**	**787**	**877**	**646**	**671**	**671**	**1491**	**1903**	**1190**

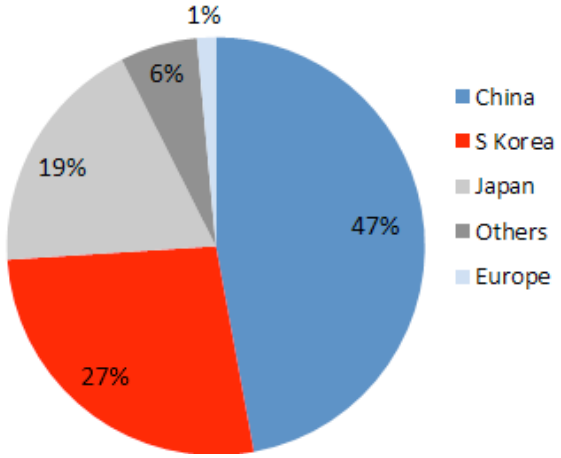
Data includes all vessels with LOA estimated at >100m

Where scheduled month of delivery is unknown an arbitary month of build has been applied for orderbook data

The orderbook by year of delivery on this page is based on reported orders and scheduled delivery dates and do not necessarily represent the expected pattern of future deliveries

All data taken as of 1st August 2014

Orderbook (DWT) by builder region



Source:
Clarkson Research Services

把脉经济金融走势 权威解读行业政策
船舶经济贸易
SHIP ECONOMY & TRADE

The prospects of bond-issuing shipbuilders

Shipbuilders in China have increased debt financing notably since 2008. At the end of April 2014 there were 12 shipbuilder bonds totalling US$13.32 billion in the market. With the shipbuilding market warming up the overall solvency index is expected to remain steady while credit quality will continue to vary, reports Wei Yuan Wu Cui / China Credit Rating Company Limited

Shipbuilding is a capital intensive endeavour. The capital demand of shipbuilders is comprised mainly of capital expenditure required for expanding production and working capital for making advance payments.

Between 2005 and 2007, shipbuilders were keen to invest in expanding production and capital demand in that respect reached its peak. In the advent of the global financial crisis in 2008, as the industry held back investment in expanding production, capital demand dropped notably. However, with the industry's prosperity index as well as the proportion of pre-payment receipts dropping since 2008 and advance payments to be made, the working capital demand of shipbuilders has climbed markedly.

As a result, shipbuilders have stepped up their fundraising effort in the bond markets and the scale of debt financing of the industry has spiralled.

Shipbuilders started to issue bonds in the open market in 2008 and, by April 2014, the market had 12 bond-issuing shipbuilders with their names on 36 bonds with a total value of RMB82.02 billion (US$13.32 billion). Issuances of state-owned shipbuilding enterprises are typically larger than those of their private counterparts.

Since the financial crisis hit the industry's credit risk has surged and individual issuers have had their ratings downgraded. Looking ahead, despite the increase in shipbuilding activity, shipbuilders continue to face liquidity pressure from the delayed impact of the market slump and the credit ratings of bond-issuing shipbuilders will continue to vary.

Issuance size

In recent years, affected by the financing mode of large enterprises, the issuance size of shipbuilder bonds has fluctuated. With the industry's prosperity index trending down, the pre-payment proportion shrinking and major shipbuilders stepping up financing in the bond market, the overall scale of bond issuance of the industry swelled radically in 2012 and only decreased in 2013.

The most shipbuilder bonds, 15 in all, were issued in 2012 raising all together RMB41.14 billion (US$6.67 billion), about half of the accumulated total since 2008. The phenomenon is attributable to the industry's prosperity index sliding continuously since the financial crisis struck, shipowners changing from paying in five equal parts – at contract signing,

Year	Corporate Bond	Intermediates	Short-term Note	Ultra-short-term Note	Convertible Bond	Corporate Debt	Total
2008	35.00	30.00	0.00	0.00	0.00	0.00	**65.00**
2009	0.00	60.00	20.00	0.00	0.00	0.00	**80.00**
2010	0.00	0.00	53.00	0.00	0.00	0.00	**53.00**
2011	00.00	29.00	93.00	0.00	0.00	0.00	**122.00**
2012	5.40	299.70	18.00	0.00	80.50	7.80	**411.40**
2013	7.00	10.00	14.40	50.00	0.00	0.00	**81.40**
2014 (Jan–Apr)	0.00	00.00	7.40	0.00	00.00	0.00	**7.40**
Total	**47.40**	**428.70**	**205.80**	**50.00**	**80.50**	**7.80**	**820.20**

Table 1

NUPAS CADMATIC

Solutions for Marine Networks

6.1 VERSION

XBow model courtesy of Ulstein Group ASA

Structural • Outfitting • Machinery • Piping • Electrical • HVAC

Nupas-Cadmatic's latest software version, V6.1, is an extremely powerful 3D CAD/CAE/CAM system designed specifically for shipbuilding and offshore industries. **Nupas-Cadmatic** is an innovative solution that simplifies the entire building cycle from the design phase all the way up to the vessel launch. The system saves design time, production time and materials throughout all the ship creation phases: from basic structural design, preliminary design of engine rooms and piping systems to detailed engineering and production information.

Nupas-Cadmatic is a concurrent engineering tool for ship hull, piping, outfitting, HVAC, cable tray and electrical engineering. Powerful 3D modeling in conjunction with advanced production modules significantly improve the quality of production and greatly shorten construction times.

Nupas-Cadmatic is represented globally by a network of 21 sales and support partners. Our unified goal is to keep our more than 400 Nupas-Cadmatic clients one step ahead of the competition in continuously changing market conditions.

Some V6.1 Highlights

- New Ribbon User Interface
- High Level Topology
- Copy Manager
- Improved Hull Viewer
- Enhanced support for Unicode
- Renewed HVAC routing
- 3D spaces and compartments
- Improved Shell Views
- New Diagram – 3D Model Integration
- Electrical Cable Router
- eBrowser model comparison
- eBrowser location views
- Topological Seams & Butts
- Enhanced hole management

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Cadmatic Oy
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tel: +358 2 412 411, email: sales@cadmatic.com

www.nupas-cadmatic.com

	2008	2009	2010	2011	2012	2013	2014	Total
China Shipbuilding Industry Corporation (State-owned)	65.00	20.00	50.00	90.00	110.00	0.00	0.00	335.00
China Shipbuilding Industry Company Limited (State-owned)	0.00	0.00	0.00	0.00	80.50	0.00	0.00	80.50
China State Shipbuilding Corporation (State-owned)	0.00	60.00	3.00	15.00	165.00	50.00	0.00	293.00
Huarun Dadong Dockyard Co., Ltd (State-owned)	0.00	0.00	0.00	0.00	4.70	0.00	0.00	4.70
Sanity Marine Corp. Ltd (State-owned)	0.00	0.00	0.00	0.00	7.80	0.00	0.00	7.80
Taizhou Sanfu Ship Engineering Co., Ltd (Private)	0.00	0.00	0.00	3.00	3.00	7.00	0.00	13.00
(Jiangsu Yichung Group) (Private)	0.00	0.00	0.00	0.00	4.00	7.40	3.40	14.80
JiangSu New YangZi Shipbuilding Co., Ltd (Private)	0.00	0.00	0.00	14.00	0.00	0.00	0.00	14.00
Jiangsu Rongsheng Heavy Industry Co., Ltd (Private)	0.00	0.00	0.00	0.00	20.00	0.00	0.00	20.00
Evergreen Holding Group (Private)	0.00	0.00	0.00	0.00	13.40	4.00`	4.00	21.40
Taizhou Kouan Shipbuilding Co., Ltd (Private)	0.00	0.00	0.00	0.00	3.00	3.00	0.00	6.00
Private yard-name unknown	0.00	0.00	0.00	0.00	0.00	10.00	0.00	10.00
Total	65.00	80.00	53.00	122.00	411.40	81.40	7.40	820.20

Table 2

when production begins, when outfitting on building-berth begins, launch and then delivery – to making the bulk payment close to delivery, squeezing payment receipt before delivery to between 20% to 50%, and that in turn pushed up the working capital requirement of shipbuilders who need to make advance payments.

At the same time, banks tightened their credit policies and that added to the capital pressure on shipbuilders. Such enterprises as China Shipbuilding Industry Corporation (CSIC) and China State Shipbuilding Corporation (CSSC) reached deep for funds in the bond market. CSIC and CSSC together issued RMB27.5 billion (US$4.46 billion) worth of bonds – RMB11 billion (US$1.78 billion) and RMB16.5 billion (US$2.68 billion) respectively, 66.85% of the total the industry raised that year.

By 2013 the outlook of the industry was still dim. With key shipbuilders active and making considerable claims [early in the year] and interest rates for financing climbing, the overall financing volume of the industry took a dive to RMB8.14 billion (US$1.32 billion). Between January and April 2014, with no major shipbuilders issuing bonds, the industry drew a total of RMB740 million (US$119.9 million) from the bond market, down 89.92% [period-on-period]. It is obvious that the financing arrangements of the two shipbuilding giants CSIC and CSSC weigh heavily on the scale of bond issuance in the industry.

As for bond types, intermediates or medium-term notes and short-term financial notes are shipbuilders' main choices, but with ultra-short-term financial notes gaining prominence, their issuance volume may increase. As at the end of April 2014, there were 13 intermediates, 17 short-term financial notes and one ultra-short-term financial note issued by shipbuilders, valued at RMB42.87 billion (US$6.95 billion).

The issuers

Among the 12 bond-issuing shipbuilders, five are state-owned enterprises and seven are private enterprises. Although state-owned shipbuilders are fewer in number, since 2008, the size of their issuances has been bigger than those of private shipbuilders. Between 2008 and April 2014, state-owned shipbuilders amassed RMB72.1 billion (US$11.68 billion) in all, whereas private shipbuilders together managed RMB9.92 billion (US$1.61 billion). The scale of issuances of private shipbuilders is not expected to increase in the future while their state-owned peers will continue to boast relatively stronger financing clout.

Up to the end of April 2014, 50% of the bond-issuing shipbuilders were given a double-A rating. More precisely, their ratings ranged between double-A and triple-A and six, or half of them, were designated double-A. Among the six, except for stated-owned Huarun Dadong Dockyard Co., Ltd, which derives its income and profit mainly from vessel conversion and repair, the other five are private enterprises. The three rated triple-A are CSIC, CSICL and CSSC.

Maturity dates

At the end of April 2014, there were 19 bonds totalling RMB48.98 billion (US$7.94 billion) in the market maturing between 2014 and 2022 and none will be in 2020 and 2021.

The peak reimbursement period will fall between 2017 and 2019 during which a good number of bonds issued in 2012 will mature. In 2022, two intermediates of CSSC will mature with reimbursement amounting to RMB10.5 billion (US$1.7 billion). With the issuance size of

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Year	Assets to Liability Ratio (%)	Debt Capitalisation Ratio (%)	Total Debt (Billion Yuan)	Net Operating Cash/Short-term Debt (Times)	Total/EBITDA (Times)
2008	80.60	43.92	12.85	0.70	2.21
2009	72.04	43.84	12.04	0.35	2.57
2010	69.81	43.41	16.84	0.38	2.82
2011	65.55	46.78	27.54	-0.04	3.86
2012	68.25	52.00	37.77	0.09	8.68
2013	68.77	54.37	54.00	0.05	8.52

Table 3

shipbuilder bonds subjected heavily to the financing arrangement of key players in the industry, the maturity dates of shipbuilder bonds can fluctuate.

Liquidity pressure persists

Generally speaking, since orders climbed in 2013, the number of completed vessels is likely to increase by mid-2014 and orders in hand may see a steady increase. With vessel prices picking up since June 2013 and price of ship plates and diesel remaining comparatively low, the pressure on shipbuilding costs has receded, meaning the industry can expect a small overall improvement in profitability as well as its prosperity index in the latter half of 2014.

That said, the industry is still troubled by the problem of excessive capacity and vessel prices are at their cyclical low, hence a full rebound is unlikely and its prosperity index will still linger low in the valley.

However, the delayed effect of production meant the industry's prosperity index lagged its profitability change. In 2012, the revenue median of the 12 bond-issuing shipbuilders started a steep slide from its peak in 2011 and the gross profit margins of sample enterprises also kept shrinking. As a result, the median profit of the shipbuilders fell far more than the median revenue.

Taking into account the notable rise in orders in 2013 and the relatively low comparative base of the previous year, a meagre rise in profitability is expected for the industry in the latter half of this year, though it would still be a long way from the peak level. As the five equal payment method is unlikely to return soon and more vessels expected to be completed in 2014 requiring shipbuilders to make more advance cash payments than in 2012, the industry will continue to feel the liquidity pressure.

Corporate credit quality continues to vary

In 2013, the assets-to-liability ratio of the shipbuilding and related manufacturing industry dropped slightly to 68.28%, but the peak was 82.63% in 2008. The median ratio among sample enterprises started trending downward in 2009 and has stayed at about 70% in the past couple of years.

The overall drop in debts of the industry could be attributed to shipowners deciding to pay the bulk of due fees closer to delivery, hence cutting pre-payment receipts as well as the non-interest-bearing debts of shipbuilders. At the same time, the interest-bearing debts of sample enterprises has increased notably between 2008 and 2013 and their debt-to-capitalisation ratios have climbed, a result of shipowners changing their payment mode requiring shipbuilders to seek credit for advance payments.

Since more vessels are expected to be completed in 2014, shipbuilders' interest-bearing debts are also going to stand high translating into capital pressure for them.

Shipbuilders need funds for paying debts, but most of the receivables will not be paid until just before delivery. This a heavy burden on shipbuilders in areas including their operational strategies (strengthening customer quality analysis, prudence in signing low-price contracts, rational production planning), capital management (adequate financing capability in respond to shipowners' new payment mode, forward assessment of financing requirements), supporting policies (financing support from local banks and export credit insurance companies, government tax rebate policies), etc.

As the interest-bearing debts of sample enterprises swelled, their long- and short-term liability indexes also worsened. Their net operating cash flow / short-term debts and total debt / EBITDA deteriorated from 0.70 and 2.21 times respectively in 2008 to 0.05 and 8.52 times last year.

With the industry picking up slowly and players' profitability alongside, its overall liability index can expect to stabilise, however, the credit quality of players will continue to vary. In fact, in 2014 large shipbuilders operating on multi-business models are going to have a stronger financing capability than their medium and small counterparts, meaning they will have better margins for countering cash flow pressure. And, for medium and small shipbuilders, their credit quality will vary depending on their different competitive strategies and order-taking policies.

Generally speaking, the smaller shipbuilders will be more reliant on bank loans and, should banks tighten their credit policies, most of them would feel the squeeze of added financing pressure. Shipbuilders who were aggressive in expanding production at early order stage can expect to face severe cash flow pressures. *NA*

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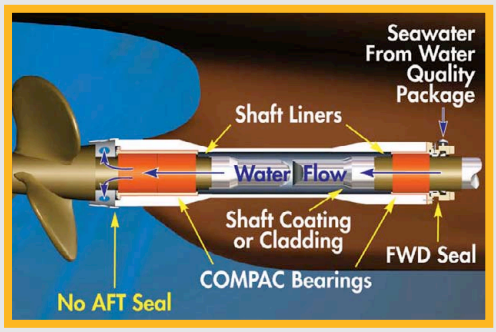

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Beijing yard reforms slow to take hold

It was the best of times and the worst of times for Chinese shipbuilding in the past year, reports Mark T. Vassel

Output tumbled across the country, but a raft of new orders held promise for better times ahead, at least from a revenue perspective.

The industry as a whole continued to take baby steps up the technology ladder, fulfilling the wishes of state planners who are eager to improve production quality and have the country's yards transition into a higher margin sector of the business. But, progress may not have been as quick as the policy-setting planners would have liked.

One of China's highest profile shipbuilding groups was censured by the country's increasingly eagle-eyed auditors in a move many observers saw as a reflection of the state's determination to enforce the commercial professionalism that will make its yards more competitive in the global marketplace.

For some buyers and bankers, improvements cannot come soon enough: One in three ships ordered from Chinese builders was delivered late in 2013, according to data from Clarksons Research, a leading provider of shipping data and analysis. It was a small improvement from 2012, when 36% were delivered late, but severely lagged the performance in Korea, where shipyards routinely delivered ahead of schedule.

Overall output at Chinese yards fell by almost a quarter in the first five months this year to 13 million deadweight tonnes (dwt), according to the China National Association of Shipbuilding Industries (CANSI).

In line with the "good news-bad news" theme this year, the relative boom in ordering in 2013 pushed the aggregate operating revenue for the 87 domestic shipbuilders surveyed by CANSI companies in the Chinese shipbuilding industry surveyed by 9.4% to RMB97.7 billion (US$15.83 billion).

In an interim report, Cansi said Chinese yards received new orders for vessels totalling 40.8 million dwt in the first six months of this year, up 78.2% year-on-year. The total orderbook reached 152.1million dwt as of end-June, up 39.5% on year and 16.1% from the end-2013 levels.

But, with far too much shipbuilding capacity available in China, buyers held the upper hand when negotiating unit prices, driving gross profitability for the same 87 yards down 33.6% year-on-year to RMB1.8 billion (US$292 million).

However, orders for new ships at China's yards in the first five months doubled against last year's comparable tally, to 34.7 million dwt, and orders for export – the vast majority of the market – grew 167% year on year over the same period.

When all was said and done, the volume of ships on order at Chinese yards as of the end of May had grown 14.9%, to 150.5 million dwt, since the end of 2013.

Still, most observers believe profitability will elude all but a few yards in China this fiscal year, which is expected to be the most difficult in terms of output – and therefore revenue – despite rising new orders.

Ren Yuanlin, the executive chairman of Singapore-listed Yangziajiang Shibuilding (Holdings), probably offered the most succinct summary when he told shareholders in April: "This is the fifth consecutive year of downturn in global shipbuilding. It has certainly impacted China. Vessel prices are still at the market bottom, but the cost of production has continued to increase, affecting sector margins. The global vessel glut remains stark."

"Over the past four years, the number of [Chinese] shipbuilding companies has decreased by half to about 1,600," Ren said. "Industry insiders expect more [yards] to go bust in the year ahead, as only 4% secured new contracts in 2013. Nevertheless, the darkest hour is nearest to the dawn."

Although a jump in ordering may have somewhat relieved the pressure since April when Ren made those comments, an overall concentration of ordering has become a trend in China.

For example, Chinese state media recently pointed out that 80% of US$37 billion in new ship orders in 2013, were won by just 20 yards. In some regions, the debts are mounting and more casualties may be on the horizon.

The country's state planners have been actively adjusting the policy levers to keep the industry on course. Depending on who you ask, the directives are either partially responsible for China's meteoric rise to the top of the global shipbuilding table, or a contributor to its capacity glut and the industry's present economic malaise. Some say both.

China convinced its banks to step up their support for the ailing industry in late 2008 by offering foreign firms financing for China-built ships at a time when more risk-averse western financiers were reducing their exposure to the sector.

Critics say this may have saved a few high-profile yards and tens of thousands of jobs, but it also contributed to global overcapacity on land and at sea.

And, more recently, opening the financial taps may ultimately have exposed banks to performance liabilities as declining revenue from fewer orders affected the ability of many yards to honour contracted delivery dates.

Most related legal suits are settled in arbitration, so meaningful data on the number or total value of disputed contracts is scarce. But, loan officers at the China Export-Import Bank (China Exim), the Bank of Communications, the Bank of China and Shanghai Pudong Development Bank have all told Reuters recently that refund claims for missing delivery dates rose rapidly in 2012 and 2013.

At the end of the first quarter, China Exim alone revealed it was holding a shipbuilding-related loan portfolio of RMB306.5 billion (US$49.7 billion) in addition to another US$40 billion in letters of guarantee.

So while China would like to encourage consolidation or closure of the poorer performing shipyards, the continuance of a dependable flow of investment capital would appear to indicate that reform is not desired at any cost.

"The government and the banks, which belong to the government, would not like to see yards going bankrupt, which leads to unemployment, a reduction of tax revenue and unrecoverable debts and loans," Hu Jintao, president of the Shanghai Merchant Ship Design & Research Institute (SDARI), told *The Naval Architect*. "Only a few have

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been closed, and some are struggling at the level SDARI serves."

State planners also have kept themselves busy since 2005, by issuing a series of directives to encourage the country's yards to improve construction practices and prepare for a technological advance to the higher margin end of market, held by the builders of offshore assets, car carriers and large container and gas ships.

By and large, the technology push has paid dividends in some areas, even if the overall pace of adoption has been slower than desired both with domestic planners and international buyers.

"The Chinese shipbuilding industry has made great progress in raising its technology standards," SDARI's, Hu, said. "All yards have implemented 3D production design and some even have newly developed computer integrated manufacturing systems to optimise their production efficiency."

The most recent initiative came late last year from the powerful Ministry of Industry and Information Technology (MIIT), which set new government requirements aimed at modernising the industry.

Known as 'Issue 55', some of its laudable targets were meant to improve design and manufacturing processes, raise the quality of product standards, lower the industry's environmental impact by reducing resource and energy consumption, and eliminate excess shipbuilding capacity.

While no one doubted the efficacy of the initiative or the value of its intent, Issue 55 would not have been well received by small and medium yards in the private sector, already struggling under the pressure of reduced ordering, lower vessel prices and higher construction costs.

For example, yards are encouraged to limit their energy consumption to the equivalent of 0.2tonnes of coal for every RMB10,000 (US$1,620) in revenue; their steel utilisation rates should exceed 90%; and semi-automated welding rates should reach 65% or over.

In line with most modern shipbuilding nations, all yards are required to meet quality and environmental standards set by recognised independent third parties such as the ISO.

Moreover, they have now been set a target to invest 2% of revenue into research and development.

Compliance with the full scope of Issue 55 will ease the renewal of business licences and, in some cases, has already seen the provincial authorities grant "high/new technology enterprise" status to individual companies, which reduces an associated yard's tax burden from 25% to 15% for a period of three years.

But, like some of China's shipbuilding directives, which are often offered as strong guidance rather than law, Issue 55 may have come in like a lion, but its impact has been lamb-like thus far, according to SDARI's Hu.

Hu said Issue 55 has provided basic criteria for the development of modern yard practices, which will help their global competitiveness. But, with the current market the extraneous capital of even elite yards, few are in a position to make the required investment.

"In such a low market, the required investment to achieve some of the criteria may trouble the yards. But, as it is not mandatory, I do not believe they will care too much about it, unless the government releases further clear statements," Hu said. "I've seen little evidence that it has had a big influence on the industry, directly. The direct impact always comes from the market and the buyers do not care if the yards are in compliance or not."

That is not to say that some of China's yards haven't increased their technical capabilities. Many used the past year to diversify product portfolios or reinforce international reputations for specific ship-types. Most progress was made by elite yards, but there were a few surprises.

For example, Guangzhou Shipyard International further established themselves as one of the world's pre-eminent makers of medium-range product and chemical tankers; these types of vessels currently represent 40 of the 42 ships they have on order, according to Clarksons.

Jinling Shipyard, in Nanjing, solidified a similar global reputation for ro-ro ships and is developing international respect for the quality of its car-carriers. (Jinling was one yard that benefited greatly from the recent ship-buying surge, already securing 20 orders in 2014.)

Shanghai Waigaoqiao Shipyard, the nation's No 1 builder with more than 13.4 million dwt of contracted tonnage on its books, reinforced its reputation as a world-class builder of capsize bulkers and tankers.

The venerable Dalian Shipbuilding, the nation's No 3 yard by tonnage and which has been around in one form or another since 1896, looks to be on the verge of breaking Hudong Zhonghua's high-value monopoly on the construction of Atlantic-max LNG carriers, having signed an letter of intent with the HNA Group. The proposed ships were designed by Dalian.

Nantong COSCO KHI Ship Engineering (NACKS), which presumably would be able to combine the clout of China's biggest shipowner with Japanese design expertise, in June signalled its intent to start building LNG ships in China.

Kawasaki Heavy Industry, the NACKS' Japanese partner, believes the cost of building LNG ships in China to be about 20% cheaper than in Korea, whose yards presently hold about 80% of the market.

Elsewhere, Qingdao Wuchuan Heavy Industry, captured the spotlight this month (subs: August) with the announcement that it had been contracted to build the world's first compressed natural gas ship, designed by the state-owned CIMC Ocean Engineering Design & Research Institute.

But, in general, new designs, at least those which are attractive enough to secure buyers, did not emerge from China's shipyards in the number expected last year. Tweaking an existing design was by far the norm.

"There are very few innovative designs emerging from the yards," said Hu. "But, they have updated current designs to lower energy consumption by optimising hull shapes and applying new engines that facilitate slow steaming."

So while reformists may grow impatient at the pace of consolidation and technological advance in China's shipbuilding sector, slow progress is being made.

The present lack of investment capital, a product of 2012s ordering slump, may have limited how much most yards could allocate this past year to achieve well-intentioned state guidance. But, this year's renewed contracting should ensure a return to steady progress.

"All China can afford is to apply the brakes lightly, then reaccelerate. The best way out of a nasty turn can be to accelerate a little to maintain some contact with the road," said veteran Hong Kong-based transport analyst, Charles De Trenck.

"The [shipbuilding] overcapacity has been a great conduit for the growth of semi-skilled workforces over the last couple of decades. China cannot afford to have those workforces scaled back too much, even if consolidation is needed." *NA*

SDARI plans next generation boxship

Deliveries of the 18,000TEU container ships began with last year's delivery of *Maersk Mc-Kinney Møller*, Shanghai-based naval architect SDARI is planning the next generation of container ships. However, economies of scale are becoming more difficult to realise as more design complications become apparent

Economies of scale are, according to some ship operators, becoming harder to realise as ships get larger. So the economies of scale of a 10,000TEU ship over an 8,000TEU vessel are comparatively greater than the economies of scale achieved by a 12,000TEU boxship compared to its 10,000TEU predecessor. That is the economies are reduced as the ships get bigger.

It is expected that the trend will continue with the next generation of container vessels, which are now on the drawing board. However, the succeeding vessels, one of which is currently being designed by the Shanghai Merchant Ship Design & Research Institute (SDARI), will leap up in size from 18,000 to 22,000TEU, a more than 22% capacity increase, significantly greater than the 10.3% increase from the 14,500TEU vessels, of the new post panamaxes, when the 16,000TEU *Emma Maersk* was launched in 2006.

In making this leap in size SDARI's designers have met with significant difficulties in terms of the structural design of the new vessel during the design process that the naval architects are currently working to find a solution to.

Ms. Lin Jie, SDARI's chief designer of container vessels and project manager of the R&D department, told *The Naval Architect* that the company is still trying to find the best solutions for the design complications of the ultra large container ship (ULCS).

"One possible solution is to add two rows more than the design of the CV18000 [the 18,000TEU ships]. That is to say, the beam will be about 65m. The loa will be within 400m and the scantling draft will be 16m as is the CV18000."

Another possible design variant that SDARI are investigating is adding two 40' bays and an extra row to the 18,000TEU design, this would give the new design a 62m beam and a loa of between 430 and 440m with the scantling draft similar to the 18,000, at 16m, explains Lin.

"In my opinion, the problems we have to overcome are the over-stability, lashing pattern and lashing force, torsion coursed buckling and fatigue, whipping and springing, emission control and energy saving solution," explains Lin.

> "Structure problems are the core items of ULCS design. Fatigue induced by torsion, whipping and springing is the most important question"

Structure problems are the core items of ULCS design. Fatigue induced by torsion, whipping and springing is the most important question, she says.

"Whipping is the global hull girder vibrations induced by slamming. It is a transient phenomenon. It will increase the bending moment, it will induce additional high frequency stress cycles, increasing the stress range", while "springing is the resonance phenomenon due to vertical bending and torsion. It will also increase the stress range," Lin says.

In an effort to analyse the effects of springing SDARI is carrying out a spectural fatigue analysis on typical critical details of the springing effects, in particular in areas such as the section immediately in front of the engine room.

"We would compute the extreme bending moment including the whipping effects and carry on fatigue analysis including hydro-elastic effects," she says.

Lin continued to explain that container ships normally lack stability and ballast water is required to increase the GM value to add vessel stability.

However, Lin argues that with the: "ULCS, the beam is much wider than before, the stability is better than small sized container vessels and sometimes, the GM value is too high, the vessel rolls quickly. The crews will feel uncomfortable. The rolling may cause high lashing forces and destroy the loose lashing fittings."

To combat these rolling movements caused by the instability of the vessels, which was a particular problem with the 18,000TEU ships that was solved using anti-roll tanks placed in a high position on the ship; it may also be necessary to place heavier cargo higher in the stacks.

Lin says it will be necessary to stack containers higher on deck. "But, the barrier [to stacking containers higher] may be the capability of the lashing fittings. So the makers [designers] of the lashing fittings are researching a better pattern for lashing on the ULCS." One possible solution may be external lashing and higher lashing bridges, says Lin.

Lin believes that to date lashing bridges of up to four tiers high have been popular for the ULCS of around 18,000TEU. However, she believes: "there will be more effective solution in the future."

If greater economies of scale are to be realised in the future a lasting lashing solution, and effective solution, will need to be at the core of the bigger designs. ***NA***

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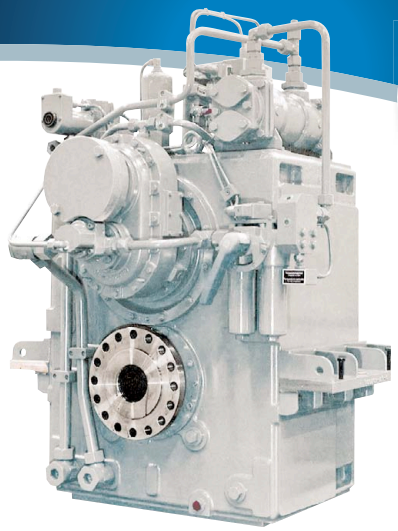

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SWS orderbook stutters, but yard powers ahead regardless

Few new orders in this year's improving market are the only dark cloud on the horizon for Shanghai Waigaoqiao Shipbuilding, writes Mark T. Vassel

Shanghai Waigaoqiao Shipbuilding (SWS), China's biggest shipyard by contracted volume, defended its position last year as the country's pre-eminent builder of Capesize bulkers and VLCCs.

It also captured the industry's attention in March by securing an order to build the largest ever containership in the country's history. Designed with a capacity of 17,700TEU, the ship was ordered by the ship-leasing arm of SWS's parent and will ultimately bear the colours of the France's national carrier, CMA CGM.

The audacious deal, struck by a yard usually viewed as a bulker specialist, was illustrative of the kind of management ambition that is commonly derived from a long track record of success.

A member of the state-owned China State Shipbuilding Corp (CSSC), Shanghai Waigaoqiao has contracted and delivered more tonnage than any other Chinese yard since its inception in 1999, almost 51 million dwt of merchant ships, according to Clarksons.

It currently boasts China's biggest orderbook by volume, 69 ships which will ultimately displace almost 13.5 million dwt. Only two of the 54 bulkers it has on order are below 180,000dwt.

In 2007, the CSSC formed SWS's sister yard, SWS Offshore, to tap into growing demand for the construction of offshore assets. That foresight paid dividends this year when SWS Offshore delivered the first jack-up rig ever built in Shanghai, and secured more orders for platform support vessels (PSV).

The jack-up is being deployed to the North Sea by French oil major Total.

The PSVs, based on Ulstein's PX 121 design, were ordered in September and April by Singapore's Pacific Radiance, which now has four units on order at SWS.

"It's exciting to see Shanghai Waigaoqiao introducing these efficient and flexible PSVs to the market," Ove Dimmen, the manager of Ulstein Design and Solutions said after Pacific Radiance doubled its order in March.

The keel was laid on the first unit in May, and all are to be delivered by the end of next year.

Another assembly line that is staying busy is the one dedicated to the construction of jack-up rigs.

As of June, SWS Offshore had orders for 10 jack-ups, including JU2000E units designed by the Houston-based naval architects Friede & Goldman for Seadrill and Prospector Offshore. It is also building Gusto MSC's CJ46 and CJ50 model units for Shandong Offshore Engineering.

Far from a minority contribution to group success, in June SWS and SWS Offshore's parent Shanghai Waigaoqiao Shipbuilding Co Ltd said it expects the construction of assets for the offshore sector to account for 25% of its production this year.

That would be a considerable achievement for the seven year-old SWS Offshore, especially given the size of SWS's orderbook for merchant ships.

SWS's client list reads like a 'who's-who' of international shipping. As expected, CSSC's acquisitive Hong Kong-based vessel-leasing arm is a loyal customer (they were indirectly behind March's giant boxship order), as is the influential state-owned China Merchants Group.

The yard's foreign contingent features blue-chip shipowners such as Norway's Fredriksen Group (10 Capesize bulkers on order) and the prominent German bulk specialist Johann Blumenthal.

However, SWS's foreign-owned orderbook is dominated by the Greeks. The yard delivered its first Aframax tanker to a Greek owner in 2005, and the European nation's merchant shipowners have been knocking on its door ever since, ordering more than 120 tankers, bulkers and boxships. Greek shipping interests have ordered more ships at SWS than any other foreign shipping community.

Every second year Greece hosts Posidonia, an elite global maritime exhibition; this year a delegation from SWS was there in force, holding a special promotional event for their top Greek customers to showcase the Group's new ship designs.

According to SWS, the main emphasis of the presentation was to highlight their new Capesize bulker designs (comprising 180,000, 186,000 and 208,000dwt models), their latest very large crude carriers (318,000 and 300,000), Aframaxes (115,000) and containerships (9,400 and 18,000TEU).

Among the new designs presented was also one for an 85,000m^3 gas carrier, illustrating the Group's ambition to enter another new market.

Late last year CSSC announced that SWS would spend RMB134.68 million (US$21.82 million) to purchase a 26% stake in Shenghui Gas & Chemical Systems.

Ultimately, the goal is for SWS and the Group's ship-leasing arm, CSSC (Hong Kong) Shipping, to take a 51% controlling stake in Shenghui, allowing SWS to enter the small and middle-sized LNG product sector, and forming a "complete industry chain for LNG", CSSC said.

The future looks bright for SWS. But, if there is an off-coloured cloud on its horizon it may be found in the details of its orderbook.

Unlike other elite yards in China, which have benefited from a mini-surge in vessel-ordering since the beginning of the year, SWS has only received orders for five new ships since January. And the last of its 69 ships is scheduled to be delivered in January 2017, enough business to keep its thousands of shipyard workers employed for just over two years. *NA*

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Some like it hot

Some of China's shipyards are experiencing increasing difficulties and the Jiangsu Rongsheng Heavy Industries shipyard encapsulates many of the problems being experienced all in one yard. Mark T. Vassel explores the current complications being experienced at the yard

Management at Jiangsu Rongsheng Heavy Industries endured another year of the yard's financial problems capturing the spotlight, with all new contracting activity remaining stubbornly silent.

After a year where the yard's mounting losses, non-performance-related lawsuits, delayed deliveries and labour unrest dominated industry headlines, its orderbook paid a predictable price, a reflection of evaporating market confidence.

China's biggest privately owned yard by contracted volume a little over a year ago, as of 24 July it had slipped to eighth on the table, registering 37 ships that will displace an aggregate 4.86 million dwt, according to Clarskons.

In terms of compensated gross tonnes, a measure that gives some recognition to the value of the orderbook, it ranked 12th in the country.

Moreover, further delivery delays – and the fact that Clarksons data indicates the yard has not secured any new orders for merchant ships since February 2012 – continued to erode its orderbook at a rate, which would alarm management and shareholders.

According to its parent's annual report for 2013, at year end Jiangsu Rongsheng had orders for 94 ships equalling 12.1 million dwt.

Clarksons data shows the yard had delivered nine ships this year as of the end of July, meaning up to 48 ships have vanished from its books in the first seven months of 2014.

Those numbers, and persistent overcapacity on most the world's major trade lanes, would appear to belie management's stated prospects for this year.

"We believe that the global shipbuilding industry has bottomed out," the Hong Kong-listed parent China Rongsheng Heavy Industries Group said in its annual report. "The current excessive shipping capacity is expected to be absorbed by growing trade volume in the course of the global economic recovery.

"Against the backdrop of the recovering shipping demand versus the shrinking shipbuilding capacity, we expect an increasing demand for bulk carriers and large containerships with a steadily rising pricing index in the coming years," it said, in a bid to bolster shareholders' lagging confidence after a dismal result.

The Group followed last year's RMB8.7 billion (US$1.41 billion) loss, its biggest ever annual deficit, with news in April that it had lost another RMB288.8 million (US$46.2 million) in the first quarter of this year.

Jiangsu Rongsheng itself posted a net loss of RMB6.94 billion (US$97.6 million) for 2103 and disclosed further liabilities of RMB29.8 billion (US$482.82 million).

Remarkably, CFO, Sean S.J. Wang, in March attributed the Group loss to RMB5.7 billion (US$923.52 million) in impairment charges on trade receivables, delay penalties and inventories, provisions he blamed on shipowners' inability to meet payment obligations. He denied the Group was responsible for any of the construction delays, according to some reports.

Clients have since lined up to disagree. In April, the Group reportedly initiated arbitration proceedings with the Greek shipowner Thenamaris in an attempt to avoid or delay refunds associated with the cancellation of the contract for two Suezmax tankers.

The same month, another Greek-owned entity, the Nasdaq-listed DryShips, told investors that it was unlikely Rongsheng would be able to deliver four ice-class panamax bulkers due this year.

DryShips privately owned associate Cardiff Marine expressed similar concerns about delivery of the three Suezmaxes it had on order at the yard.

In May, the Group also repelled the second of two applications for trial submitted by the Aegon Industrial Fund, which was seeking to recover losses it attributed to Rongsheng's inability to finalise the acquisition of the local marine engine-maker, Anhui Quanchai Engine Co.

And its losses were not restricted to shipbuilding.

Earlier this year, the Group's Singapore-based subsidiary, Rongsheng Offshore Engineering, lost what amounted to its entire fledgling orderbook, its first two C46 jack-up rigs worth US$360 million (plus two options) and a deepwater tender barge valued at US$125 million (with three options) after it was unable to secure export credit insurance and bank financing, Wang said.

Management undoubtedly will draw a huge sigh of relief when public discussion about the Group eventually leaves its poor financial state and refocuses on its core activity, shipbuilding.

What's perhaps been lost in all the news about its financial travails is that it remains one of China's elite shipyards, with the enviable capability to build a diverse range of vessels from Handysize bulkers and Post-Panamax-sized containerships to very large crude and ore carriers (VLOC).

While the industry was transfixed by its teetering balance sheet, Jiangsu Rongsheng in July quietly delivered the latest in the series of 16 400,000dwt VLOCs, its flagship product, ordered by the Brazilian mining giant Vale.

In June the Group completed its third issue of convertible bonds in two months, raising an aggregate HK$3 billion (US$387 million) of much needed capital and, perhaps more importantly, suggesting the market had some confidence left in its eventual recovery.

Certainly, Wang, the Group CFO, has remained positive throughout: "Once we can obtain the financing, I'm very confident some of the customers may come back and renew the orders, be it ships or offshore projects, and resume business relationships with us," he reportedly said in April when explaining the cancelled offshore orders. *NA*

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Bestway's latest eco-boxships

Shanghai-based Bestway Marine Engineering Design saw the launch of its first Emerald 39,000dwt bulk carrier. In addition, Bestway has been developing eco 2,500 and 3,500TEU containerships

Ship development is now focused on improving the environmental impact of the industry and creating vessels that have an environmental profile that will meet with the demands of regulations in the future, whilst saving shipowner's money. The economies of scale slider, seems to be in a constant shift, while shipowners weigh up the solutions available and what will be the best option to invest in.

Bestway Marine Engineering Design (Bestway) has been developing its latest environmentally friendly containerships, borne out of its Emerald 39,000dwt design and also on the ultra-handy ship design; these latest designs have used both dual-fuel and optimisation of design to achieve better environmental efficiencies.

Zhu Zhen Tao, senior engineer, Bestway Marine Engineering Design explains that: "In respect of containerships, slow steaming is the current fashion because the fuel oil price is pending at a high point, but, the freight rate is low. A lot of containerships that operate at high speed are struggling to make a profit where the expense of operation is becoming more costly. Shipowner's are now looking to reduce the speed of their vessels and increase the deadweight to get more profit."

Bestway Marine Engineering Design has launched its latest range of eco containerships; the first is set to be delivered at the end of 2014

The 2,500TEU design is based on the Bestway, Emerald 39,000dwt design. The first of this design, *Cascade*, was launched earlier this year. The development of the Emerald design was collaboration between the Shanghai-based design team and Lloyd's Register. Its aim to develop an environmentally friendly bulk carrier that would achieve results that would exceed expectations, claims the company.

The Emerald design stands out as one of the most efficient vessels to date, due to the results that it has achieved in testing, Bestway also says. After excessive model testing, the design of the vessel showed a 19.5% reduction in fuel consumption, fuel oil savings of a further 6.5% and the propeller design, which adds a further 2% energy savings. Six of these vessels are currently under construction.

In relation to the latest 2,500TEU, Tao adds: "Concerning this containership, which continues the Emerald theme, with good feathering of the hull line, high efficiency, flexible in that it capable of loading containers with a high loading ratio."

The first of the 2,500TEU's in under construction at Wuzhou Shipyard for Zhonggu Shipping, but will not feature a dual-fuel propulsion system. "The first 2,500TEU is not dual-fuel in accordance with the owners' initial demands," Tao adds, "however, Bestway holds a lot of experience in dual-fuel-driven ships, and follows the Chinese governments environmental policy development."

Bestway says that it has been carrying out research in the area of LNG in dual-fuel propulsion set ups. It highlights the construction of a 28,000m^3 LNG carrier and a dual-fuel tug that it has recently delivered. The company also says that it has been talking to the owner of the 2,500TEU and it would like to see this option being taken up at a later date.

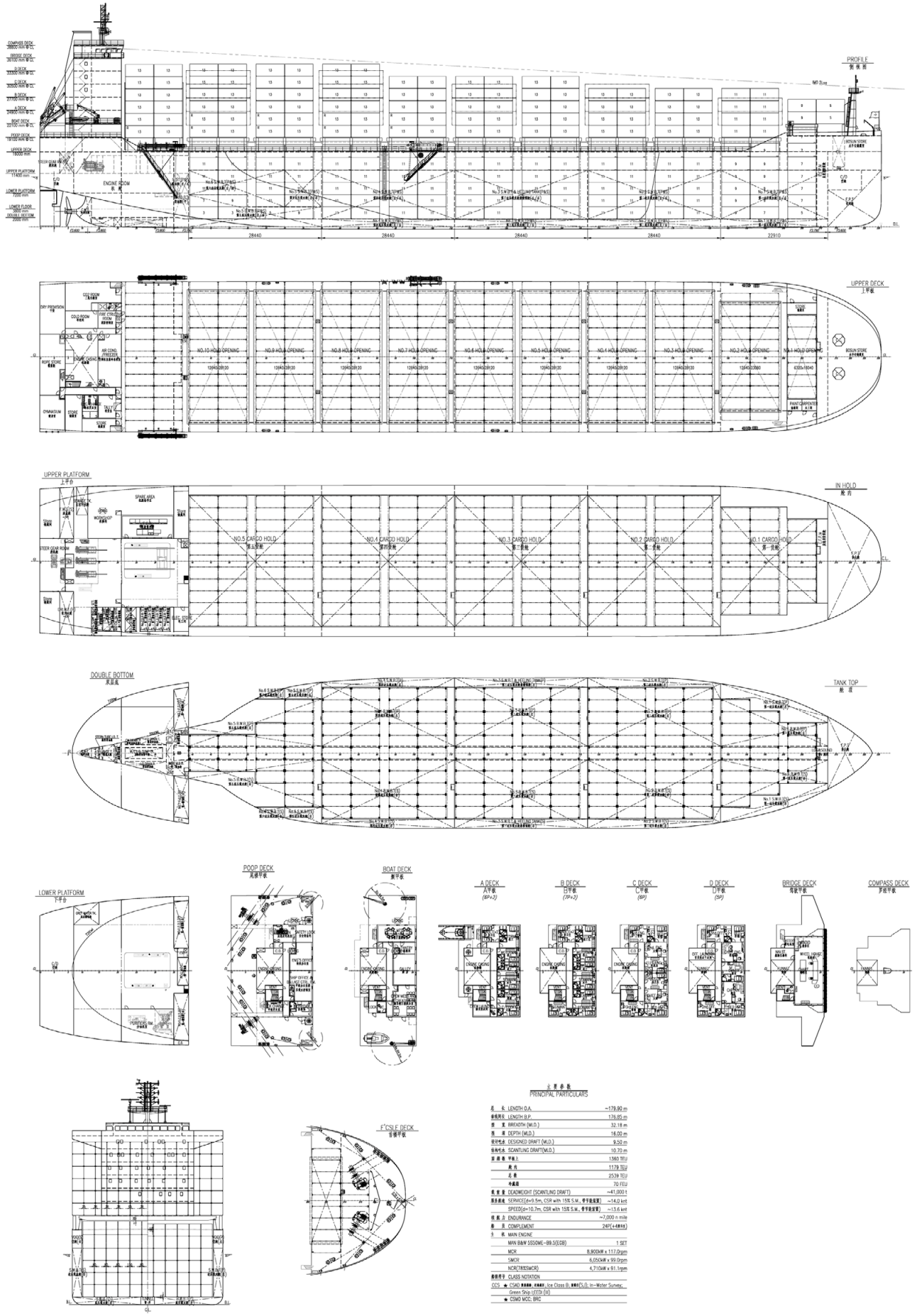
The 3,500TEU vessel design that Bestway has also developed is based on an ultra-handy sized ship, which has also been developed with energy efficient systems and the optimisation of the hull form applied. Both the 2,500TEU and 3,500TEU have been designed to operate at slow steaming speeds. To achieve this Bestway has increased the cube coefficient (Cb), which in turn has increased the vessels deadweight capacity. The vessels will be able to transit in domestic navigation under domestic business. The vessels are also capable of carrying a higher proportion of heavier containers. *NA*

TECHNICAL PARTICULARS

2,500TEU container carrier (dual fuel)

Length oa:	179.90m
Breadth:	32.18m
Depth:	16.00m
Draught	
Design:	9.50m
Scantling:	10.70m
Deadweight:	40,500dwt
Gross:	28,600gt
Speed:	14knots
Container capacity:	2,457TEU
Main engine	
Type:	MAN B&W 5S50ME-B9.5-GI
Output:	6,050kW x 99rpm
LNG fuel tank:	2 x 280m^3
EEDI index:	5.0(7.20)

GA of 2500TEU containership



CSBC introduces its Super Eco Feeder family

CSBC Corporation has been focusing its efforts to produce more energy efficient vessels to meet with the upcoming regulation requirements, which has prompted the development of it Super Eco Feeder Family designs

CSBC says that the start of the development of the Super Eco Feeder Family (SEFF) began when environmental efficiency became the main focus for the shipping industry. The SEFF designs cover 1,800TEU, 2,500TEU and 3,000TEU designs with ES10 (energy saving 10%) and Sea-Sword Bow (SSB) technologies being applied, with initial development of the concept coming from the 1,800TEU.

"We started to make efforts on 3rd generation of the 1,800TEU container vessel, including hull line modifications and energy saving devices around the end of September 2011, without a SSB. A remarkable milestone had been set up from the research and development of the project, so we then tried to apply the SSB in a proposed design around the summer of 2012 with the SSB testing carried out at HSVA in December 2012, the proposed design was accepted by an owner last March and signed the contract for construction last April," says Wen-Jung Yang, engineer, CSBC Corporation.

CSBC says that it has spent a lot of time in developing hydrodynamics and energy saving technologies. The delivery of the 3rd generation 1,800TEU container vessel *Kestrel*, hull No.979, in 2013, was the vessel that had the results from the ES10 project applied and also equipped with several energy saving devices, such as twisted rudder and rudder bulb, to cut off one cylinder of the main engine, under the same design speed.

The first SEFF 1,800 for SITC

Yang adds that: "By such successful improvement, we were encouraged to set up another target, which is ES20, to save an additional 10% compared to the ES10. To make our clients more competitive in the market, more flexibility in operations should be taken in to account. Hence we built up our own brand, Seaway Optimum Design & Operation (SODO), and invited owners and research professionals to join us."

CSBC has for the 4th generation of 1,800TEU container vessel, hull No. 1030, not only applied the ES10 technologies, but also the achievements of the ES20 project, which is the SSB. CSBC explains that with these adaptations the design is less sensitive to trim and draught, and also there is less green water

TECHNICAL PARTICULARS	
SEFF 1800	
Length oa: 172.40m	
Length bp:	169.60m
Breadth:	27.60m
Depth:	14.00m
Draught	
Design:	8.50m
Scantling:	9.50m
Gross:	17,500gt
Deadweight:	21,200dwt
Main engine	
Type:	MAN 6S60ME-C8.2
Output:	12,050kW x 105rpm
Container capacity:	1,800TEU

TECHNICAL PARTICULARS	
SEFF 2500	
Length oa:	172.00m
Length bp:	169.10m
Breadth:	32.20m
Depth:	16.70m
Draught	
Design:	8.80m
Scantling:	11.50m
Gross:	24,000gt
Deadweight:	32,700dwt
Main engine	
Type:	MAN 6S60ME-C8.2
Output:	12,350kW x 105rpm
Container capacity:	2,450TEU

TECHNICAL PARTICULARS	
SEFF 3000	
Length oa:	190.00m
Length bp:	186.20m
Breadth:	34.90m
Depth:	17.70m
Draught	
Design:	8.50m
Scantling:	11.00m
Gross:	28,700gt
Deadweight:	37,600dwt
Main engine	
Type:	MAN 6G60ME-C9.5/ Wärtsilä 6X62
Output:	11,840kW x 85rpm
Container capacity:	3,000TEU

effect. The company goes on to say that the results that they have seen with this design has mainly been as a result of the SSB, which gives the vessel good transit through waves, since the wave is just passing by without breaking on the hull, which reduces the power consumption of about 9-10% less than a traditional bow design, under sea state 5.

"Nevertheless, we are thinking a step beyond, especially for entering in to the new era with EEDI. At the moment, people are not sure what EEDI should look like, for vessels of the next generation," says Yang.

Despite the considerations of operation speed and careful selection of the specific maximum continuous rating (SMCR), CSBC says that container vessels should be wider in beam, for added advantages of stability. But, to achieve the results that it has seen from its SEFF 1800 (1,800TEU) design, it cautions that this has raised difficulties in the hydrodynamics, such as the unfavourable factor of speed-power performance and manoeuvring ability.

CSBC, however, have been facing these challenges and from them has developed it SEFF 2500 (2,500TEU) design, which it says will be a good choice for emerging countries and companies. For the considerations of shallow draught performance, the SEFF 2500 has a much lower operation cost, per TEU, including the fuel, but with almost the same design speed and better manoeuvrability, no matter if it is in deep sea or at slow speed.

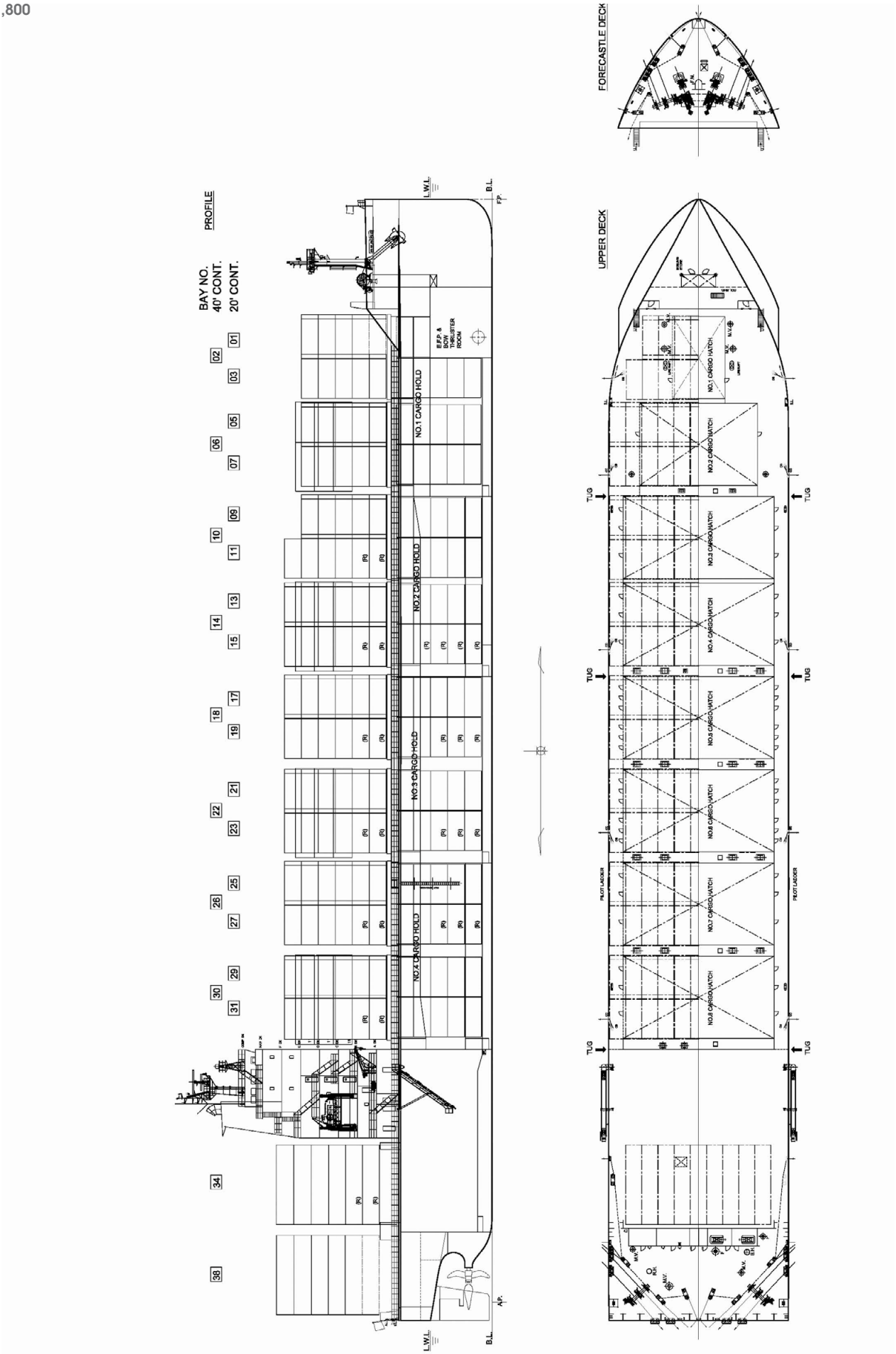
"We thought about the next generation feeder from August 2011, including the compliance with the code of safe practice for cargo stowage and securing (CSS), energy saving devices, SODO concepts and the study of main dimensions. The aim of this ship type is to comply with the requirements of EEDI 2025, which is 30% lower than the baseline. The first proposal was released to buyers in March 2012 with feedback and design improvements, we have updated the design further," Yang explains.

CSBC says that although it estimates that a smaller length-beam ratio could not be over looked, a longer vessel may have better performance in speed, under same operation requirements, if it was still possible in speed, under the same operation requirements, if it was still possible to meet with limited increase in fuel consumption, which a wider beam vessel would achieve. In relation to this the company notes that the SEFF 2500 is a compact design and is expected to meet with requirements.

The SEFF 3000 (3,000TEU) design has been developed from the SEFF 2500. The development started in March and is a larger feeder containership design. Yang highlights that: "From the limitation of Vietnam and Bangladesh (operations), the bigger feeder is about 3,000TEU. But, we shall also consider the lifting volume for this design."

CSBC currently has 16 orders of its SEFF 1800 series. The first vessel in the series is due to be delivered in October this year to SITC, with a further 11 vessels still on order from them. Iseaco and EastMED also have two vessels each of this type on order. *NA*

GA of SEFF 1,800



DSIC steps on the gas

Dalian Shipbuilding Industry Corp (DSIC) may be close to taking its long-awaited leap into gas-ship construction with the signing this spring of a letter of intent to build four Atlantic-max sized LNG carriers for a member of the mercurial state-owned HNA Group. Mark T. Vassel reports

Dalian Shipbuilding Industry Corp's (DSIC) main shipyard Dalian Shipbuilding, agreed in principle to build four 160,000-175,000m^3 LNG carriers for Shanghai-listed Tianjin Marine, a subsidiary of the HNA Group, for US$200 million-US$230 million per unit, according to an April exchange filing from the line.

After almost a decade of watching Hudong Zhonghua snap up all the orders for large gas ships in China, DSIC drew closer to shedding its historic role as China's bridesmaid in the LNG sector.

But, members of the HNA Group have left more than a few companies waiting at the payment alter, and Tianjin Marine has six months from filing to finalise the deal.

A year ago, Tianjin Marine unveiled a planned share-placement to raise up to RMB12 billion (US$1.95 billion) to buy four gas ships and 10 VLCCs; another member of HNA Group agreed to buy 30% of the offering, which still awaits approval from state regulators.

Presumably, China would want to strategically support a diversification of state LNG shipbuilding capabilities, given its mandate to ensure that 50% of energy imports be carried on Chinese-made and owned ships by 2020.

Industry watchers say the historic Dalian Shipbuilding, is the logical candidate to be the next wholly state-owned yard to build LNG ships, having promoted its related in-house designs for more than a decade.

According to a recent presentation by the International Standards Organization, the DSIC Design Institute has nearly 1,000 employees, 700 of which are directly engaged in engineering design.

They undertake design and development of products for: the defence industry; ships for civil use; ocean engineering and non-ship products; research projects financed by state ministries and commissions; and scientific research.

According to Clarkson's Shipping Intelligence, the Dalian Shipbuilding had 46 ships representing almost 7.5 million dwt on its books as of 7 July, with containerships and tankers predominant. It also has orders for Capesize bulkers, product carriers and a floating production, storage and offloading (FPSO) unit it is building for the state oil major CNOOC.

According to DSIC president, Yu Fengping, the Group would like to move FPSO production to DSIC Marine Services, another subsidiary located in the Bohai Bay, where they are better equipped to build the units.

Dalian Shipbuilding owes its healthy orderbook of merchant vessels to its long-term support from the country's state-owned enterprises. The yard has been operational in one form or another since 1896.

Twenty-seven of the of the 46 ships currently on its books have been ordered by state-owned companies, including Shenzhen-listed China International Marine Containers, the Cosco Group and China Merchants.

Most of its foreign clients are presently based in Singapore, including regional container carrier Pacific International Lines and IMC Shipping. The lone exception is Norway's Fredricksen Group.

Dalian is presently building three series of VLCCs for Shandong Landbridge, the COSCO Group and China Merchants.

It also has a letter of intent from Tianjin Marine to build two similar tankers, the contract for which is expected to be signed in October, pending state approval of the line's proposed share placement. None of the LOI units – the VLCCs or gas-ships – are represented on its confirmed orderbook.

Whereas many of its domestic competitors have only recently branched out into building assets for the offshore sector, Dalian Shipbuilding is an established player by Chinese standards.

DSIC Offshore, a member of the group, has an international reputation as jack-up specialist and is determined to extend that to include the construction of high-specification semi-submersible drilling rigs.

Norway's Seadrill, Petrochina and China Oilfield Services (Cosl), a unit of state oil major CNOOC, are among the blue-chip firms that have jack-ups on order at DSIC Offshore. In all, the company had 28 offshore 'projects' under construction as of June.

It was also working with COSL on the final touches of a semi-submersible design with a DP3 dynamic positioning system, which would be the first built at DSIC Offshore if first steel is cut as scheduled in September.

Management has targeted a 15% jump in offshore revenue for this calendar year, but says any growth will not come from pursuing semi-submersible fabrication at the cost of its core jack-up product.

"We will focus on semi-submersible and high-spec jack-ups such as the CJ-54 and CJ-70 designs for operations in 450-500m of water," DSIC Offshore vice-president, Li Minggao told investors in April, adding that the market had been flooded last year with speculative orders for jack-ups, particularly the JU2000E model.

DSIC president, Yu echoed those sentiments in June at MarineMoney conference in Dalian.

"The demand for jack-up rigs dropped 25% in the first half of this year comparing with the same period of 2013; also there are more orders from speculative investors," Yu said, warning that speculative buyers may struggle to place the units.

Nevertheless, he said DSIC Offshore was targeting a sales volume of US$1.6 billion this year. *NA*

China's top transformer

Yangzijiang Shipbuilding has successfully transformed itself from a standard shipbuilder to a yard with the capability of building high-value, complex, vessels that can compete with the world's best yards, writes Mark T. Vassel

Yangzijiang Shipbuilding Holdings, China's largest private shipbuilder, has emerged in the past year as one of the poster-children of the government mandate for the country's shipyards to move up the technology ladder.

The Jiangsu-based Group's top yards comfortably transitioned into the higher-value end of global shipbuilding, positioning themselves as credible rivals to those in Korea and Japan for the biggest containerships, while taking an initial foray into the construction of offshore assets.

In March, Jiangsu New Yangzi Shipbuilding, its main yard, was awarded "high/new technology enterprise" status by the provisional government, lowering to 15% its tax rate for the three years to 2016. The standard tax rate for yards in China is 25%.

The Group said the lower rate will allow them to maintain profit margins despite having clients recently exercise options on deals that were struck at the nadir of the shipbuilding cycle. It will no doubt also fund research and development activities as the Group continues its climb up the technology ladder.

Buoyed by a growing international reputation for building quality boxships and 'eco'-bulkers, the Group has posted some healthy financial numbers of late: it saw a comparative 24% increase in first-quarter revenue to RMB3.6 billion (US$582.81 million); an 11% jump in profit to RMB799 million (US$128 million); and a gross profit margin of 24% for its core shipbuilding businesses.

The Singapore-listed Group produces a relatively diverse range of merchant vessels; containerships, bulk carriers, multi-purpose cargo vessels and offshore engineering projects from its six Yangtze-river-based yards, which include:

- Jiangsu New Yangzi Shipbuilding (Jiangsu New)
- Jiangsu Yangzi Xinfu Shipbuilding (Xinfu)
- Jiangsu Yangzijiang Shipbuilding (Jiangsu Yangzi)
- Jiangsu Huayuan Metal Processing
- Jiangsu Yangzijiang Offshore Engineering
- Jiangsu Yangzi Changbo Shipbuilding (Changbo)

In its first-quarter disclosure to shareholders, executive chairman, Ren Yuanlin, said the Group had and order book of 125 vessels worth US$5.19 billion, a workload that would "keep the shipyards fully utilised until the end of 2016".

The Group has secured several significant orders since then, not the least of which included four 260,000dwt bulk carriers for the world's fourth biggest iron miner, Fortescue Metals, a contract valued by the Australian company valued at US$275 million.

The ships, to be built at Jiangsu New are the largest units ever secured by the Group. In total, Jiangsu New, its primary yard, had contracts for 16 dry bulk vessels with capacities exceeding 200,000dwt on its books as of July.

According to Clarksons Shipping Intelligence Network, Jiangsu New, the Group's primary yard, had orders for 113 vessels (or almost 10.9 million dwt) on its books as of 6 July, making it China's No 2 yard behind Shanghai Waigaoqiao.

Jiangsu New is comfortably China's busiest private yard in an era when many of the country's non-state-owned yards are struggling to meet new technology, employment and production-efficiency

Seaspan's latest Saver design has an 10% increased capacity and a 20% reduction in fuel consumption

targets set earlier this year by the powerful Ministry of Industry and Information Technology.

A close inspection of its orderbook reveals a healthy balance of asset classes and a blue-chip client base, both foreign and domestic.

Its most loyal foreign client is the Vancouver-based, New York-listed Seaspan Group, which in March increased to 15 the number of 10,000TEU container ships it is building at the Group's yards.

In June 2011, Seaspan turned the global spotlight on Jiangsu New when it placed an order for seven 10,000TEU boxships – with options for 18 more – the first ever order for ultra-large containerships in China.

It has since taken up two four-unit options for the ships, which were originally designed in partnership with the Marine Design and Research Institute of China.

Seaspan, which also builds ships at Korea's leading yards, is clearly impressed with the jointly developed 'Saver' design, which it believes has "substantial operational improvements", when compared with other 10,000TEU ships.

"The cargo capacity has increased by 10%, while fuel consumption has been reduced by 20%," a spokesman told *The Naval Architect* last year. "The new hull design allows the vessels to carry minimum amounts of ballast water while in operation … and they are designed to reduce the emissions to air by approximately 20% to meet future regulatory emission requirements."

Construction of the ships from the last option is being split between Jiangsu New and Jiangsu Yangzi.

The Group also has aspirations to compete with the Koreans in building mammoth vessels that can handle up to 18,000 boxes, according to Chairman Ren.

"We want to make container ships our signature product," he told Reuters in April.

Maybe so, but its subsidiary Jiangsu Yangzijiang Offshore Engineering also is making concurrent forays into the offshore sector, a move that further diversifies the Group's potential revenue streams and positions it for future growth.

Construction of the Group's first jack-up rig, ordered by Malaysia's Mena Offshore Investments, is on track for delivery in mid-2015. The Le Tourneau Super 116E Class self-elevating mobile offshore rig is being classed by the American Bureau of Shipping.

And it continues to develop and market its semi-submersible designs despite the cancellation in May of a January order for 2+2 Moss CS50 semi-submersible drilling rigs worth an estimated US$1.65 billion when the owners, Singapore-based Primepoint, met with financing issues.

The order would have been the first time a MOSS CS50 design rig had been built in China. *NA*

Shanghai yard secures LNG orders

Mark T. Vassel reports on the management at Shanghai's Hudong Zhonghua Shipbuilding, which would have gained considerable comfort from the quartet of Atlanticmax LNG carriers the yard secured in late July

Prior to 2014 there had been little in the way of new business for the elite Hudong Zhonghua Shipbuilding yard, which has seen its orderbook fall to 14th in the nation as of 22 July.

The yard, China's sole builder of large LNG carriers, had only a series of 13 capesize bulk ships ordered by the Monaco-based Scorpio Group to show its sales efforts over the past 12 months.

With a reputation as China's pre-eminent builder of high-tech, high value ships, Hudong Zhonghua's management has not always necessarily measured their success in the volume of tonnage they contract.

But, even when stated in compensated gross tonnes (Cgt), a measure which accounts for the value of a ship, the yard's orderbook now ranks No 3 in China, behind Jiangsu's Yangzijiang Shipbuilding Holdings and Shanghai Waigaoqiao Shipbuilding.

Prior to the Scorpio orders, Hudong Zhonghua had only one bulker on its books and, at a declared price of US$31.4 million per Capesize, management must be a little concerned about having to visit the lower-value end of the market to fill shipbuilding slots.

The 174,000m^3 LNG ships, which will be delivered to partners Vancouver-based Teekay and the CNOOC-China Merchants joint venture China LNG Shipping, by comparison will add an estimated US$200 million per unit to the yard's annual revenue.

Teekay will reportedly oversee construction of the ships at the yard.

As of 22 July Hudong Zhonghua had 51 ships on order displacing just under four million dwt, China's 14th-highest volume.

As an illustration of how its commercial fortunes have differed from some rival blue-chip yards in China in the past year, last year at this time its orderbook ranked seventh in the country when measured in deadweight tonnes, second in, compensated gross tonnage.

However, high-value and speciality ships continue to dominate its orderbook, ostensibly making it less vulnerable to the shrinking profit margins currently threatening security domestic competition who are building simpler ships.

STI Amber the first of the latest series of bulk carriers for Scorpio was deliverd in 2012 by a Korean yard

Hudong Zhonghua currently has contracts to build 10,000TEU, 9,400TEU and 8,888TEU containerships for the China Shipping Group, China's Bank of Communications leasing arm and Hong Kong's OOCL; multi-purpose heavy-lift ships; combination chemical and oil tankers; mid-sized roll on-roll off containerships and 14 Atlantic-max LNG carriers split between domestic and foreign buyers.

Some of the OOCL ships have been on its books since 2007, with delivery dates continuously pushed back at the carrier's request.

Hudong Zonghua has long been the preferred yard of China's ruling elite, a position and privilege that historically put it at the front of the queue to build domestic and foreign naval vessels and, since 2007, the country's LNG ship programme.

But, its position as China's only builder of large LNG carriers, and its dependence on that asset class as a primary source of revenue, is coming under pressure on several levels.

China has had relative success in ensuring that 50% of its seaborne oil imports are transported China-owned and built ships. Its potential to achieve the same goal for natural gas supplies continues to be restricted by domestic shipbuilding capacity.

Hudong Zhonghua may be the country's undisputed leader in building large LNG ships, but it has only delivered six units in the past eight years.

Moreover, the lack of LNG-related and delivery slots and overall experience is seeing China's shipbuilders miss commercial opportunities. In July the state-owned China LNG and its partner Teekay opted to build their new ice-class carriers at Daewoo Shipbuilding and Marine Engineering in Korea, whose yards currently hold about 80% of the global orderbook, reportedly in part because Daewoo could meet the required early delivery dates.

The ships are bound for the gas fields of Russia's Yamal Peninsula, where the first train is scheduled for 2016; Teekay's order at Hudong Zhonghua has pushed delivery dates to 2019.

So state planners will be eager to support the emergence of national competitors, with Nantong COSCO KHI Shipbuilding and Dalian Shipbuilding expected to break Hudong's domestic LNG monopoly within the next year.

There also has been a flood of LNG ship-ordering of late, sparking fears that the market's appetite for the capital-intensive ships may have peaked.

According to some reports, new LNG ships have been ordered at the rate of about one a week in the first half, 23 ships in all worth about US$4.6 billion (See Clarksons Data pg 34).

As of July, the global orderbook for LNG carriers stood at 128 ships, according to Clarksons' data, a number that represents about 32% of the operational fleet of some 400 ships.

All things considered, Hudong Zhonghua's reputation as China's highest value shipbuilder is fading and it looks set to come under even more pressure in the next few years. *NA*

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GSI snaps up GLS

Key strategic acquisitions by the dual-listed Guangzhou Shipyard International last year should ensure that it is positioned to remain among China's top shipbuilders for the foreseeable future, writes Mark T. Vassel

On June 16, China's 19th largest shipbuilder by contracted tonnage completed the up to US$163-million acquisition of Guangzhou Longxue Shipbuilding, the country's No 5 builder.

Combined, they hold China's No 3 orderbook, and there is more to come for Guangzhou Shipyard International (GSI), a subsidiary of the China State Shipbuilding Corp (CSSC).

In a 24 July filing to the Hong Kong stock exchange, where its shares have been frozen since April pending details of an overall restructuring, it alluded to further acquisitions of third-party companies and an injection of more assets from the CSSC.

"As the assets proposed to be injected by CSSC include certain core military assets, [GSI] and CSSC are required to consult the state-owned assets supervision and administration authority and the national defence technology administration authority," GSI told shareholders.

The company provided few additional details, but the acquisition of Longxue is seen as one of very few concrete examples of a much-needed strategic consolidation in China, where over capacity has threatened the existence of some top yards.

It will merge China's top builder of product carriers and chemical tankers, with Longxue, south China's largest yard, which is fast developing an international reputation for building Capesize bulkers very large ore carriers.

As of July 25, the yards' had orders for 72 ships on their books, displacing 8.57 million deadweight tonnes, according to Clarksons. Moreover, the acquisition allows GSI to move up the value table: if the combined book is stated in compensated gross tonnes, a measure that recognises the value of the ships on order, GSI has leapt from 14th to 4th on the national shipbuilding table.

There have been growing pains, however. GSI's first-quarter performance – the first which consolidated Longxue – revealed a net loss of RMB113.9 million (US$18.2 million), compared with RMB15.7 million (US$2.55 million) for the same period last year, despite a 21% jump in overall in comparative sales.

Stena Weco has been one of GSI's clients testing out the yards capability for modern tankers

About RMB5.4 million (US$875,000) of the loss was attributed to the acquisition.

The result followed GSI's full year loss of Rmb226m (almost US$37 million) in 2013, as declining demand and overcapacity drove down the price of new ships while increasing the number of cancellations.

However, both have been actively securing new orders this year (10 in all) and both have a blue-chip list of clients.

Predominant among Longxue's clients is the acquisitive Berge Bulk, one for the world's biggest independent dry bulk owners managed from Singapore. Berge returned to Longxue in March to order its 8th and 9th VLOC, all for delivery by the end of 2016.

The COSCO Group returned to GSI in June to order a new series of 50,000dwt product tankers; while, in January, while the giant Dutch commodities trader Trafigura Beheer, which has an annual revenue exceeding US$100 billion, doubled to eight its order of 50,000dwt chemical and oil tankers at the yard.

State planners will point to GSI's commercial strategy as the way forward for the industry. Not only has the acquisition given the industry a blueprint for consolidation, the company doubled to RMB152 million (US$24.67 milliion) the amount of capital it spent on research and development last year to move up the technological ladder and boost its presence in the offshore sector.

According to its annual report, much of the research is being conducted into improving the operational and environmental performance of 'hi-tech' ships it is already marketing, namely VLOCs, Capesizes, Kamsamax bulkers and an 'eco' series of medium-range tankers.

"In respect of shipbuilding, [GSI] has independently developed low fuel consumption and environment-friendly 40,000dwt and 50,000dwt MR tankers, whose energy efficiency meet phase II [IMO] requirements," GSI said.

It is also looking at opportunities to build medium range passenger ships (suitable for 1,400 people) and 2,000m capacity combination ro-ro passenger ships.

It is also investing in research to build the new double-hulled Floating Production, Storage and Offloading units that are in demand in the offshore sector. GSI said it believes offshore construction holds great promise.

Its offshore business contributed about a quarter of the revenue attributed to its marine activities last year. And while the revenue GSI generated from shipbuilding fell 43% year on year, revenue from its offshore engineering activities grew a comparative 13.6%, to RMB692 million (US$112.13 million). *NA*

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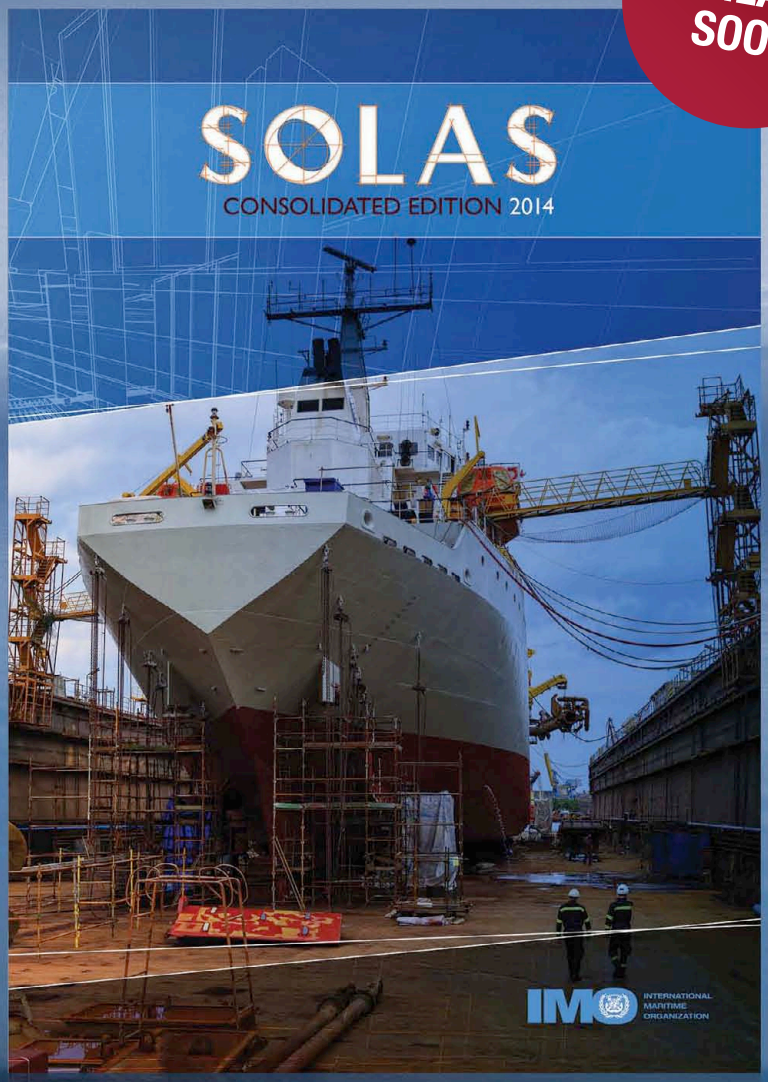

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Trim Optimisation – Don't blind me with science!

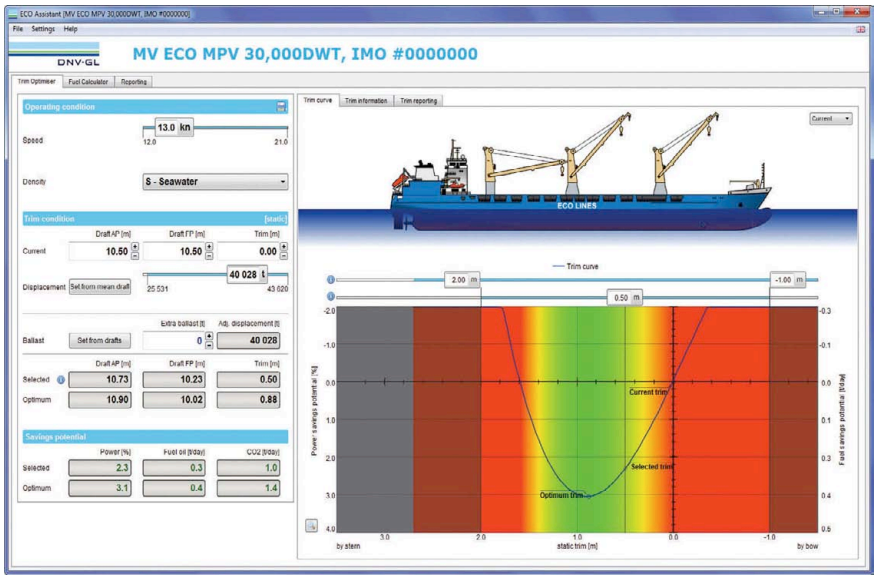
Volker Bertram, from the Department of Mechanical and Mechatronic Engineering at the University of Stellenbosch and DNV GL sheds some light on the dark arts of trim optimisation

All standard references for ship energy efficiency, such as the IMO greenhouse gas (GHG) report or the the Oil Companies International Marine Forum (OCIMF) study for emission-mitigating measures, rank trim optimisation highly as a recommended measure.

Indeed, trim optimisation is easy to refit and generally gives short payback times, typically in the order of several months. But, customers are faced with an ever increasing array of vendors which use incomprehensible jargon. Should I take a "dynamic performance model based on advanced machine-learning technology" or rather the "RANSE with VoF"?

Simple advice: Don't be blinded by science; don't be impressed by a smoke screen of jargon. You don't need to programme the software; you just want to understand the basic principles and the pros and cons of the different approaches.

The following gives an introduction to available options, explains some of the jargon and discusses strengths and weaknesses of the different approaches.



Screenshot of trim assistant software ECO-Assistant

A knowledge base is crucial

There are several commercial trim optimisation tools on the market. These vary in price, user friendliness, fundamental approach and performance. However, they all combine two key elements:

1. A ship specific database (often called the hydrodynamic "knowledge base") for resistance or power as function of operational parameters
2. A user interface displaying the trim recommendation. Virtually all systems use an intuitive traffic-light scheme for good, acceptable and poor trim options.

Key operational parameters considered are speed, displacement (respectively draft) and in rare cases also water depth. Other factors, such as seaway, are seen as secondary for trim optimisation and therefore not considered. For certain cases, such as ferries or ships trading frequently in shallow waters (e.g. Baltic Sea), the inclusion of water depth as a parameter makes sense. For most other ships, water depth may be neglected. On very shallow water, aspects of safe manoeuvring overrule energy efficiency considerations.

The hydrodynamic knowledge base should be a dense matrix of speed, trim and draft values. Its range should cover all feasible operational combinations. Typically this requires 300-400 data sets (combinations of trim, draft and speed) for deep water, and 3-5 times as many if also shallow water variations are to be covered. The discrete data sets are connected by smooth interpolation (multi-dimensional response surface in jargon), allowing consistent interpolation for whatever operational conditions are specified by the user.

While each trim optimisation tool must have a hydrodynamic knowledge base, the chosen approach to generate this knowledge base decides costs and performance of a trim optimisation system.

First school, then work

There are two fundamentally different approaches to develop trim optimisation tools. The first group of systems is based on a "laboratory" hydrodynamic model which creates the knowledge base systematically and completely, before the trim optimisation software is used.

The system goes to school first and learns the knowledge base before being sent out to the real world. This school training may be through model tests or numerical simulations. As this approach does not require interfacing with onboard systems or sensors, it makes installations much more cost effective on most ships, especially for fleets of sister vessels. However, the

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approach requires a geometry model of the hull, which may have to be re-engineered from available cross sections and main dimensions or from 3D scanning.

Model tests are in principle an option, but the creation of dense knowledge base involves much more time and cost than CFD (computational fluid dynamics). In addition, model tests suffer from scale effects (different wave breaking from full scale ship) and have thus also a slight accuracy handicap. Hence, some of the older trim optimisation systems were based on model tests, but today CFD-based approaches are now preferable.

Older CFD approaches used simpler flow models (using jargon such as potential flow, panel or Rankine singularity methods). These fail for breaking waves and have poor or no propeller models, leading to less accurate results. Better flow models give more accurate results and thus better trim recommendations and higher fuel savings.

Such high-fidelity simulations (using jargon such as full-scale RANSE simulations, viscous CFD, two-phase flow, Volume-of-Fluid (or VoF) method) may be more aptly called "numerical sea trials" than "numerical towing tank" tests, as they mimic the full-scale ship rather than the scaled-down model of a model basin. They are capable of modelling breaking waves accurately, which is essential in conditions where bulbous bows partially emerge or transom sterns partially immerse.

Learning on the job – Beware of incomplete training

The second group of trim optimisation systems is based on system identification of the actual ship. Typically some machine learning techniques are employed. This approach does not need any information about the ship hull geometry. However, it requires rather extensive sensor information. Ships must then be equipped with advanced data acquisition systems. These systems have to cope with changing ambient conditions (wind, waves, current, water temperature, etc.), which affect the resistance of the ship.

Even if sophisticated correction methods are used, the uncertain nature of the ambient conditions introduces unavoidable scatter in the target data. Machine learning techniques perform in essence the task of putting a smooth "curve" through the scattered data. The more parameters are involved, the slower the computer learns. Therefore machine learning approaches work best for ships which feature fewer changes in operational and ambient parameters, such as ferries or cruise vessels.

While the first group (model test and CFD-based knowledge base) had the benefit of a proper school education, the second group has to learn on the job. Typically there is an apprentice period, though: Initial dedicated training periods vary draft, trim and speed, ideally during days where the ambient conditions do not contaminate the data sets too much. After that, it is life-long learning to fill missing patches in the knowledge base and to update existing knowledge. This continuous learning is called "dynamic" in trim optimisation jargon.

In a shipping fairy tale one captain was faced with a dilemma; the story goes like this: Once upon a time, there was a shipowner who was looking for the best trim optimisation for his vast empire of ships. He looked for suitable candidates and installed a CFD-based system and a machine-learning system on one of his ships. One fine day, the captain asked both systems for advice. The CFD-based system said: 1m down by the bow. The machine-learning system said: 1m down by the stern. Who should the captain trust?

It sounds like a fairy tale, but rumour has it that this happened more than once. But, the solution to the puzzle was that the comparison was made shortly after installation. The captain had never before driven the ship on that draft and at that speed other than with trim by stern. The machine learning system had, therefore, never "seen" that by trimming by bow the fuel consumption was lower and picked the best solution from its limited experience. Its knowledge base was patchy and thus its recommendation not good. The CFD-based system had covered the whole knowledge base before installation and thus gave the right recommendation.

In all fairness, had the machine-learning system been trained on all possible conditions, it would have given the same recommendation. The vendor no doubt wrote this in his instructions. But, there is always the danger that we don't read the instructions.

Integrated or stand-alone?

Trim optimisation may come as part of larger advisory systems, e.g. coupled with stowage planning, voyage optimisation, or performance monitoring. Trim optimisation software in itself is good, but even better if combined properly with other functionality. The coupling to stowage planning is attractive as optimum trim should be achieved without extra ballast.

Similarly, automated recording functions are nice to have. The automated reporting serves a double purpose: as proof of energy efficient operation (for SEEMP documentation, national and port authorities, between charterers and shipowners, charterers and cargo owners, etc.) and as incentive for increased usage of the system.

Use with caution and exploit economies of scale

Trim optimisation is highly advisable for virtually all ship types. CFD-based trim optimisation is the most cost-effective trim optimisation option for fleets of sister vessels. Care should be taken that the CFD approach used is not based on out-dated potential flow methods.

The big advantage of CFD is that one can exploit the advantages of parallel computing. Dense knowledge bases can be typically generated in one or two weeks on high-performance computers with several thousand parallel processors. This is a unique advantage over model tests and system identification on real ships.

Machine-learning systems may give similarly good results, but must be trained properly, which requires more time and crew awareness. *NA*


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Resistance is Futile

To optimise a ship hull form for calm water resistance you need engineering science, for seaway optimisation you may also need luck. Facing the increasing interest in ship power at sea the Hamburg Ship Model Basin carried out resistance and propulsion tests in regular waves from various directions. The results are intriguing, for all scientists interested in resistance. Petri Valanto and YongPyo Hong of HSVA report

Notwithstanding the fact that resistance of ships in seaway is futile and hard to reduce, the rewards in energy efficiency and cost savings certainly make it worth to try.

For over 100 years the Hamburg Ship Model Basin (HSVA) has carried out tests and applied research on ship resistance and propulsion, in calm water, in seaway, and in ice. Recently, this work in the model basins has gained further importance, as it is essential in the reduction of CO_2, and other exhaust gas emissions from worldwide shipping.

In the framework of the on-going joint research project *PerSee* (Ship Performance in Seaway) sponsored by the German Federal Ministry for Economic Affairs and Energy (BMWi) HSVA has carried out a large number of measurements on wave added resistance in regular waves in seven wave directions between 180degs and 0degs of ship heading.

In addition, propulsion losses in these conditions were investigated with a limited number of propulsion tests. In all tests a new towing arrangement was used, which allows the ship model as free motions in oblique seas as possible, but makes it simultaneously possible to measure the towing resistance.

The ship model is towed with a vertical *towing pole* located in the middle of the ship. A vertical *guiding pole* at the bow controls the ship model direction. The ship motion components roll, pitch, and heave are completely free. The surge, sway, and yaw – components are restrained with suitably soft springs allowing the cyclic motions of the model in seaway, but keeping it softly on its course and position.

For accurate measurement of wave added resistance the ship must be able to execute roll motions freely in all wave directions. For this it is important to have the roll axis of the ship model at the correct height above the baseline, also when the ship model is connected to the towing system. This is realised with two articulated force balances.

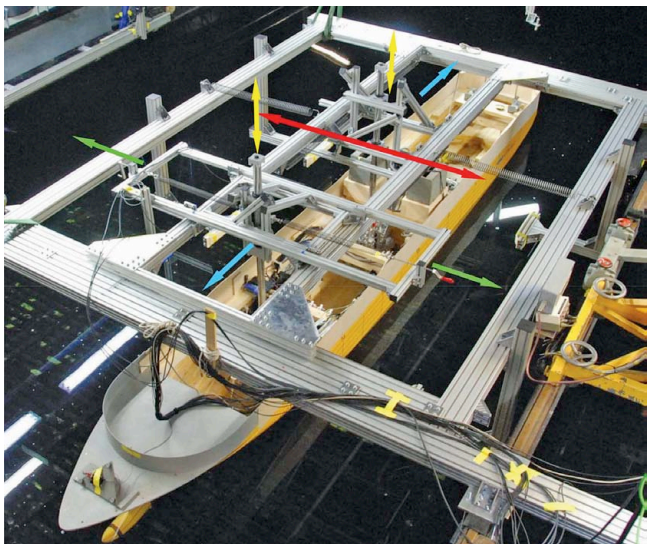

Figure 1: Trial version of the new towing arrangement for oblique seas in the HSVA large towing tank. The arrows show the direction of the movement of the different components of the system.

Figure 2: Two different bow forms of the hull were tested and compared.

The towing arrangement shown in Figure 1 allows researchers to carry out measurements on the resistance of ship hulls with different bow forms, as in Figure 2, also in oblique seas, thus giving impulses to ship hull design and optimisation. Second, it allows researchers to study the efficiency of the propulsion in seaways of all wave directions. The new towing arrangement will help in designing ship hulls for optimum performance in seaway and in choosing the best propulsion point for a chosen ship design.

Test programme

The towing tests in regular waves were carried out with the model of a 221m long cruise ship design by *Meyer Werft* in regular waves having wave length to ship length (λ/L_{pp}) –ratios between 0.18 and 2.5. The corresponding wave periods varied between 4.81 seconds and 18.99 seconds in full scale.

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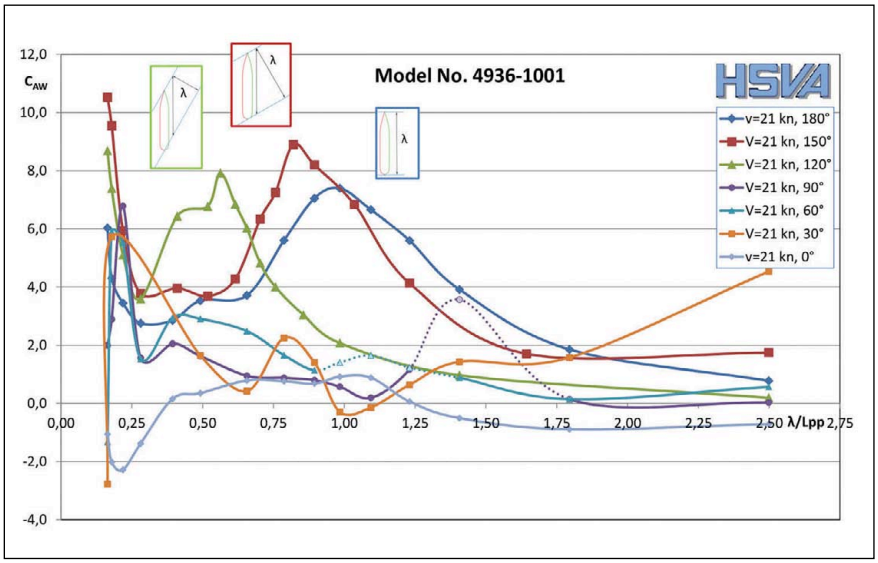


Figure 3: Measured C_{AW}-curves for the wave added resistance as a function of the λ/L_{pp} - ratio.

The main goal of the tests was to measure the response amplitude operators (RAO) of the wave added resistance on the whole wave length range in seven wave directions between head and following seas. For each wave direction 11 – 15 resistance points were measured to get complete RAO-curves. Most of the tests were carried out with the full scale speed of 21knots a small number with a slower speed of 15knots for purposes of comparison.

Wave added resistance

The wave added resistance R_{AW} is obtained as the difference between the total resistance measured in waves R_{TMW} and the total resistance measured in calm water R_{TMC}

$$R_{AW} = R_{TMW} - R_{TMC}$$

The dimensionless added resistance coefficient C_{AW} becomes

$$C_{AW} = \frac{R_{AW}}{\rho g \zeta_A^2 B^2 / L_{pp}}$$

where R_{AW} is the wave added resistance, ρ density of the tank water, g the acceleration of gravity, ζ_A the measured wave amplitude, B the breadth of the ship model at the design waterline, and L_{pp} the length between perpendiculars. Figure 3 shows RAO - curves of the coefficient C_{AW} as a function of the λ/L_{pp} - ratio, where λ is the wave length.

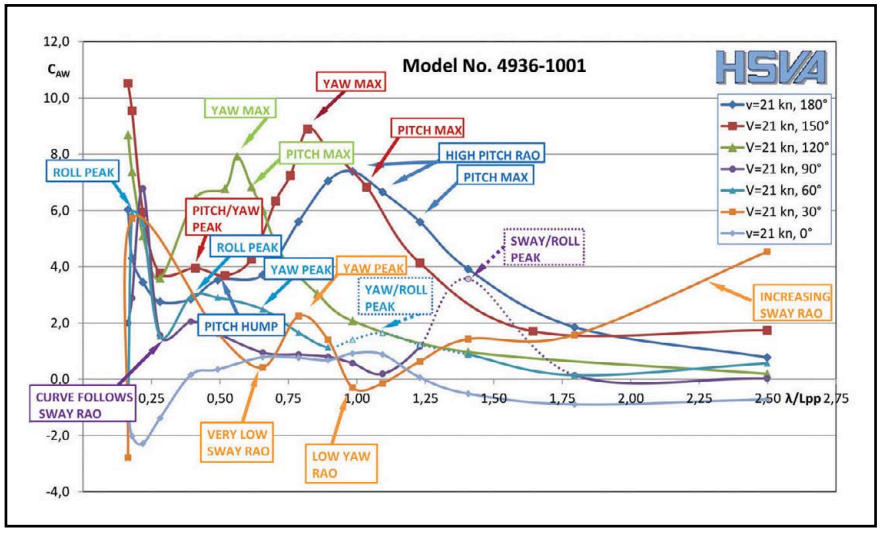
The measured points are directly connected with splines without any smoothing of the curves. The small sketches above the curves are colour coordinated and they show how the ship lies in the waves having different encounter angles with the ship. With the increase of the relative angle between the direction of the wave propagation and ship direction the peak of the RAO moves toward shorter and more frequent waves in the oceans. Not only are the peak values of the C_{AW} in bow quartering seas (120degs, 150degs) higher than in head seas, but these peaks are also reached in shorter and more frequent waves than the peak values of the RAO for C_{AW} in head seas (180degs), as shown in Figure 3. All this emphasizes the relative importance of the wave added resistance encountered in bow quartering seas.

At short wave lengths the C_{AW} - values increase steeply, which is quite common. However, at the area of very short waves the accuracy of the measurements is at the lowest, which should be kept in mind when assessing the results.

In beam (90degs) and stern quartering (60degs, 30degs) seas the C_{AW} - values are in general lower than in bow quartering seas, but by no means negligible.

Also the RAO's of the ship model motions were measured in the tests. A careful study of these curves shows that many of the humps and hollows of the non-dimensional wave added resistance C_{AW} - curves coincide with the high and low values of the RAO-curves of the ship motions. Thus what at first look may have looked as data points scattered off the correct path of the C_{AW} - curve, are in fact properly measured data points simply reflecting high or low values of the C_{AW} to certain ship rigid body motion components. The measured C_{AW} - curves are shown once again in Figure 4, with labels indicating the lows and highs of the ship motion RAO's. It

Figure 4: Measured C_{AW}-curves for the wave added resistance. The positions of the peaks or low values of the ship motion RAO's are indicated in the figure with colour coordinated arrows and labels. The dotted parts of the curves may be influenced by the towing frame



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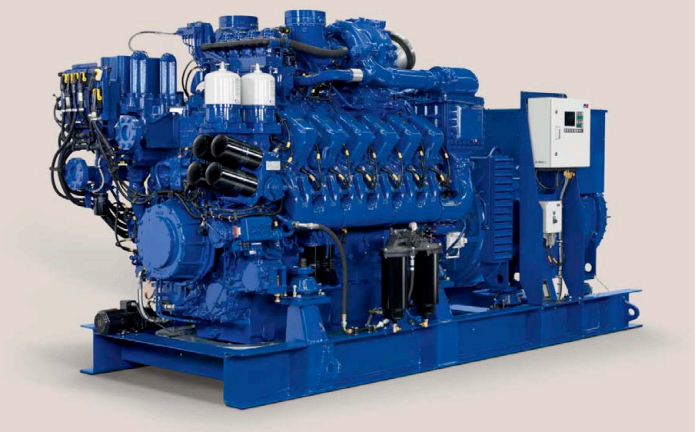

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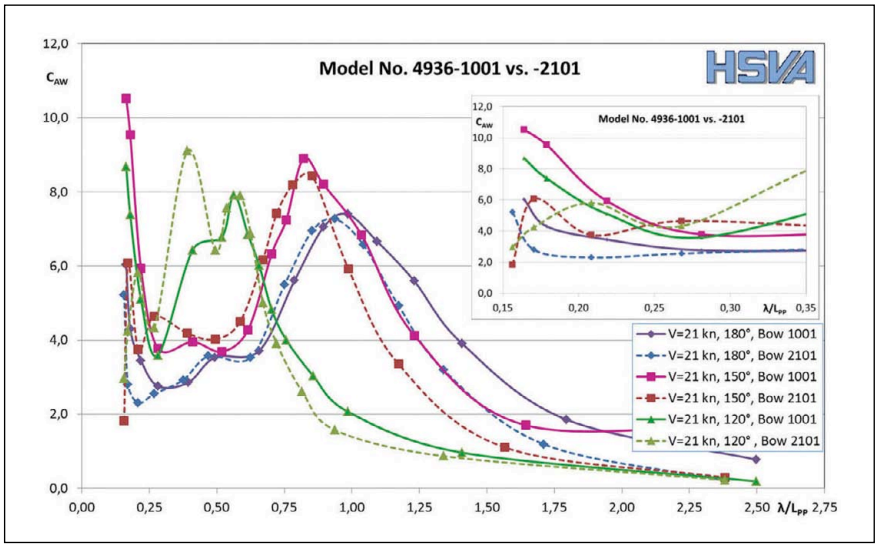

Figure 5: Measured C_{AW}-curves for the wave added resistance for two bow forms. The small plot up on the right shows the curves at very short wavelengths.

should be obvious that increased ship motions lead also to elevated values of wave added resistance.

Bow comparisons

Figure 5 shows the measured C_{AW} - values for the two bow forms investigated in the tests. In general the differences between the two bow forms are not large. In very short waves, at the λ/L_{pp} - ratio of 0.16 – 0.28, the vertical bow form (-2101) without a bulb yields lower resistance values than the original cruise ship bow (-1001) in wave headings 180degs and 150degs. When the waves become longer, this difference becomes less clear, eventually the tendency can reverse.

The wave pattern along the ship bow in regular short head waves is shown in Figure 6 for the two bow forms. The original cruise ship bow (-1001) on top has a bulb and more inclined frames in the bow. The vertical bow without a bulb (-2101) has more vertical frames in the bow. Notice the difference in the wave pattern between these two bow forms. The wave system with the vertical bow (lower figure) shows a very smooth behaviour, whereas the waves along the original bow (upper figure) all break as a result of the wave elevation. It can be assumed that this is an important mechanism causing higher wave added resistance in short waves with bow forms having inclined frames, in comparison to bow forms with more vertical frames.

Conclusions on Ship Resistance in Seaway

The highest wave added resistance values were not measured in head seas, but in bow quartering seas.

Practically all ship motion components in a large range of wave lengths have a clear effect also on the wave added resistance.

The comparison between the two bow forms -1001 and -2101 shows that it is possible to design an alternative, vertical bow without a bulb having equal calm water resistance, a slightly lower resistance in short waves, and about equal resistance in waves about the ship length. Thus for a cruise ship sailing much in shorter waves the vertical bow with steep frames is an interesting design alternative. For a cargo ship such a vertical bow would have the additional advantage that the bow without a bulb would be less draught dependent than the classical bulbous bow form.

Based on this study the highest resistance in seaway is experienced in bow quartering, in more frequent sea states than those leading to maximum resistance in head seas. From the point of view of the actual energy efficiency and savings in the fuel consumption of the ship, it is not enough to study only the head sea condition.

Propulsion tests

After the analysis of the resistance tests also propulsion tests were carried out with the same cruise ship model and ship speed of 21knots in regular waves of various lengths and wave directions.

These propulsion tests are closely related to the earlier towing tests. In both test series the new towing arrangement for seakeeping tests in oblique waves was used. The regular wave trains used in the tests were identical, so that as well resistance as propeller thrust and torque values in identical conditions are available.

The propulsion tests were carried out with the British Method, that is, with constant speed. Two rates of propeller revolutions for each test point were used. In these tests the propeller revolution rates provided thrust values slightly above and slightly below the ship propulsion point. Thus the model was towed with a force closely approximating the skin friction difference between model scale and full scale.

With the British method the model is towed at constant speed and the rate of propeller revolutions needed to provide the required thrust is interpolated. As with a free-running model also in this case the advance ratio J is reduced, this time due to increased rate of propeller revolutions, leading to a lower open water propeller efficiency η_o than in calm water.

Figure 7 shows the different propulsion efficiency coefficients in regular head waves. These coefficients are shown as a function of the wave length to ship length -ratio. As the wave heights and the resistance values in waves are not constant, also these are indicated with labels in Figure 7. The notation R/R_{cw} is the relation between the ship resistance in waves to that in calm water in full scale.

The relative rotative efficiency η_R is the ratio of the propeller torque in open water to that behind the ship and it shows only very small variations in the tested wave lengths and wave heights.

The hull efficiency η_H is the ratio of work done on the ship ($R_T V$) to that done by the propeller (TV_A). This coefficient shows slightly lower values than in calm water, when the wave height exceeds 3.2m and the wave length 0.8 ship lengths.

The propulsive efficiency η_D is the ratio of the effective power P_E to the propulsive power P_D . The η_D is also the product of the hull efficiency η_H, the propeller open water efficiency η_o , and the relative rotative efficiency η_R, thus the changes in the latter three are reflected also to the propulsive efficiency η_D.

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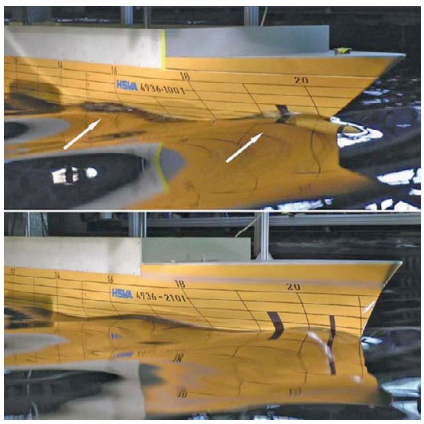


Figure 6: Breaking (arrows) and non-breaking waves at the bow of the model No. 4936-1001 (up) and No. 4936-2101 (down), respectively, in head seas. The speed is 21knots and the λ/L_{pp} -ratio 0.18.

In waves shorter than 0.65 ship lengths and wave heights between 1.2m and 3.0m the open water propeller efficiency loss is less than 2.8% of the calm water value. This value is related to the increased resistance of the ship in waves, which lies between 104 and 132% of the calm water resistance in full scale. The corresponding loss in the propulsive efficiency with less than 1.2% of the calm water value is clearly lower. There is a difference of about 1.6% points between the mentioned changes in the efficiency values, which undoubtedly could result from the accuracy limitations of the measurements. However, as such differences can also be seen on the curves measured in other wave directions, these differences can also be due to the moderate ship motions in waves, which according to other sources can have a positive effect on the inflow to the propellers.

In waves longer than 0.65 ship lengths and wave heights between 3.2m and 3.6m the propeller open water efficiency goes down to 92% of the calm water value. The corresponding propulsive efficiency goes down to 91% of the calm water value. There is a difference of one percentage point between these efficiency values. Thus a propulsion efficiency loss of only about one percentage point cannot be explained with the open water propeller efficiency reduction due to changes in the advance coefficient *J*, but results from the effect of the wave orbital and ship motions in waves.

Thus summarising, in the investigated wave height and length area in head waves the total ship resistance increased up to 185% of the calm water value, the propeller open water efficiency dropped to 92% of the calm water value, and in addition the efficiency loss due to ship motions in waves was about one percentage point, leading to the propulsion efficiency of 91% of the calm water value.

The situation in other wave directions with identical wave lengths and wave heights varies, but the conclusions remain the same. The highest difference between the propeller open water efficiency and the propulsive efficiency of 3% points was reached in 3.6m high waves, having the length of about 0.75 ship lengths and the wave direction of 120degs. The corresponding ship resistance value was 149% of the calm water resistance.

Conclusions

In view of the experimental data, it is easy to come into the conclusion that the largest gains in ship energy efficiency can be obtained with the reduction of the ship (wave added) resistance, as illustrated in Figure 8.

Resistance reduction in shorter waves is possible with changes in the bow form, whereas clear resistance reduction in waves having about the ship length would tend to require changes in the main dimensions. In view of the calm water resistance and frequently encountered shorter waves modifications in the bow form may be the more attractive choice. Here, however, also other wave directions than head seas need to be investigated.

Despite of the development in the numerical methods, for the task of this study, that is, for ship form development and optimisation for real conditions at open sea, the ship resistance and propulsion tests in seaway from various directions in model scale will remain an indispensable tool still for a quite some time to go.

Within the joint research project *PerSee* the HSVA has acquired some useful data on ship resistance and powering in waves. This is a part of the present work in HSVA to make the ship hull form optimising for seaways more reliable than ever before. *NA*

Fig. 7 Propulsion efficiency coefficients vs. the wave length/ship length –ratio in regular head waves.

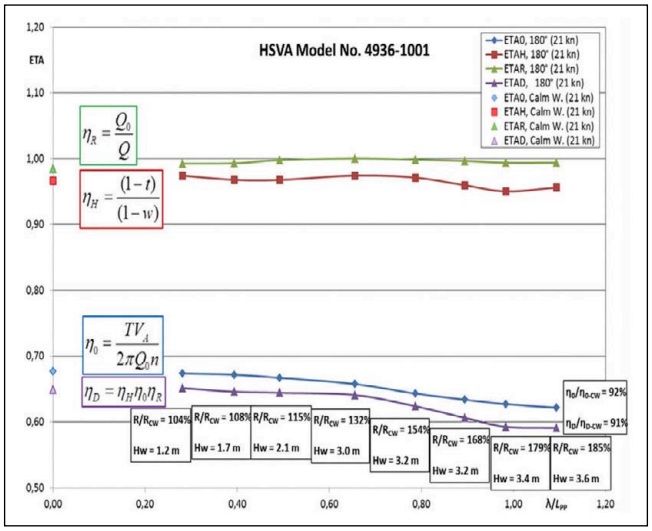
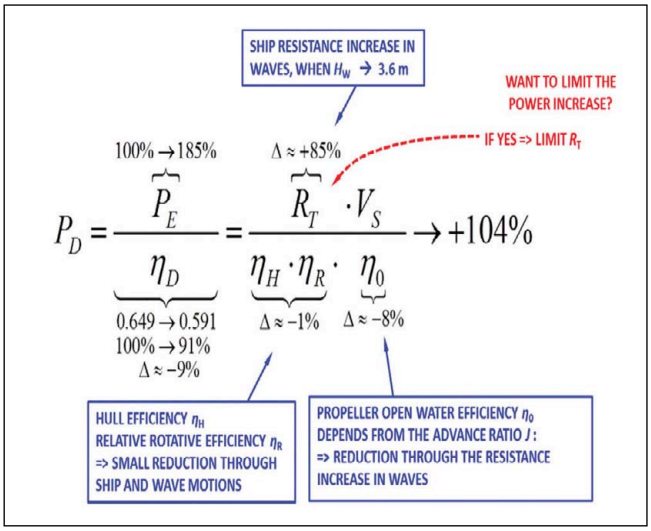


Fig. 8 Diagram of the power increase in regular waves, when wave height goes to 3.6m and the wavelength/ship length –ratio to 1.09.



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Smooth Operator – Roadmap for Antifouling

Popular copper-based vessel hull coatings are under scrutiny by environmentalists who demand a general ban on biocide coatings. Various alternatives start to emerge. Volker Bertram, Department of Mechanical and Mechatronic Engineering, University of Stellenbosch; also DNV GL, discusses the alternatives, outlining their working principles and shortcomings

Fouling, that is marine growth on ship hulls and propellers, progresses in stages; slime develops within hours of a ship being immersed in seawater.

The hull accumulates a microbial biofilm, consisting of bacteria and single-cell organisms. This microscopic slime already reduces the ship's performance by several percentage points and it is widely considered as inevitable.

This biofilm quickly develops into slime that is visible with the human eye and enables other organisms to settle such as algae and marine fungi.

Soft fouling in the form of green weed can then grow up to 15cm long in a band a few meters wide at the waterline. It grows rapidly and scrubbing it off triggers an even more vigorous growth within a few weeks.

Shell fouling (also known as "calcareous fouling" from calcium in the shells) may consist of barnacles, mussels, tubeworms, etc. This hard fouling may penetrate coatings and destroy them. It is also hard to remove, requiring a forceful cleaning that may also damage coatings.

The US Navy uses a simple system to rate hull fouling, *NN (2006)*. Via an image catalogue, fouling severity and coverage is rated from 0 to 100, in steps of 10. This allows quick qualitative monitoring of fouling. But, how does fouling translate into fuel penalties?

Weed and shell fouling decrease the ship's performance sometimes drastically with typical values in the range of 30-50% more fuel consumption (and associated emissions) compared to a smooth hull. For comparison, many energy saving devices target 3-5% fuel savings. Antifouling, the prevention of marine growth on ships, is thus both an economic and ecological necessity for shipping.

The importance of antifouling measures is widely known in shipping circles. But, attempts to improve antifouling strategies stop often after the first encounter with jargon of coating experts: low surface energy coatings; self-polishing copolymers;, surface treated coatings. You may have heard the terms, but who wants to admit not understanding the jargon of the coating industry?

Generally, neither naval architects (in shipyards), ship engineers (in superintendent positions) nor ship masters receive any training in the basics of ship coatings – except global statements on the importance of good hull surface husbandry. The following shall give a simple introduction to commonly used and more recently proposed coating approaches.

A problem solved?

Fouling has been a headache for shipping since ancient times. Some of the oldest testimonies are Greek texts dating from 300 BC describing the use of tar and wax to protect ships.

By 1850, antifouling paints had become the predominant way to prevent marine growth on ship hulls. The basic principle was the same as in most of today's antifouling paints: In contact with seawater, antifouling paint releases biocides (= poison) which form a toxic boundary layer preventing marine growth. A certain concentration of these toxicants has to be maintained for effective protection.

Toxicants are washed as the ship moves through water, so the paint has to re-supply the protective boundary layer with new toxicants. The poison enters the water through contact and shear forces created while the ship moves through water. The leaching rate depends then on ship speed.

The earlier antifouling paints were so-called contact paints. Here seawater penetrates the paint film as the toxicants dissolve, leaving a honeycomb structure. This increases surface roughness and therefore the resistance. It also yields an exponentially decaying leaching rate, releasing far more poison than necessary in the beginning and dropping below the minimum effective level long before all poison in the paint has been released. After about one year, ship performance has usually dropped drastically making a dry-dock interval necessary for re-painting.

The solution came with self-polishing copolymers, i.e. a coating matrix that also dissolved slowly in water. Self-polishing paints dissolve slowly in seawater exposing toxicant particles. As the hosting matrix film (the co-polymer in self-polishing copolymers) dissolves, the surface remains smooth (self-polishing) and an almost constant leaching rate is obtained. Various self-polishing paints have been developed tailored to ship types, speed, and operational area. According to this leaching mechanism, a self-polishing paint may be classified as depletion type, hydration type, or hydrolysis type.

The most popular toxicant was TBT (tributyltin), a member of the organotin

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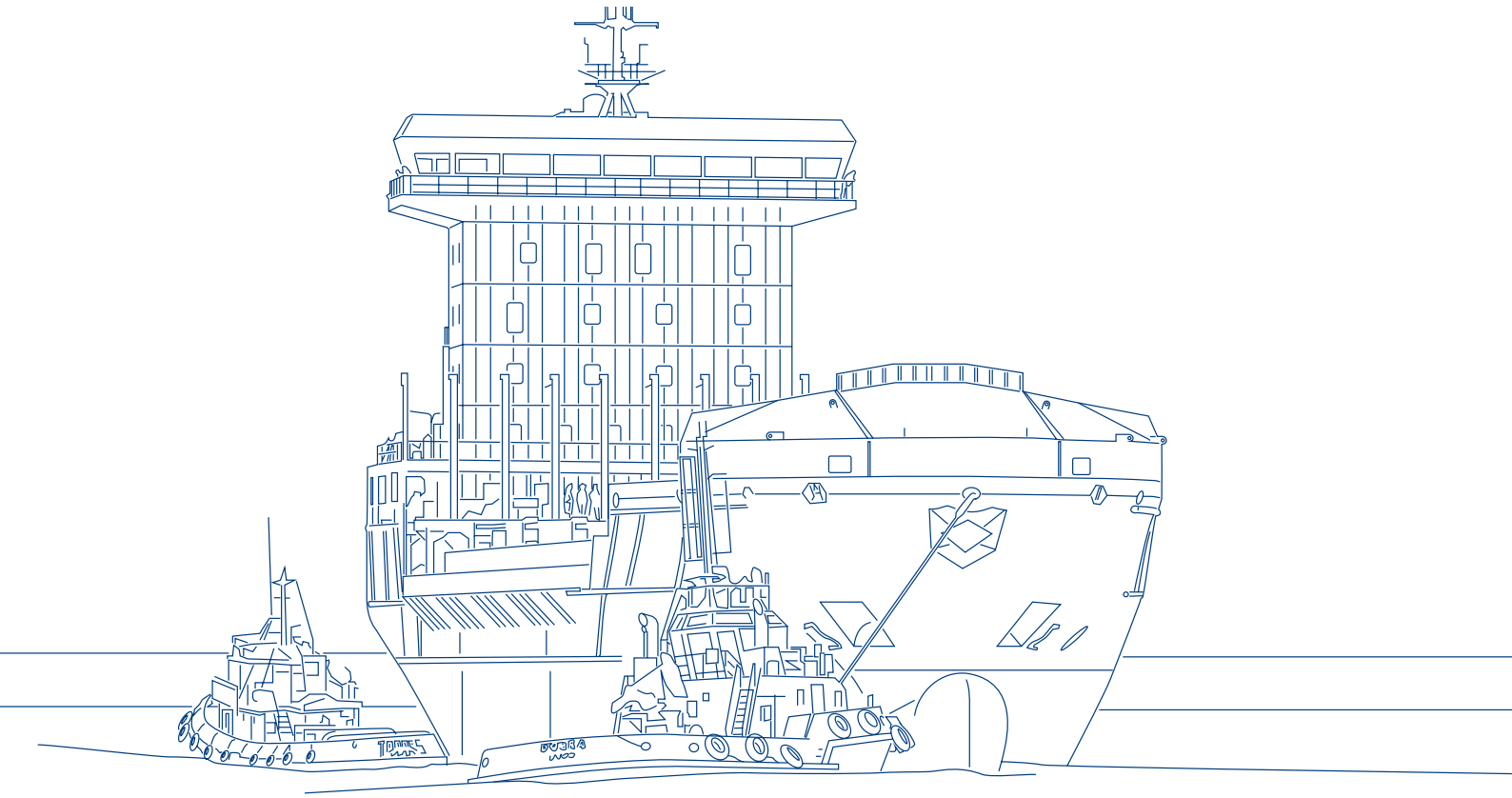

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chemicals. This tin-compound was highly toxic. Hence small quantities sufficed to protect the hull from fouling. TBT provided up to five years fouling-free performance, kept the hull smooth with a low-resistance and was easy to apply.

The antifouling problem seemed to be solved at last. However, in the early 1980s it became clear that organotin (TBT) not only killed fouling organisms. Its slow release into the water had toxic effects on a wide range of other marine species, particularly molluscs such as whelks and oysters. Environmental concerns grew as poisoning of marine organisms including fish had risen to alarming levels. These concerns prompted world-wide regulations restricting the use of TBT coatings, first for pleasure boats, then for commercial shipping. Since 2008, TBT coatings have been banned by IMO for all ships.

Copper-based coatings

The short-term solution for the shipping industry was copper-based antifouling paint. As TBT was 10 – 20 times more effective (toxic) than copper compounds, copper-based paints require much higher leaching rates than TBT paints. Therefore, usually more paint is required, and even then the paints are not 100% effective. Various herbicides and fungicides are added to address plant fouling that is not affected by copper-compounds. These additional toxicants are somewhat misleadingly dubbed boosters in marketing jargon.

While being more expensive and less effective than TBT paints, copper-based coatings were rapidly embraced by the industry after the TBT ban. An estimated 90% of the world fleet used these in 2010. However, there is reason for concern:

- Some organisms have developed a copper resistance. These gladiator species cause increasing concern, particularly with respect to the spreading of invasive species.
- Marine biologists publish concerns about the long-term effect of copper-based coatings. Already some states (Washington and California in the USA, The Netherlands, Sweden and Denmark for the Baltic Sea) have banned copper-based coatings for recreational craft. The ban on TBT started the same way.
- The precautionary approach is a legal sword of Damocles in this respect. In layman terms, the precautionary approach puts the burden of proof on the industry (suppliers, but possibly also shipowners and operators) that a substance or procedure does not damage the environment. The EU has already made the precautionary approach a statutory requirement. It is expected that the precautionary approach will also guide future IMO antifouling legislation.
- Many ports do not permit hull cleaning, partly to reduce problems with invasive species, partly because the additional leaching of toxicants contaminates the port waterbeds. Disposal of the contaminated soil after dredging will become increasingly costly.

  One can only speculate about a global ban on the currently popular copper-based antifouling paints.

  A US wide ban of these paints is expected to swing IMO opinion. But, convincing alternatives must be in place before such a ban could enter into force.

Many alternatives to antifouling paints have been proposed and patented in the course of time. Ideas which were at the time of invention impractical are now being reviewed in the light of new technologies, for example:

Low-surface energy (LSE) paints

Fouling may be prevented basically by making adhesion of slime mechanically difficult. All marine fouling organisms use adhesive secretions for attachment. The lower the surface energy of the hull the weaker the adhesion.

Hull coatings with sufficiently low surface energy should prevent fouling because organisms would not be able to adhere to it. The principle is similar to that of a Teflon surface. Even if fouling is not completely prevented, such "non-stick" coatings make the surfaces easier to clean, e.g. by wiping or low-pressure rinsing.

On fast-moving boats, they can be self-cleaning, but on slower ships cleaning is necessary, especially in niches with low water speed (such as bow thruster tunnels and sea chests). The LSE coatings developed so far are mostly based on fluorinated silicone elastomeric, chemical cousins to Teflon. LSE coatings contain no biocides and remain active as long as the coating remains undamaged.

However, like Teflon, these coatings are mechanically sensitive and fouling starts rapidly after the coating has been scratched. Consequently, performance of the LSE coatings degrades over time significantly.

Mechanical cleaning / grooming

In 1862 mechanical patents proposed scrubbing of the hull by rotating knives. This proposal can be seen as a forefather to present ideas using robot technology for mechanical cleaning of hulls.

Cleaning strategies should depend on the coating used. Copper-based antifouling paints release toxicants under shear forces. Therefore any brushing or wiping will release more toxicants and each cleaning will deplete more toxicants leading to premature degradation of the coating. LSE coatings are damaged by hard cleaning, and require more frequent soft grooming. Hard coatings are suited for frequent cleaning.

Surface Treated Coatings (STC) embed tiny glass or platelets to achieve a ceramic-like hard surface. In itself, this surface offers no fouling protection, but allows frequent cleaning. "Frequent" may mean every two weeks, to give an idea. While the coating technology is in place, more work is needed to develop cheap, fast and widely available cleaning. Recent developments on robotic cleaning are very interesting in this respect, *Darling (2014)*.

Biologically inspired surfaces

Surface structure of e.g. shark skin or lotus leaves makes adhesion difficult for

the same probability of survival for all three GZ curves in Figure 1, although the curves represent three different subdivision designs.

In contrast, the GOALDS formulation makes the distinction between such cases and directs the designer towards subdivisions of which flooding results in large angles of heel to unstable equilibrium (e.g. the curve #3 in Figure 1). Such behaviour can be achieved if design of the watertight subdivision guarantees the distribution of watertight volume high and wide (far from the centreline) on the vessel. In this sense, the new formulation has brought the damage stability regulations into line with common sense.

In light of these findings, a design optimisation exercise of a large ro-pax ship, of which baseline had been provided by Meyer Werft shipyard, was undertaken. The primary objective was to significantly raise damage survivability, subject to design requirements and commercial objectives. In particular, it was interesting to see whether index "A" values higher than the newly proposed index "R" values could be achieved.

To that end, a diverse design team was set up, specifically involving: Meyer Werft, Color Line, Germanischer Lloyd, Danish Maritime Authority, and the Ship Stability Research Centre of Strathclyde University. The design objectives were the maximum damage survivability, commercial viability (NPV), and fuel efficiency (EEOI, MEPC.1/Circ.684). The design was constrained in minimum damage survivability, baseline cargo capacity and positive NPV. In total, 827 district design alternatives were explored while looking for solutions of the design problem.

The outcome was indeed interesting. This study resulted in an unconventional hull shape and a drastic change in the watertight arrangement (e.g. the originally present long lower hold was removed and the number of watertight transverse bulkheads decreased), whereby the damage survivability was increased from 84 (baseline) to 97%. Additionally, the new hull shape provided flexibility to accommodate extra cargo on the main car deck, allowing offsetting a potentially insignificant increase in the building cost. The newly proposed index "R" values were satisfied by a significant margin.

The unconventional hull shape is shown in Figure 2. The baseline hull up to deck 3 was retained, whereas decks 3 and 4 were widened by 6m. Additionally, the car decks were subdivided transversely by two bulkheads and also longitudinally to define side casings. The general arrangement of the selected optimised design is shown in Figure 3. The unconventional hull form (UFO) hull allows distributing the watertight volume high and wide on the ship, thereby significantly increasing the damage stability. Furthermore, the design as a whole becomes simpler: as there is enough cargo space on car decks, the notorious long lower hold became redundant, and the transverse subdivision of lower decks can be less densely subdivided. Certainly, the UFO hull introduces new engineering challenges, e.g. structural difficulties and slamming risk, but they seem to be solvable.

In summary, this study has demonstrated how the knowledge implied in the new GOALDS formulation can be materialised, resulting in safe and commercially attractive design solutions. Thus, solid understanding of damage stability basics, as of any other discipline, is essential for making right design decisions. The combination of this with design experience and formal design optimisation methods secures the progress towards superior design alternatives.

The same approach will be adopted in the currently running project FAROS (www.faros-project.eu). The ultimate objective of the project is to understand, integrate and demonstrate the role of human error in risk-based ship design. (see page 28-33). *NA*

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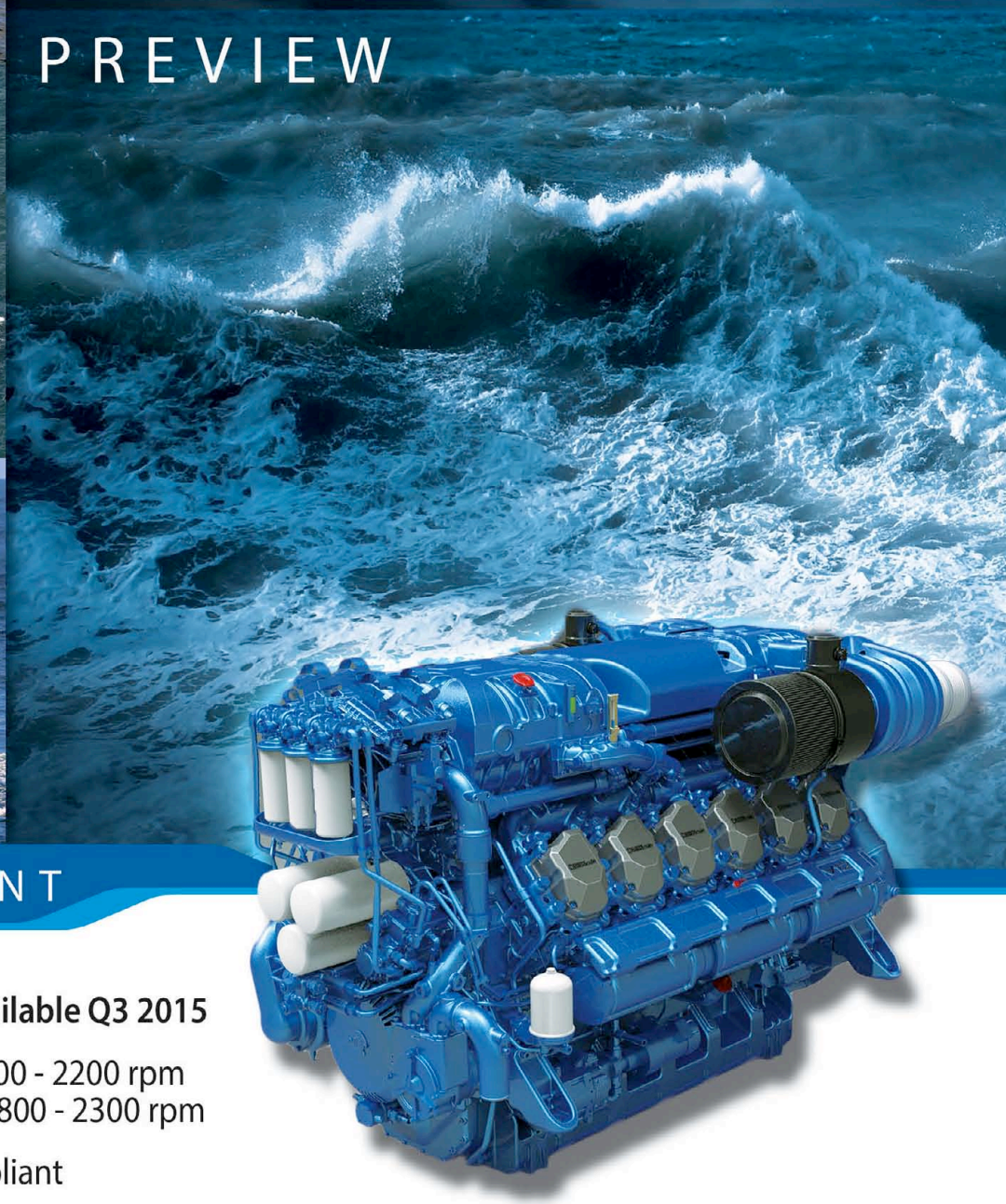

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organisms. There are assorted efforts to recreate these effects industrially for ship coatings. Nano-coatings are water-repellent, dirt-repellent paints known as anti-graffiti coatings for houses. Nano-coatings are increasingly popular also for ships. A major marine coating supplier gave the performance as not yet superior to LSE coatings in personal communication. The German Fraunhofer institute developed a riblet varnish that mimics shark skin. Open problems with this approach include long-term deterioration, re-application of coating and application is high-curvature areas.

Metal sheathing

The history of metallic sheathing for fouling protections dates back to ancient times. Copper sheathing was used by navies and expensive ships such as tea clippers in the 19th century. However, copper and iron in contact lead to galvanic corrosion.

The rapidly increasing demand for steel ships in the second half of the 19th century ended the era of metallic sheathing and the era of antifouling paints started. The 1980s saw a renaissance of research for the sheathing approach. Researchers in Japan and the USA found copper alloys that gave at least satisfactory antifouling performance. For most sheathing systems, the complete hull must be immersed in a bed of the sheathing alloy. Installation costs, both for material and application process, make sheathing unattractive.

Air or gas carpets

In the 20th century, some patents proposed (chlorous or other) gas insertion at the keel. Also the use of steam from steam engines was proposed as antifouling measure. More recently, air lubrication has been proposed to reduce ship resistance. It is yet unclear how air lubrication may affect fouling of the ship bottom, but in any case it is impractical for the vertical walls where the buoyancy of the bubbles prevents stable coverage.

Electric protection

In 1891 Edison patented his ideas for an electric antifouling system. In 1907 a US patent was granted for electric protection of the ship hull by forming a boundary layer of antifoulant gases through electrolysis. In the 1960s, these ideas were revived in Japan. Since the early 1990s, Mitsubishi Heavy Industries has commercialised an electrical antifouling system named MAGPET. Using electric hydrolysis, sea water is decomposed forming hypochlorite ions (ClO-), a well-known antifouling agent. The water contact surface of the hull shell plating is coated with an electro-conductive paint film. A small current is passed through the paint film attracting the hypochlorite ions. This prevents adhesion of marine growth such as micro-organisms, algae, and seashells. The ions react again to sea water when detached from the hull avoiding long-term contamination. As a limitation, the system requires sea water and does not work in fresh water. Possibly due to high installation costs, it was not accepted by the market.

> "The importance of antifouling measures is widely known in shipping circles. But attempts to improve antifouling strategies stop often after the first encounter with jargon of coating experts"

Ultrasonic solution

In the 1960s, ultrasonic antifouling methods were investigated in Norway, England, and Japan. Ultrasonic vibrations cause very high accelerations which destroy cell structures of algae and weed. However, ultrasonic antifouling requires many oscillators over the hull and constant energy supply. Ultrasonic antifouling systems have been successfully applied to yachts, where oscillators are spaced typically at intervals of 6m. For large cargo vessels, this would lead to many oscillators which will require a network of electrical supply and will be difficult to maintain or replace in case of failures.

Bio-Paints

Many sea creatures repel marine organisms without causing widespread harm. Research on the actual mechanisms of repulsion and chemical agents used by repelling plants and animals is active, but at an early stage. Bio-paints are still a long way away from being a practical alternative. World-wide, over 400 marine organisms are important in causing fouling problems. The biological compounds found so far deter only a fraction of these and a natural poison is still a poison. Natural compounds must be mass produced, either by chemical engineering or farming. And compounds must stay active for several years for application in shipping. This makes biological paints at present rather impractical as an alternative.

Conclusion

Antifouling methods for ships date back to ancient times, but still we are striving for a solution that satisfies all aspects of easy application, durability, effectiveness, and minimum ecological impact. Creativity, interdisciplinary co-operation, and a lot more research will be required before we might be able to find this 'final answer' to the ship fouling dilemma. It is encouraging to see both a growing awareness of the problem and first steps which could lead eventually towards the desired goal. *NA*

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RA remains on guard

Raytheon Anschütz has launched its latest shipboard security solution, ShipGuard, after an increase in demand for security onboard vessels

ShipGuard integrates a vessel's existing navigation systems such as automatic identification system (AIS) and radar with a suite of commercial surveillance cameras. ShipGuard is available as a stand-alone system that can be used to upgrade existing bridge system installations or as a functional task on Raytheon Anschütz Synapsis multifunctional workstations.

Martin Richter, marketing manager, Raytheon Anschütz explains the development of the system: "A few years ago we recognised the threat of piracy as a major problem in shipping with huge costs (insurance, security, personnel) and sometimes low efficiency for shipping companies. We joined a research project focusing on piracy aversion systems. Results from this project have been subject to further development to present a new situational awareness system."

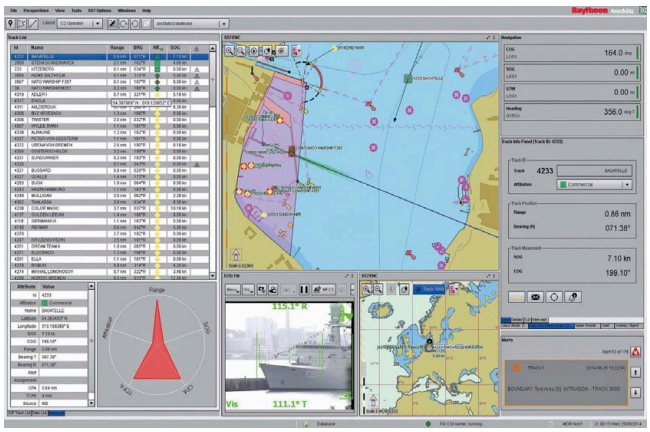
With ShipGuard, Raytheon Anschütz says, shipowners will be able to increase vessel security and maritime situation awareness onboard. In its basic configuration ShipGuard will be able to offer the crew early detection and identification of approaching vessels, classification and alarm zone monitoring as well as being able to monitor, what Raytheon Anschutz highlights as "friendly" vessels, such as support vessels and tender boats.

What differentiates ShipGuard from standard radar/navigation data is that "the system evaluates data from Radar and AIS and provides targets with a classifier of friendly, suspicious or uknown," says Richter.

Based on a sea chart (but, with different map options like Geo Tiff) it allows creating geo-referenced or own-ship-referenced alarm zones to monitor the ships' environment. The fully integrated camera automatically slews to unknown or suspicious targets that enter an alarm zone; in addition an alarm is generated and displayed on all alert displays within the navigation system.

Data can also be shared via data links and counter-measures such as water curtains, laser lights or acoustics devices can be activated. All together, the situational awareness, not related to a navigational situation, but to a potential threat, is significantly increased the company claims.

ShipGuard has been built on Raytheon Anschütz Synapsis system architecture. ShipGuard can be easily configured and integrated with individual components to meet with individual requirements. The system uses onboard navigation equipment and requires additional hardware such as a surveillance camera. This latest solution is applicable to a wide range of vessels that are travelling in high-risk areas. *NA*



Raytheon Anschütz's latest product, ShipGuard, aims at keeping ships away from danger

Setting the standards

Methods for completing sea trials were regulated in 2002 when the International Organization for Standardization (ISO) established ISO 15016. However, the introduction of the IMO's Energy Efficiency Design Index has prompted the IMO to re-evaluate the standard; and the debate over ISO 15016 is now reaching its climax

Up to 2002 the sea trials assessment was an ad hoc affair, which the shipyards adopt different sea trial assessment methods. In an effort to standardise the method the International Organization for Standardization (ISO) developed ISO 15016. Then ISO 15016 has been adopted by many shipyards.

On 1 January 2013 the IMO's Energy Efficiency Design Index (EEDI) became mandatory for new vessels and prior to this the IMO had stipulated that the sea trials data should be used to verify the EEDI value for each ship. In anticipation that IMO's Energy Efficiency Design Index regulation was to be formally introduced 1 January 2013, IMO was anxious to see that the sea trial assessment methods, being the core element in verifying the EEDI, will be transparently standardised.

Dutch testing tank MARIN looked at ISO 15016 to establish whether the standard was sufficiently accurate to use for the EEDI verification, the report by MARIN, released in April 2011 was not encouraging. MARIN itself reported in *The Naval Architect* (see page 24, April 2013) that ISO 15016 was "a cumbersome analysis method based on a wide choice of outdated correction methods and empirical data".

MARIN had reached this conclusion in its 2011 report which reported that: "Based on the evaluation of the different correction approaches and the discrepancies in speed from the speed trial analyses" MARIN found that there could be wide variations in the sea trial results.

The IMO Marine Environment Protection Committee (MEPC) 62 noted the shortcomings of the standard, and requested to develop a verifiable and accurate method for the sea trial assessment.

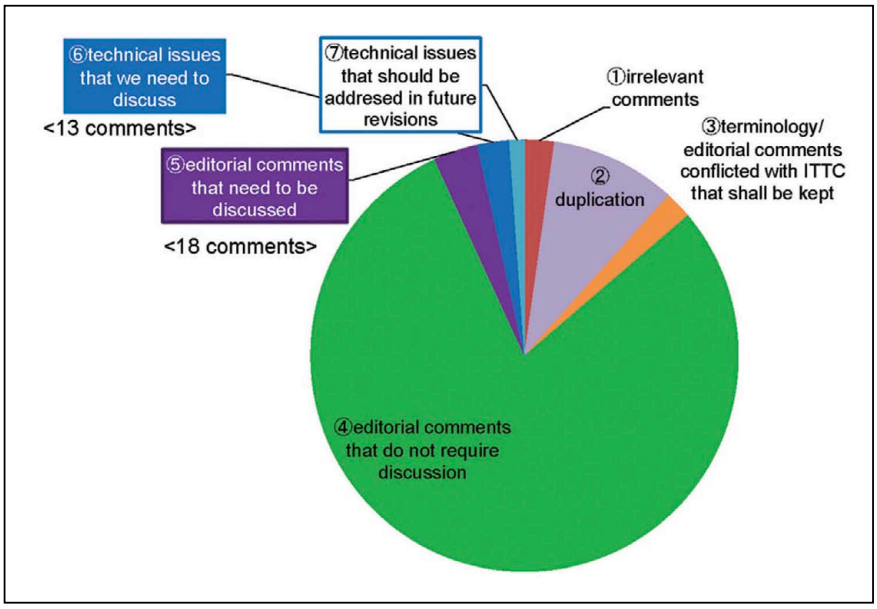


Figure 1: Categorisation of the comments during the voting

Item	Comments	No.
Iterative method	BIMCO, (UK1+309, DE12, NL12, IT18) Validation is required.	1 (+5 duplications)
Run numbers for sister ships	DE17(GR5, NL17), Reducing run number for sister ships in case of MoM. IT10, Two double runs required for sister ships in case of Iterative method.	2 (+2 duplications)
G modulus of shaft rigidity (ISO: 82,000 N/mm^2)	DE6(GR3, NL6): 82,649 N/mm^2 IT1: 82,400 N/mm^2	2 (+2 duplications)
Power setting range	DE14(NL14): between 65%-100%MCR instead of between 50%-100%MCR	1 (+1 duplication)
Preparation and conducting	IT2, IT3, Trim & displacement IT9, UK126, Trial area	4
CFD	IT15, IT16 and IT17: Enlarge the applicability of CFD tool	3

Figure 2: List of technical comments

In order to achieve a more reliable standard a "Specialist Committee on Performance of Ships in Service" in the International Towing Tank Conference (ITTC) was established. ITTC closely co-operated with the STA Group, the Sea Trials Analysis-Joint Industry Project, to review and improve the speed/power trial procedures and measurements, as well as the analysis and correction methods.

On this basis the ITTC Recommended Procedures and Guidelines 7.5-04-01-01.1 and -01.2:2012 (ITTC-RP) was developed.

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At almost the same time, ISO started to coordinate with ITTC and other industry experts to exclude arbitrariness and ambiguity from the existing "ISO 15016:2002". As a result, the ISO/DIS draft was developed through collaborative efforts between ISO and ITTC and had already reflected most of the ITTC-RP into it.

The difference between the ISO and ITTC methods is that the former proposes an additional form of analysis, an Iterative approach for the current correction against only Mean of means method in the ITTC RP, but with an advanced degree of harmonisation between the two standards.

The Mean of means method, which was already introduced in 'Principles of Naval Architecture (1967)', is the classic method for the current correction and was used even before World War II. The advantage of the Mean of means method is that the calculation is very simple. However, it was considered that accuracy was not enough in the case of longer time periods between the runs since the Mean of means method could make corrections only if a current velocity is varying parabolically with time. In fact, the run interval is very long in VLCCs or other large ships which have been built recently, which acts negatively in making effective corrections.

In order to solve this problem, the Taniguchi-Tamura method was developed. This method enables the correction of the current velocity, which is affected by lunar cycles and varies periodically. Therefore, this method has an advantage when applied to VLCCs or other modern large ships.

The Taniguchi-Tamura method was adopted in the ISO 15016:2002, and has been used by shipyards in East Asian countries for many years. However, as IMO started to discuss EEDI regulation, some people pointed out that the result was not reliable. Specifically, analysis results might depend on the individual analyst because a historical current curve is to be manually drawn.

Taking this into consideration, STA-Group decided to go back to the classic Mean of means method. On the other hand, Japanese experts developed an innovative method for the current correction, called Iterative method. This method retains the advantage of the Taniguchi-Tamura method to obtain accurate results with fewer runs even if the run interval is very long, while this method surpasses the weaknesses of the Taniguchi-Tamura method in respect of arbitrariness and ambiguity, since the method would not require manual drawings.

Solving the issue appeared to be in reach earlier this year when the group of countries debating the ISO 15016 issue voted on changes, but the new methods were not approved (see page 8, July/August 2014 *The Naval Architect*).

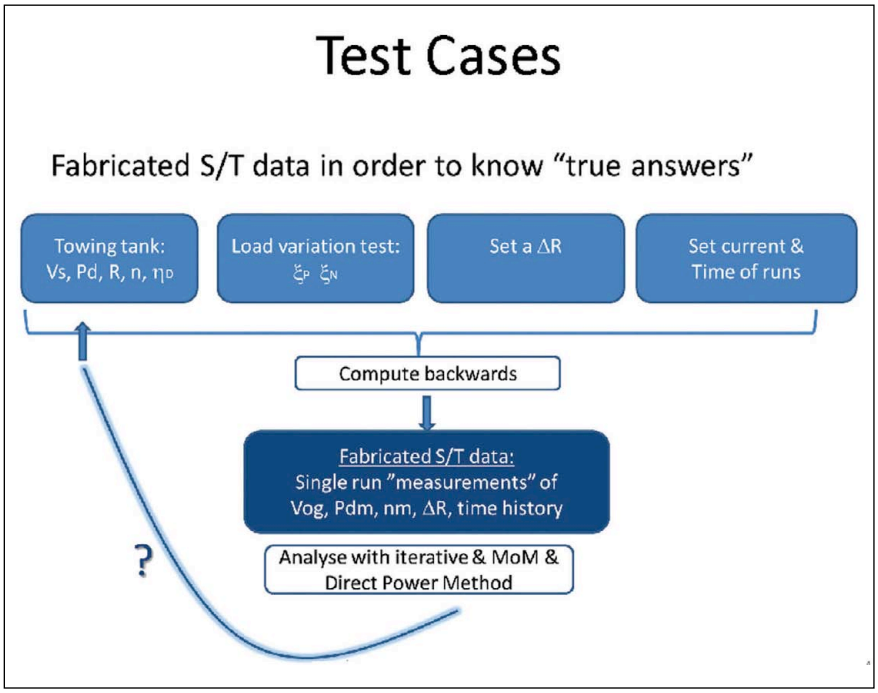

Figure 3: ITTC's validation is achieved by fabricated cases

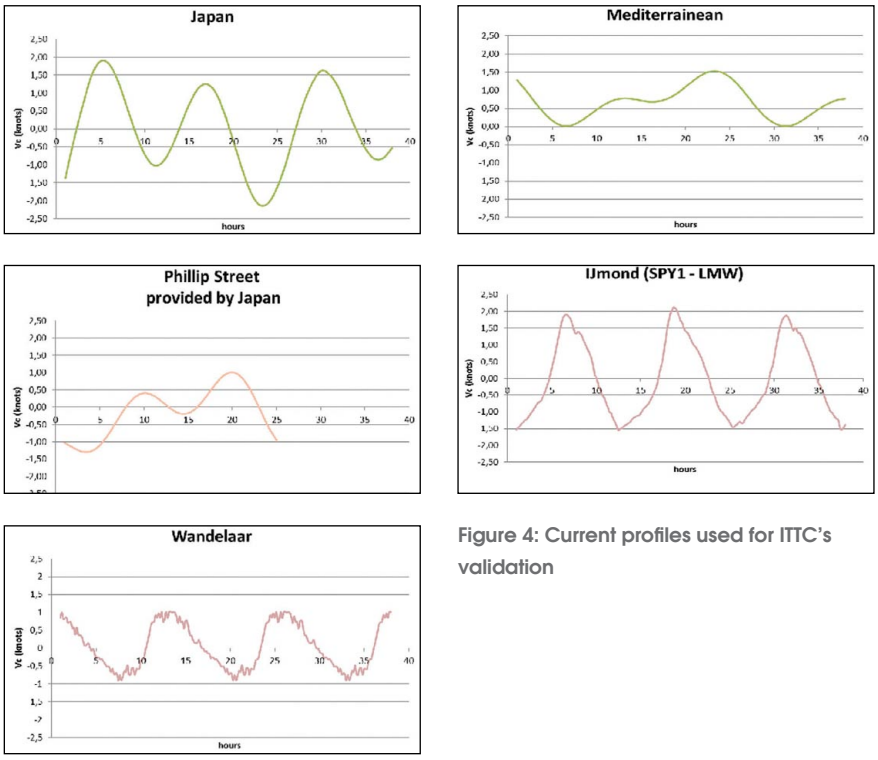

Figure 4: Current profiles used for ITTC's validation

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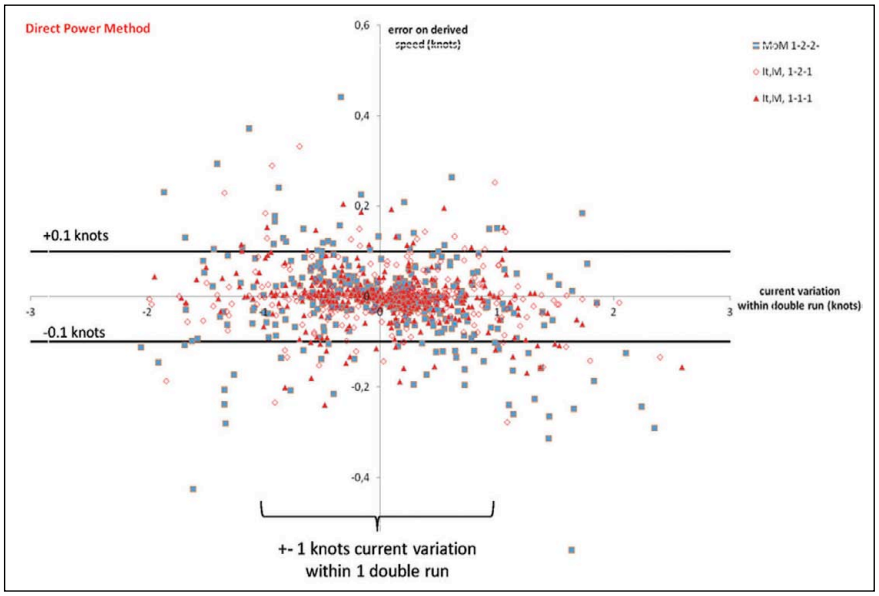


Figure 5: ITTC's statistical approach (the spreading of the results of the two methods, where all red points represent the iterative and the black points represent the MoM

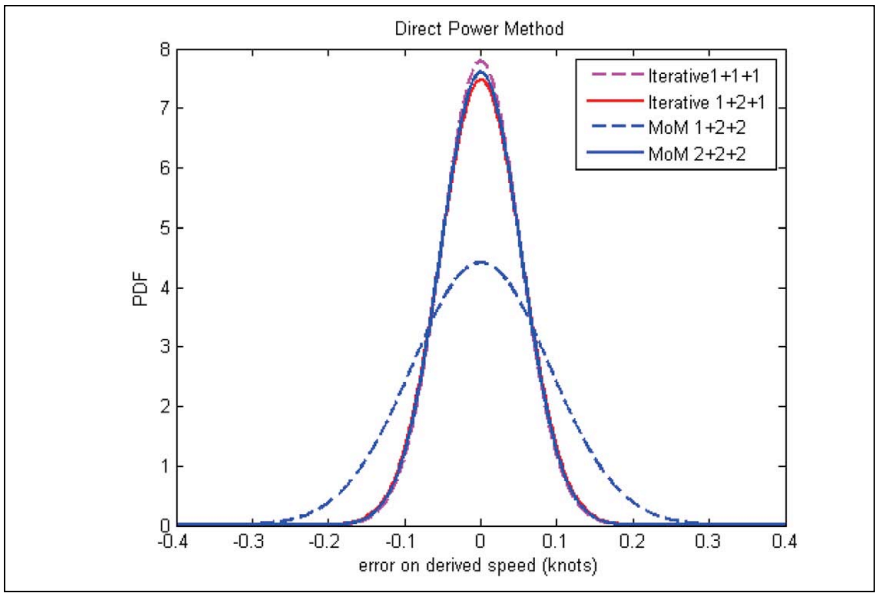


Figure 6: ITTC's Statistical distribution: both methods are adequate if for the MoM method at each power setting two double runs are performed (dotted blue line represents MoM with 1+2+2 double runs)

Five countries, Germany, Greece, Italy, The Netherlands and the UK rejected the amendments in April this year and so the group has agreed to make further changes and vote again, over a two month period, this autumn. Of the 537 comments by the member states only six were significant technical issues, the rest were mainly editorial comments. The technical issues included a validation of the Iterative method, a discussion on the run numbers for sister ships (reducing the number of runs for the Mean of means method and two double runs for the Iterative method), the G modulus of shaft rigidity, the power setting range where between 65-100% was preferred to 50-100%, preparation and conduct of trials and CFD where there was a request to enlarge the applicability of the CFD tool. The top-priority issue is the insufficient validation of the Iterative method, while there were no other major issues. (Figure 1 and 2)

ISO and its expert members maximised its efforts to bring the validation result hopefully in time for the ISO 4th Meeting in London in late June, through coordinating the views of all related parties, and though through a complex debate, managed to establish the way forward, where all participants who actively looked into the matter made a positive report.

Minutes of the last meeting held in London in late June reveal the complexity of the debate between the group of experts consisting of Professors, ITTC, STA-Group, major class societies, shipowners, and naval architects working for shipyards.

Initially ITTC presented their validation work that it concluded on the Iterative method. ITTC says in general the Iterative method leads to fewer errors on average of the tested cases when (1+2+2 double runs) are used in the Mean of means method. In addition, in using the Mean of means method for each power setting, two double runs should be made (2+2+2 double runs). (Figure 3, 4, 5, 6)

In the case of shorter time periods between the runs (up to 60 minutes) the methods are equally adequate. In specific cases, the Mean of means method has advantages over the Iterative method.

ITTC also reported that in cases where the speed-power curve deviates significantly from the assumed power function (a+bV^q), e.g. in cases where there is a large speed range and/or humps and hollows occur within the power curve, again the two methods are equally effective.

However, ITTC reported: "In cases where the current time history deviates from the assumed parabolic/sinusoidal trend and the change of the current within the timespan of two double runs is very high, neither of the methods is applicable. These areas, when known, should be avoided."

ITTC also says that the Iterative method is fully compatible with the simple Direct Power Method.

The expert group noticed that the Iterative method is less sensitive when there are equal distance and time intervals. However, exact equal distance and time intervals are not required for the Mean of means method and a random time deviation of up to ±25% is acceptable.

INTEGRATED CONTROL SYSTEMS FOR ADVANCED DIESEL-ELECTRIC ICEBREAKERS

At the present time the leading company in the field of automation of vessels and ships – the JSC Concern Avrora Scientific and Production Association is delivering the Integrated Control Systems of Technical Facilities (ICS TF) for diesel-electric icebreakers of the 21900M project.

These new ships are the modernized «Moskva» and «Saint-Petersburg» ice-breakers.

Designing of ICS TF «Zaliv-LK-21900M» was connected with solution of wide variety of problems. Among the most important are integration of technical facilities of the vessel into a unified technological complex, assurance of system reliability, unification of equipment, cost reduction, meeting the requirements of the customer and the regulatory agencies.

Fulfillment of the above mentioned tasks is achieved by means of a redundant 3-level system based on the advanced and unique imported and domestic technologies.

The ICS TF of the 21900M project has a client-server architecture. All the data received from ICS TF controllers and local automation systems, as well as commands of operators, come on two redundant high-reliability servers installed in different compartments.

SCADA project of the system is stored in the servers; operator's stations are clients, which receive information periodically or on request. Thus, the task of interfacing the levels of the system is solved, and unification of software enables an operator to display the information received from sensors or via interface channels from other systems on any of the stations. The servers archive all the necessary information and send the archive data to operator's stations on request. By means of this data exchange, an operator can analyze trends for quite a long period and diagnose in advance insignificant deviations of parameters, which are warning of serious failure of mechanisms.

Reliability of the servers is assured by the use of high-performance all-in-one PCs manufactured by the Concern. These AIO PCs are specially designed for severe operating conditions of a ship and have no comparable counterparts in the world. Reliability of these PCs operation is assured by the use of the novel achievements of electronics, which allow to exclude the use of moving mechanical parts in a PC. The PCs have passive cooling. Instead of usual shock and vibration-sensitive HDDs, the solid-state SLC data storage media of high recording resource and MTBF are used. Data in each server are recorded on two data storage devices. As a result, on completion of testing, it was proved that these all-in-one PCs withstand even more severe conditions than those of their usage.

Icebreaker of 21900M project

The ICS TF assures control from a pilothouse and a central control room (CCR), it also includes a station for monitoring of technical facilities installed in the cabin of a chief mechanical engineer. The equipment of operator's stations in a pilothouse is built into an integrated control console. Five-section control console manufactured by the Concern is installed in the central control room. The CCR console has common form factor designed for civil marine applications and tested as part of various systems for compliance with the requirements of the Russian Maritime Register of Shipping.

Thus, the ICS TF «Zaliv-LK-21900M» assures comprehensive performance of the following functions:

- acquisition, processing and transmission of data to ship systems;
- control of technical facilities (remote and automatic), including emergency protection of mechanisms and plants connected with the system;
- signaling of operation, malfunctions, change of modes of operating mechanisms and plants, when controlled parameters reach the limit values (alarm and warning signaling (AWS));
- generalized alarm and warning signaling in control rooms, cabins, service and public rooms, as well as group alarm and warning signaling with the use of light and sound columns;
- representation of information to an operator by means of video monitors, annunciator panels and other display devices about AWS, commands of engine-order telegraph and operation modes;
- tripping of signaling for inoperable mechanisms, monitoring of running hours of mechanisms;
- transmission of information to a voyage data recorder, self-checking of the system;
- engine-room personnel monitoring system, calling of chief mechanical engineer, possibility of appointment of chief mechanical engineer;
- storage of controlled parameters, including AWS, for the period of not less than half year, making of trends in real time and for a certain period of time, output of detailed information about alarms.

For more information you are welcome to visit www.avrorasystems.com

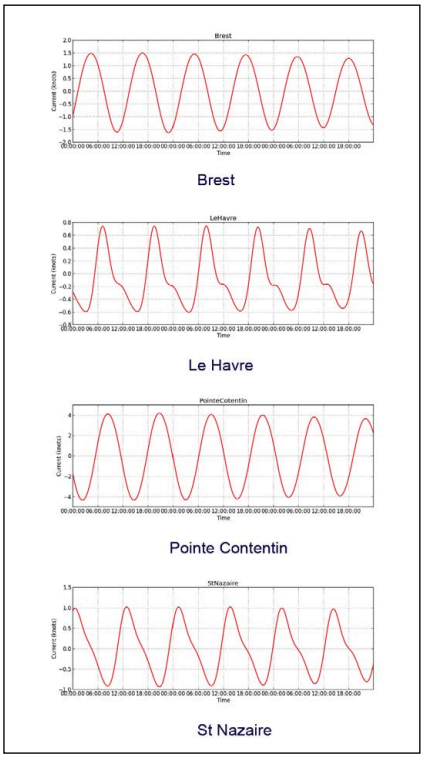


Figure 7: Current profiles used for BV's validation

Bureau Veritas (BV) also gave a presentation regarding the results of a study in which the class society used 16,320 simulations to compare both the Iterative and Mean of means method.

The BV study showed that the Iterative method (1+2+1 Double Runs) leads to fewer errors around the EEDI power range, but the Mean of means method (1+2+2 Double Runs) performed better at maximum power output. (Figure 7+8)

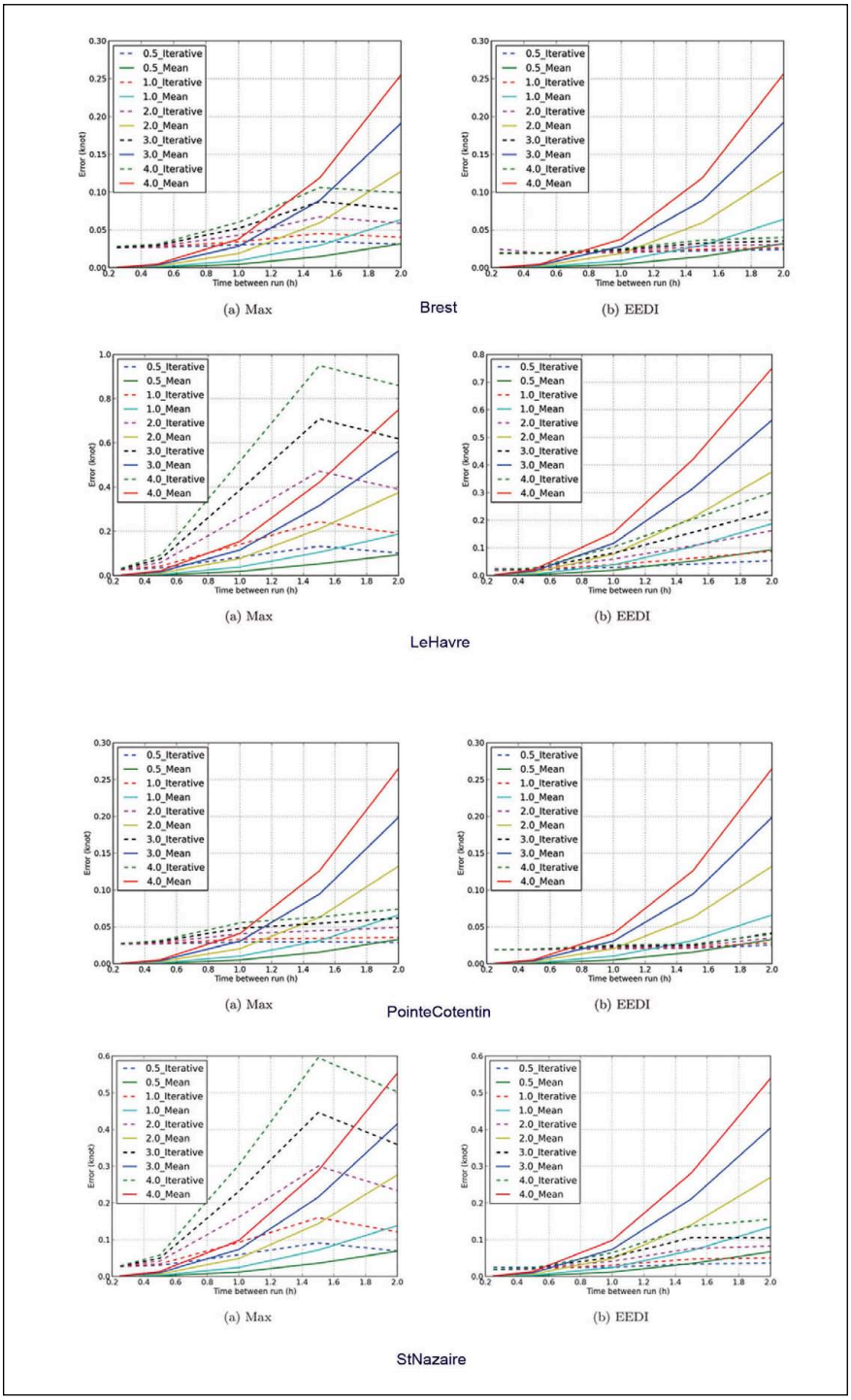
Correction methods were also discussed at the June meeting with Japanese class society ClassNK and Mitsui OSK Line (MOL) looking at current correction methods in which the two companies validated that the two methods had the "same level of accuracy". Mitsui OSK Lines said that from a shipowner's point of view the Iterative method is practical and can be applied to the new ISO standard.

Taking into consideration of the Validation work by ITTC and others, the group agreed that the Iterative method was fully validated and confirmed to be accurate enough to be used as a current correction method in the ISO draft.

The other technical issues such as G modulus, the power setting range, preparation and conduct of trials, and CFD applicability were also agreed to find an amicable solution in the ISO expert group.

Finalisation of the ISO draft is now taking place within the group and voting on the amendments of ISO 15016 will again take place this autumn. *NA*

Figure 8: BV's validation result: the errors obtained with the different current ranges are plotted against the time between consecutive runs.



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First Notice & Call for Papers

The Polar Regions continue to experience heavier traffic in marine shipping and exploration. The more convenient access to the arctic as a result of changing ice levels, and the increased competition for natural resources by different states, has focused the need for more unified and detailed regulation on the operation, safety and design of all vessels that operate in the polar environment.

Many kinds of Vessel operate near the poles, all of which are exposed to a number of unique demands. Ice exerts structural loads on the hull and propeller when keeping station, sea spray and atmospheric conditions can create an accumulation of icing on important deck equipment, and the safety and wellbeing of the crew when exposed to below freezing temperatures, not only in normal operation but also in emergency conditions, all have an impact on how a vessel is designed to operate. On top of this codes and standards need to reflect the growing exposure of vessels to these conditions, this is reflected in the growing momentum in updating the IMO Polar Code.

RINA invites classifications societies, shipyards, operators, surveyors and designers and anyone with an interest in the full of possibilities ship operation in ice, to submit papers on:

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BWMC on the verge of ratification

When the Maritime Environment Protection Committee meets for its next session in October, ballast water and the Polar Code are just two of the items that will be back on the agenda. According to Allan Graveson, senior national secretary at Nautilus International, Sandra Speares reports

The 35% of the world fleet target that it is necessary to meet for the Ballast Water Convention to enter into force is "within a fraction" of being achieved, says Nautilus senior national secretary Allan Graveson.

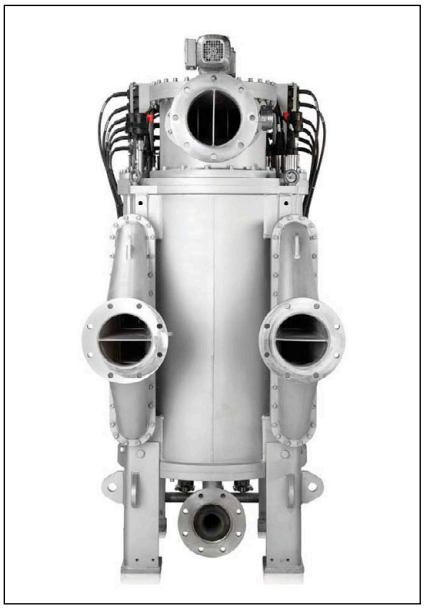
Progress towards ratification of the Ballast Water Management Convention (BWMC) has not been without its critics. The International Chamber of Shipping (ICS) – in cooperation with a wide coalition of international shipping organisations – has submitted a paper to the IMO that proposes a means of overcoming the serious implementation problems it considers to be associated with the BWMC.

The industry paper suggests solutions to these complex problems in the form of a draft Maritime Environment protect Committee (MEPC) Resolution that could be adopted by IMO Member States before the BWMC on enters into force.

The paper was agreed in principle by ICS's members, national shipowner associations, at their recent AGM in Cyprus where they considered what they deemed to be the "deep flaws in the Convention, adopted in 2004 when the technology required to comply had not been widely tested or proven commercially and possible solutions to these issues".

ICS members concluded that there is now a greater understanding of these problems amongst IMO member states, which for many seems to be the primary issue impeding ratification. These obstacles include the lack of robustness of the current type approval process for the very expensive new treatment systems that will be required, doubts about the procedures to be followed during port state control, and the need to provide confidence to shipowners that have already installed the new equipment (or are about to do so) that they will be regarded by the authorities as compliant.

The ICS says it supports the objectives of the convention and recognises that its eventual entry into force is inevitable, but it has expressed fears that unless these problems are resolved immediately at IMO, there is a considerable risk that the regime will not be fit for purpose.



Trojan Marinex is seeking US type approval for its sytsem

The trade association is particularly concerned that port state sanctions could impact unfairly on shipowners who, in good faith, have fitted type approved equipment, only to be told subsequently that it falls short of the required standard.

The ICS was joined in its submission by BIMCO, Cruise Lines International Association (CLIA), International Marine Contractors Association (IMCA), INTERCARGO, INTERFERRY, InterManager, INTERTANKO, International Parcel Tankers Association (IPTA), International Transport Worker's Federation (ITF), International Union of Marine Insurance (IUMI), the Nautical Institute and the World Shipping Council (WSC), which it believes gets over some of the hurdles associated with the convention.

ICS has stressed that at the MEPC meeting in October: "governments will need to take what may be the final opportunity to act by agreeing some relatively simple changes to how the Convention will be implemented".

The Ballast Water Convention was adopted in 2004 and as Allan Graveson points out, we are now 10 years' on and this is another example of the shipping industry putting things off. "It doesn't believe they are going to happen and is in denial. Rather than being proactive, which I'm sure would save them money in the first instance if they had grasped it rather than resisted it, and taken it forward then they could have had it in their model and in the way they wanted it".

On this issue he says he does have some concerns firstly as far as the guidance on sampling the ballast water is concerned. "There is potential here for unjustified criminalisation of masters and officers," he believes, unless there are adequate guidelines that can be adhered to for the sampling processes. In as far as the guidelines are concerned: "we are getting there," he believes.

The issue moves across most of the IMO sub-committees including the implementation of IMO instruments sub -committee because of the need for any enforcement through port state control.

The second issue, he says, is the systems themselves. Nautilus has always argued for systems that are benign. The systems that are going to be fitted into the two new British aircraft carriers will be of the ultraviolet type. "We like the ultraviolet type because it doesn't involve any chemicals, which could have an adverse effect".

One example he cites is a system that uses hydrated calcium hypochloride – a product that has controversially been known to spontaneously combust in the past. "We like the ultraviolet system because we are not using potentially hazardous chemicals". Another concern for Nautilus has been the additional workload for crew on the vessel.

One ballast water treatment system to recent receive IMO type approval is Canadian-based Trojan Marinex, a UV-based system tested in

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three different water salinities, brackish, fresh and marine, with Marvin DeVries, president of Trojan Technologies saying that the company would be seeking to obtain US type approval for its system before the end of this year.

The US is known for taking a tough stance on the issue, so any treatment system receiving US type approval could prove to be better placed to argue its case as being at the cutting edge of BWT systems.

Testing was completed in the most rigorous conditions, DeVries said, which dispelled the myth that UV systems could not be used in "the poorest of water qualities".

As InterManager highlighted at the conclusion of the last MEPC meeting there will be a number of issues to address at the meeting in October such as whether type approved BWMS currently installed on ships consistently and reliably treating ballast water to meet the ballast water performance standard described in regulation D-2 (D-2 standard);to what extent have type approved BWMS been subsequently shown under land-based and shipboard testing to be compliant or non-compliant with the D-2 standard; what is the proportion of ballast water discharges that are successful and unsuccessful in achieving the D-2 standard; do Administrations, including those conducting type approvals, have any comments on the current Guidelines (G8) or any suggestions as to how the Guidelines (G8) may be improved; and are there any specific concerns relating to performance of BWMS in extreme conditions.

MEPC 66 in April agreed that certain correspondence groups would report to the October meeting including correspondence groups covering the Polar Code, ship recycling, the use of electronic record books under MARPOL, technical and operational measures for enhancing the energy efficiency of international shipping and the review of fuel oil availability as required by Regulation 14.8 of Marpol Annex VI.

There will be a number of inter-sessional meetings in the run up to MEPC 67 including one on the Polar Code, and a meeting of the working group on facilitation of transfer of technology for ships.

The draft Polar Code covers the full range of design, construction, equipment, operational, training, search and rescue and environmental protection matters relevant to ships operating in the inhospitable waters surrounding the two poles. Environmental provisions include requirements covering prevention of oil pollution; prevention of pollution from noxious liquid substances from ships; prevention of pollution by sewage from ships; and prevention of pollution by discharge of garbage from ships.

The Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships, established in accordance with the resolution, met during MEPC 66 and agreed a work plan, which was endorsed by the Committee.

The work plan envisaged: assessing the potential implications and impacts of the implementation of the energy efficiency regulations in chapter 4 of MARPOL Annex VI, in particular, on developing states, as a means to identify their technology transfer and financial needs; identifying and creating an inventory of energy efficiency technologies for ships; identifying barriers to transfer of technology, in particular to developing states, including associated costs, and possible sources of funding; and making recommendations, including the development of a model agreement enabling the transfer of financial and technological resources and capacity building between parties, for the implementation of the energy efficiency regulations.

> "It (the industry) doesn't believe they are going to happen and is in denial. Rather than being proactive, which I'm sure would save them money in the first instance if they had grasped it rather than resisted it"

As far as recycling of ships is concerned MEPC will consider amendments to the 2011 Guidelines for the development of the inventory of hazardous materials, taking into account the report of the correspondence group tasked by MEPC 66 to finalise threshold values, exemptions and bulk listings applicable to the materials to be listed in the Inventory of Hazardous Materials.

It will also be looking at further development and amendment of EEDI- and SEEMP related and the issue of quality of marine fuel oil, following the agreement at MEPC 66 to develop possible quality control measures prior to fuel oil being delivered to a ship.

Other items on the agenda will include draft amendments to the NOx Technical Code, the methodology to determine the availability of fuel oil to comply with the fuel oil standard set out in regulation 14.1.3 of MARPOL Annex VI, taking into account the report of the Correspondence Group on the Assessment of Availability of Fuel Oil required under Regulation 14.8 of MARPOL Annex VI.

MEPC 66 approved draft amendments to MARPOL Annex VI regarding engines solely fuelled by gaseous fuels, to clarify that such engines should also be covered by the Annex VI NOx regulations, with a view to adoption in October. It also invited interested delegations to submit proposals for draft amendments to the NOx Technical Code for inclusion of provisions on engines solely fuelled by gaseous fuels, including any consequential amendments with a view to approval at MEPC 67.

A correspondence group set up to develop the methodology to determine the availability of fuel oil to comply with the fuel oil standard set out in regulation 14.1.3 of MARPOL Annex VI. The group will provide a progress report to MEPC 67, with a view to the Committee adopting the terms of reference of the study at MEPC 68 in 2015.

The sulphur content outside an Emission Control Area is set to fall to 0.50% from 1 January 2020. Depending on the outcome of a review, to be completed by 2018, as to the availability of compliant fuel oil, this requirement could be deferred to 1 January 2025.

The 0.1% sulphur cap inside emission control areas is due to come into force at the beginning of next year although most analysts feel fairly confident that there will be sufficient supply to meet demand at that point, there have been concerns raised about supplies going forward. *NA*

Unconventional design ideas for ro-ro passenger ships

Romanas Puisa, Brookes Bell and Przemyslaw Zagorski and Dracos Vassalos, University of Strathclyde explain the effect that the SOLAS2009 regulation will have on the design of ro-ro vessels

New probabilistic damaged stability regulations for dry cargo and passenger ships, aka SOLAS2009, entered into force on 1 January 2009. However, serious concerns were expressed by EU member states and the European Maritime Safety Agency (EMSA) concerning the consequent abolishment of the Stockholm Agreement standard for ro-pax ships. Research has also shown that the SOLAS2009 formulation for the survival probability, aka s-factor, is inaccurate in reflecting the effective stability of ro-pax and large cruise vessels. To address these and other issues, the European Commission funded research project GOALDS (Goal Based Damaged Stability) within 2009 – 2012.

The project was successful. It delivered, amongst others, new formulations for the s-factor and the required index of subdivision. In view of these findings, naval architects may wonder about the potential impact of these findings on ship design. Specific questions can be the following. Firstly, how different is the GOALDS formulation of s-factor, compared to its SOLAS2009 counterpart?

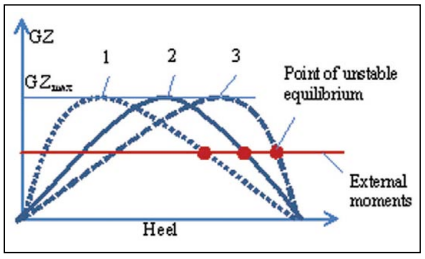

Figure 1: Different shapes of GZ curves with the same max value and the range

That is, does the GOALDS formulation deliver lower, bigger or the same probability of survival of any damage case (aka index "A")? Secondly, will sensitivity of index "A" to design variables change? And as a result, will the new formulation introduce a bias towards unconventional ship designs?

As for the first and second questions, a parametric study, which included the generation and evaluation of 600 different subdivision configurations for a large ro-pax ship, demonstrated that both formulations deliver similar index "A" values, although the GOALDS formulation was more optimistic for ships with loa > 120m [3]. It was also demonstrated that the GOALDS formulation is more sensitive to design variables such as the presence/absence of the long lower hold, the number of transverse bulkheads in forward fire zones, bulkhead deck height, watertight volume distributed high and wide on the ship, etc. These observations indicate that the new formulation represents a better design tool to achieve higher survivability. In view of on-going debates about how much the required index of subdivision (aka index "R") can be raised and whether its high values can be achieved, these properties of the new formulation are very helpful.

Concerning the question of whether the GOALDS formulation introduces a bias towards unconventional ship designs, the answer can be found in the formulations of s-factor themselves. In the SOLAS2009 formulation, the shape of the GZ curve, which reflects the fundamental stability indicators such as the metacentric height (GM) and the point of unstable equilibrium, is not captured. As a result, the SOLAS formulation wrongly delivers

Figure 2: Unconventional hull form (ref. UFO hull)

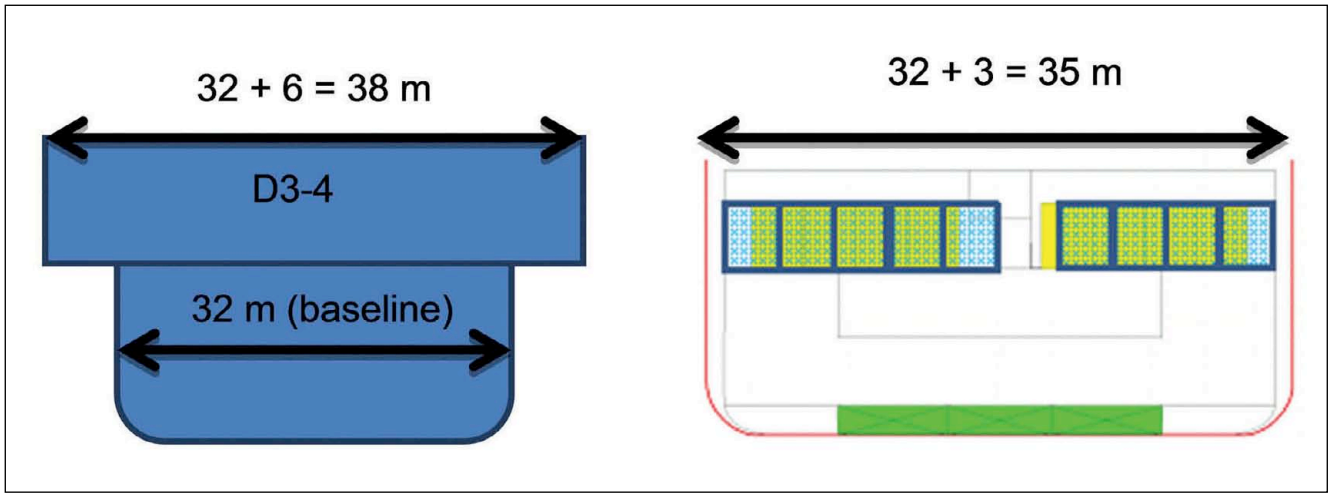

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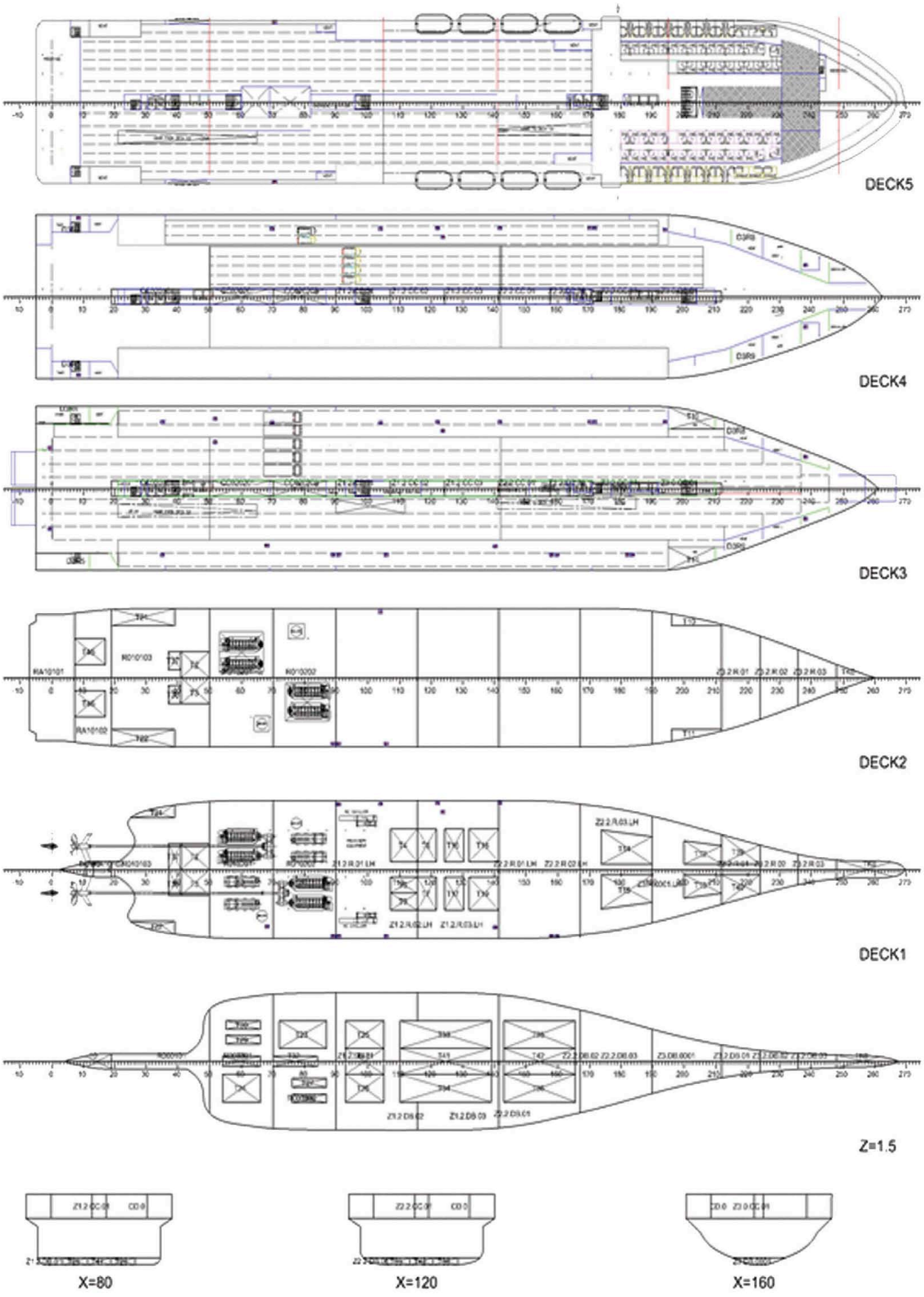
Figure. 3: General Arrangement of ro-pax design



Zero Emission is for the Elbe

Clean air becomes a scarce commodity in congested urban areas. And then there is global warming due to CO_2, which comes from burning fossil fuels. Shipping is in part responsible, too. DNV GL's innovative river ferry concept can solve some of these issues writes DNV GL's Volker Bertram

Water-borne transport is approximately 10 times more efficient than land-borne transport, but typical maritime fuels contain much more pollutants. This is about to change soon. The magic word is ECA - Emission Control Area.

The North Sea and Baltic Sea are the first such designated ECAs with much stricter emission limits starting from 2015 when sulphur content will be curbed from 1% to 0.1%. Marine diesel fuel must then have similar purity as the diesel fuel for our cars. Good for the residents, difficult for the ship operators.

For many older ships a conversion to the new clean age does not make economic sense. They will be replaced by a new generation of ships which will be much cleaner, but also much more efficient. Cleaner fuel is more expensive and the extra costs per ton fuel need to be compensated by fuel savings in ultra-efficient designs. This is quite feasible, as DNV GL demonstrates with a pioneering ferry concept for the Elbe River between Cuxhaven and Brunsbuttel.

"Each design starts with the mission requirements", explains ship designer Fridtjof Rohde of DNV GL. The Cux-Bru ferry has to cover 16nm between Cuxhaven and Brunsbuttel, with departures offered every hour. Traffic volume is estimated to be 300,000 cars, 50,000 lorries and 650,000 passengers per year. The average utilisation should not exceed 40% of the capacity to avoid bottlenecks during high season. The ferry terminal must be easily reached from the nearby motorways to save time for the customers and avoid transit traffic for the cities.

In addition to the LNG and hydrogen fuel option the Cux-Bru ferry will carry batteries for supplementary power boosts

It is therefore recommended to relocate the Cuxhaven terminal to a nearby industrial site, saving 2nm ferry distance in the bargain. The ferry is designed for maximum 15 minutes turnover time in terminal. The Elbe River features strong tidal currents of up to 4knots. The ferry is designed as a double-ended ferry avoiding time-consuming turning manoeuvres on the river.

For ships, even small changes in design speed result in significant changes of required power and fuel consumption. Thus a closer look at schedules, fleet size and design speed is well worth the while. For the Cux-Bru ferry three ships are planned to offer hourly departures with a design speed of 15knots. Even with adverse currents and waves, arrivals within 75 minutes can be ensured.

Flexibility is the trump card. The design features four permanent car lanes. In addition, there are two lorry lanes or three car lanes. In the car/lorry variant, the capacity is 140 cars, 25 lorries and 400 passengers. A light salon and a big sun deck offer passengers a "mini cruise experience".

The DNV GL designers go for flexibility. The most conventional propulsion option opts for diesel-electric propulsion, albeit with marine gas oil to meet the 2015 emission criteria. But then, one may as well consider LNG which is even cleaner and for the time being cheaper. A third variant goes all the way to zero emission. Excess energy from nearby wind power plants could be converted locally to liquid hydrogen which on-board fuel cells "burn" again to water.

Batteries supplement the fuel cells for short-term energy boosts, e.g. during manoeuvring. The technology has been proven for a long time in German submarines. Guidelines for safe arrangement and operation are also available from DNV GL. "The technology is there, commercially of the shelf. We just need the price for liquid hydrogen to drop in Germany. Then the zero-emission option becomes attractive also for Cuxhaven," summarises Rohde. *NA*

The 100m Cux-Bru ferry will have a zero emission option using hydrogen produced from local offshore wind farms

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International Conference on Ship & Offshore Technology

Developments in Ship Design & Construction

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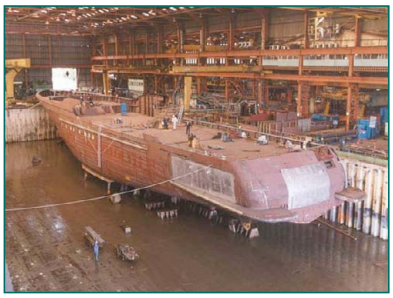

First Notice & Call for Papers

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

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

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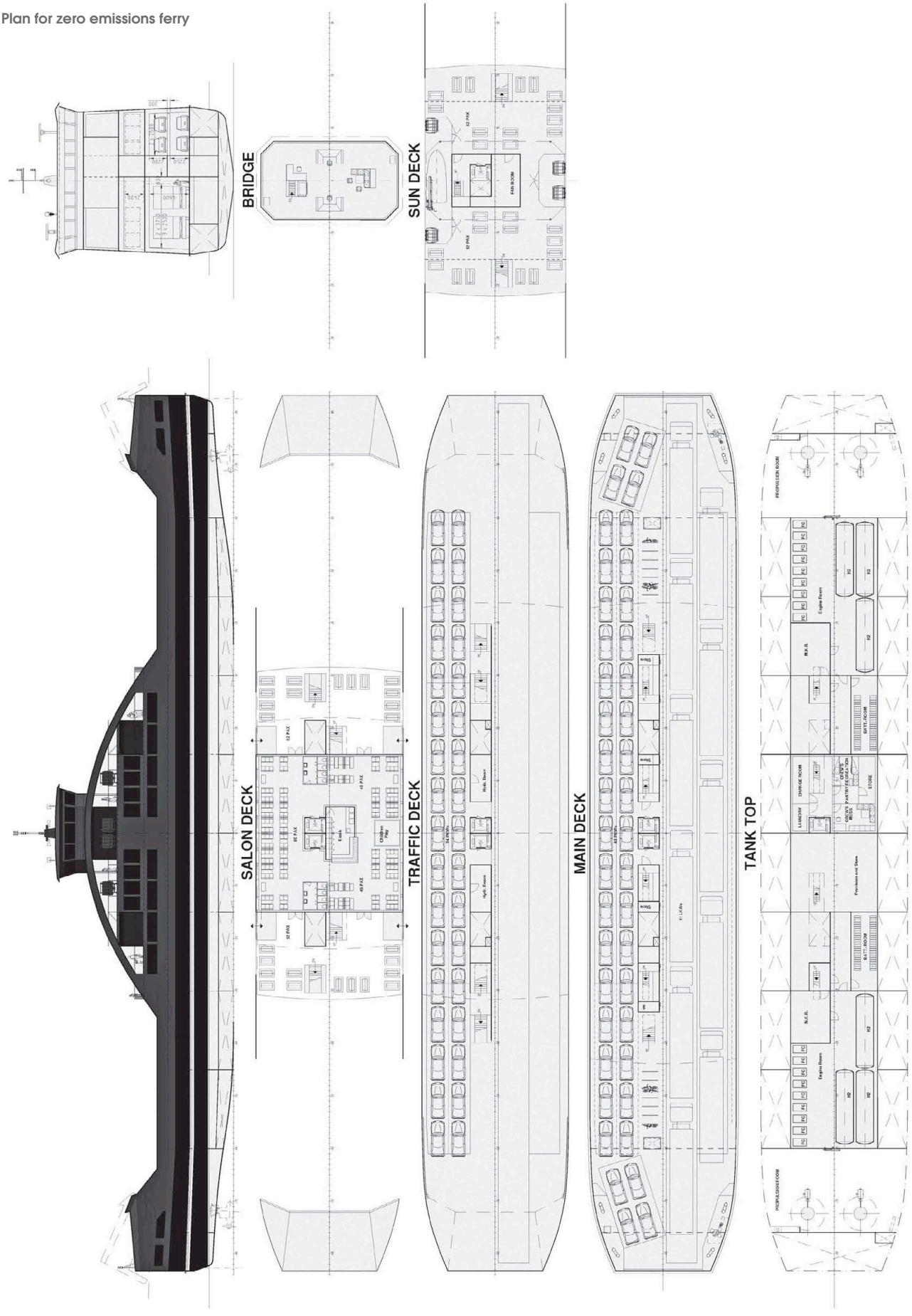
GA Plan for zero emissions ferry



Adding the human element

Design in the shipping industry is taking a turn towards being more holistic in its approach; one of the factors contributing to this approach is that the human element is now becoming a feature in the design process

The human element/human-centred approach to design is not a wholly new concept with this approach being taken up more recently for the design of bridge systems. However, the approach was highlighted back in 1997 by the IMO who defined the term human element to be "a complex multi-dimensional issue that affects maritime safety, security and marine environmental protection. It involves the entire spectrum of human activities performed by ship crews, shore-based management, regulatory organisations, shipyards, legislators and other relevant parties, all of whom need to co-operate to address human element issues effectively." [IMO Resolution A.850(20) and A.947(23): Human Element Vision, Principles and Goals for the Organisation].

Dr Jonathan Earthy, human factors coordinator, Marine Technology & Engineering Services, Lloyd's Register says that: "In recent years this has come to be misinterpreted as owners addressing competence and fatigue. Although these are important issues, the definition makes clear that all stakeholders in the marine industry need to address their part of the risks arising from the interaction between people, procedures, equipment and the ship; in particular how they affect the resilience of the total work system. In addition to safety, security and the marine environment there are risks for business performance, and the reputation of organisations and the industry as a whole."

The human-centred approach to design is generic; the benefits will vary depending on the product or system. A product designed using a human-centred approach looks at the reduction in opportunity for injury and error, simplicity of use, management of complexity, clarity of user action.

Dr Earthy explains that: "The human-centred approach is characterised by the following principles: a clear description of the operational concept that reflects the context of use; early, continuing, effective crew input; continuous improvement, learning from experience, trials or prototypes; the matching of systems to people and tasks, encompassing the user experience; multi-disciplinary teamwork. It is compatible with design methods and provides additional information to the product concept, requirements, design and during testing. It enhances the consideration of operational issues and through-life-cost in trade off decisions and project risk management."

Lloyd's Register (LR) has produced marine technical guides on how ship designers and equipment manufacturers can adopt the human-centred approach into equipment design. The guides outline the activities that will enable designers to design in this approach and to achieve the desired results. At a technical level, the implementation of the human-centred design into a project is shown as a single set of activities (in the guide), since it is likely to be resourced by very small numbers of people. The technical implementation of human-centred design is split up by technical specialist disciplines.

The structure of the equipment manufacturers' guide is similar to that for yards, but with two essential differences at management level:

- The need for product support beyond a guarantee period, with a more extended lifecycle, and less organisational partitioning between stages
- The likelihood of a greater emphasis on risk management.

Dr Earthy explains why the human element is an important factor for equipment manufacturers. "There is a limit to how safe a ship structure and how reliable its equipment can be. Yet the public and political expectation is for the marine industry to become ever more safe, secure and productive with a reducing environmental impact." He adds that the next area of improvement has to be the resilience of crew, and because seafarers and shore staff do their jobs using equipment the usability of that equipment becomes a critical factor in achieving improved resilience.

To meet this demand, equipment manufacturers have to make considering the job to be done with their product or system, and where it will be done, into a routine part of design. Who will be using it? Where will they use it and what effect will the physical environment have? What skills and training can be expected? How will they be supervised? What support will they have? "If a product does not fit this context of use there will be an impact on the effectiveness, efficiency, safety and satisfaction of the user. In addition, with time this context will change and the effect on usability needs to be re-assessed," he cautions.

As the maritime industry develops new technologies to meet with not only modern requirements, but also regulatory requirements, the way equipment is designed and manufactured is evolving and more recently this is happening at a faster pace, which in turn may cause problems for seafarers in keeping up to date with these latest technical developments.

"The speed of modern marine transport and the size of ships and cargos, coupled with a drive to reduce manning increases the likelihood and consequence of single-person error. In addition, the range of technologies that are used for efficiency and economy, or required by regulation, are beyond the ability of seafarers to understand in sufficient detail to know if equipment is operating properly, let alone to correctly diagnose a failure. Finally, the complexity and interconnectedness of marine systems is increasing and such systems can present bewildering behaviours, and amounts of data, to users; especially if something goes wrong," Dr Earthy explains.

Today we see the human element approach in design being used in other industries. Objects that we all come in contact with everyday such as mobile phones, websites and entertainment systems are some examples. Other industries such as rail, aviation, automotive, offshore, defence and nuclear have also been adopting this method. "What you can achieve with these services and their rapid adoption is largely because of a sustained focus on the user experience (a characteristic of the human-centred approach)," he adds, "Increasing problems with retention in the marine sector suggest that it also should take user satisfaction more seriously. Consideration of human factors in manual handling and tool design is having a positive result on days lost due to injury and length of working life."

Dr Earthy also explains that part of adopting a human-centred approach is for the development of equipment to take more account of how existing equipment is used. There are many ways in which to get this information: incident and near miss reports, feedback on product review sites and other social media, reports from service and maintenance staff, better specifications from purchasers (through their adoption of a human-centred approach in acquisition – encouraged by interest from manufacturers), trials with representative users, use of ergonomic guidance and standards.

"Under a human-centred influence, equipment will develop to be easier to learn and safer and more productive to use. Competition between products will not be on features or claims to increased performance, but on demonstrations of prolonged productivity, situational awareness, ease of maintenance, and overall value for money," comments Dr Earthy.

The human-centred approach is taking its time to have its full potential realised in the maritime industry. Dr Earthy explains that the factors attributed to this are the loosely-coupled nature of the supply chain for marine equipment, the engineering emphasis in the management of shipping companies, the contract environment for new builds and refits, lack of knowledge about the relevant tools and benefits in the purchasing departments of ship owning/operating companies, seafarers' pride in being able to make do with anything, difficulty in getting feedback on use of equipment (before modern communications), lack of knowledge of how to describe the impact of poor ergonomics and a belief that human-centred design is expensive all create a "perfect storm" of partial barriers to taking a human-centred approach.

"However, we appear to be at a tipping point where lack of public tolerance of failure by the marine community is changing expectations of the way seafarers should be equipped and managed," he concluded. *NA*

LOCOPIAS strengthens inland waterway shipping

Dutch-based SARC has seen the need for vessel stability software grow, opening new opportunities in the inland market

A lot has changed in inland waterway shipping in recent years, the company has said. More and more types of vessel require stability calculations and the scope of required calculations is widening. For estuary services, Belgium has developed rules where inland waterway vessels need to comply with stability criteria for seagoing vessels (with exemption to some). Furthermore, an increasing number of new (hull) designs and concepts have been developed over the last years, where previous designs were commonly rather traditional. SARC says that the gap that always existed (at least in SARC's perception) between inland waterways and seagoing vessels is rapidly shrinking.

Bart Soede, naval architect at SARC indicates the main points of design/regulation overlap between inland waterway vessels (specifically gas, product and chemical tankers and, to a lesser extent dry cargo vessels longer than 110m or under ADN rules (rules for the transport of chemical substances) and inland waterway passenger vessels) with seagoing vessels:

- Naturally, the same rules of physics and theories apply, only rules of thumb would be different
- The interpretation of existing rules for (listed types of) inland waterway vessels has become much stricter over the years: in many cases, rules are applied rigidly by classification societies, even when common sense would dictate otherwise. The same trend is seen for seagoing vessels
- Though the actual stability requirements are less strict (in view of 'friendlier' conditions) -there are no stability requirements beyond 27degs of heel where for the most common types of seagoing vessels stability requirements range up to 50degs of heel- the same type of requirements apply: initial stability (GM value), dynamic stability (area under the GZ-curve), righting lever (minimum GZ value), etc.
- Furthermore, openings are treated much the same way (open openings may not be submersed at all, weather tight openings may only be submersed beyond the angle of heel at equilibrium, etc. and there is a lot of discussion on type designations of openings
- Longitudinal strength is evaluated for still water and wave bending moments are superimposed
- Damage stability calculations are required for the vessel types mentioned above and these can be as elaborate and time consuming as for seagoing vessels.

Josef Jaegers has recently had the LOCOPIAS software installed

LOCOPIAS aims at helping crew manage cargo more efficiently

Furthermore, accidents with container vessels lead to an investigation by Dutch authorities in 2008, where it was concluded that on over half of the container vessels the stability booklet was not, or not properly, used to access stability. Additionally, for a number of years' regulations failed to include 'high cube' (9'6" containers) so that stability calculations were made as if all containers were 'regular' (8'6"). For planning of container cargo and comparison of the actual vertical centre of gravity (VCG) suitable software has been around since 1997. Today, correct procedures and/or suitable software are implemented on most container vessels.

For double hull tankers the Dutch shipping inspectorate recognised a potential problem in 2003 and ordered allowable VCG curves to be drawn up for newbuilds. Previously, stability booklets consisted only of some worst case loading conditions. Then, in 2011 a fatal accident occurred; a chemical tanker

loaded with sulphuric acid capsized in the Rhine, two crew members lost their lives and Rhine-Europe main inland waterway was obstructed for almost six weeks. The aftermath of this accident lead to regulations and market demands to have stability software installed onboard a large category of double hull tankers (single hull tankers will be phased out).

SARC says that it was well prepared for the sudden surge in orders that it saw in 2011. The first versions of LOCOPIAS (1992-1994) were actually subsets of modules from SARC's PIAS design/stability analyses software, and were ordered for the Tarquin series of gas tankers, which required more than the simplified calculations (GM or KG curves).

Soede says: "Interestingly, the versions delivered then would now classify as type 3 (direct damage stability calculations based on a 3D model of the vessel, rather than pre-calculated tables of hydrostatics, etc.)," he adds, "Interestingly, because we only received LR approval for Type 1 and 3 in 2012 (and for the much simpler Type 2 June this year)."

The LOCOPIAS software was gradually modified that SARC says started off as a spin-off of PIAS: all the required modelling tools and calculations (intact and damage stability, longitudinal strength) were available in the PIAS suite of software.

"One of the first additions specifically for LOCOPIAS was the graphical container loading module (we already had a graphic menu for tank filling). Later on we implemented more specific functions for LOCOPIAS (interfaces with a tank gauge system, graphic options to load grain, ro-ro cargo, break bulk, etc.)," explains Soede.

SARC notes that one of its most recent deliveries of its system was to the vessel *RP Brussel*. The vessel is a 110m tank barge is the third in the series of vessels for Rederji Plouvier. The vessels are part of the owner's fleet modernisation programme. SARC has also supplied its system to *Josef Jaegers,* which was retrofitted to be able to comply with the current ADN regulation (onboard verification of intact stability, damage stability and longitudinal strength). *Amberes,* a Belgium waterway vessel that can transit Antwerp to Zeebrugge and Oostende over the North Sea, which should comply with the above mentioned criteria for Belgian estuary vessel, has also had LOCOPIAS installed.

Soede explains that the benefit for all LOCOPIAS users is that the interface is easy. "Typically, in inland waterway shipping, mates, captains and owners were never trained to run any of the required calculations, either manually or using software. LOCOPIAS takes most obstacles away; the input data is simple enough, the conclusions of stability and strength evaluations are presented on screen at the push of a button," he says.

In less than three years the number of LOCOPIAS versions installed on inland waterway vessels rose from 50, gathered up in some 20 years (tankers that already had LOCOPIAS installed for longitudinal strength calculations) to over 200 (and counting). Inland waterway vessels now make up roughly a quarter of the more than 800 vessels using LOCOPIAS.

Inland waterway shipping has always been an important sector for SARC. Now that Dutch inland waterways companies are expanding outside Europe, SARC expects that new markets for their services and software will rise there as well. SARC will be exhibiting its LOCOPIAS software at SMM (Holland Pavilion B7.420). *NA*

A weighty problem

Container weights have been a niggling problem for the shipping industry since the introduction of the container to shipping, but the IMO is seeking a solution to this in the near future

The main cause for concern with misdeclared container weights lies with how the containerships are loaded. As history has shown us when weight is under-declared then it can have disastrous consequences. But, an important additional factor for today's modern containership is that if not correctly loaded the vessel will not sail in an efficient manner that will also cost the shipowner more in fuel consumption.

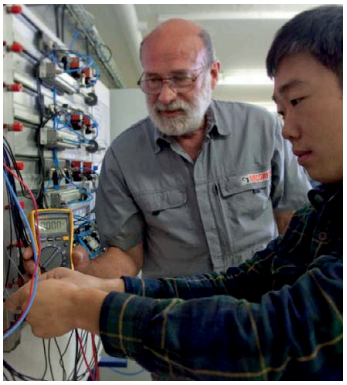
The IMO carriage of cargoes and containers (CCC) committee, last year moved to make draft amendments to SOLAS Chapter VI to require mandatory verification of the gross mass of container carrying cargo. The draft amendments will require the shipper of a container to verify the gross mass and the figure will be stated in the shipping document.

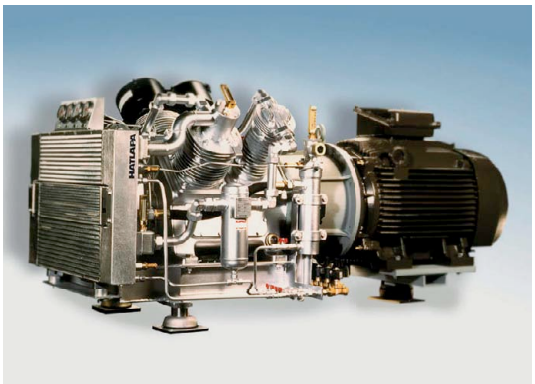
Henrique Pestana, head of ship design, ABB says that with the new guidelines shipowners will have an opportunity for cost saving. "If you look at the loading plans, sailing route and ballast loading, you can look to optimise these features in relation to the cargo that is being carried," he says.

He adds that this will not just enhance safety, but also add efficiency to how vessels are being operated. The challenge ahead is how to commercially address this. "The issue is how to organise the industry to get the required information. Shipowners do not touch data (as handled by the crew). Terminals already weigh containers and can then give this information to the owner," says Pestana. He adds that the question would then be of how this information will then be distributed to the correct recipients and has suggested that sharing the information between ports with information stored in a cloud could be a solution.

ABB is currently looking in to how and what kind of solution would be needed to address this logistics challenge.

Misdeclared weights is an issue for the industry, but the latest regulations that could come in to play could also provide a silver lining with a solution that would not only improve safety, but would also enhance the ship's operations and reduce shipowners' operational expenses. *NA*





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Tightening up on testing

Bentley Strafford-Stephenson, product marketing executive at Martek Marine explains how technology must be used to improve standards on bulk carriers to guarantee the safety of crew, cargo and environment

Despite many regulatory advances such as water ingress detection systems (WIDS) since the loss of the bulk carrier *Derbyshire*, the safety standards of these vessels still remains poor in comparison to their sophisticated counterparts in the wet trades.

A major cause of cargo damage is from water ingress in cargo holds due to a combination of poor maintenance of hatch covers and coamings or insecure hatch covers after loading. A watertight seal between the rubber packing on the holds and steel compression bars is required to eliminate water ingress. Condition monitoring of a vessel's structure is of paramount importance in addition to crew being fully trained on safety procedures, stowage requirements and the innate properties of specific cargoes as well as being competent in loading and un-loading procedures.

The Steamship Mutual insurance company state that leaking hatch covers "continues to feature…as a cause of major cargo claims", which is further highlighted by figures from the London P&I club indicating that claims associated with hatch cover issues account for 33% of all claims making hatch cover testing a must in a Club's Condition Survey.

There are several types of testing for hatch cover tightness; visual inspection of the cargo, the traditional chalk or hose tests and ultrasonic testing, which is considered by most surveyors and insurance companies to be the most reliable, accurate and safe method.

Visual inspections involve inspecting the cargo and the inside of the cargo holds to check for any water damage. Often at this point it is too late.

Hose test

The hose test is the traditional method of testing hatch cover tightness requiring two people to carry out the procedure. The first uses a hose to spray a jet of water along the cross joints and perimeter seals of the hatch covers, whilst the second stands inside the hold to look out for leaks.

The problem is that the cargo hold must be empty to do the testing and therefore the testing cannot be performed during transit and normal operations. This means surveyors and crew don't have a truly accurate report on the tightness of the hatch covers. A visual sign in a stationary environment is not in itself a satisfactory indication that there are not gaps. During transit a vessel's structure flexes and twists yet the steel compression bars and rubber packing must maintain contact to avoid sea water from seeping under the hatch covers. A hose test cannot test this and it could be too late with problems already arising. It only tests for contact and not compression.

Ultrasonic testing of hatch covers, could reduce the dangers for the industry says Martek Marine

Chalk test

The chalk test involves covering the compression bars with chalk then closing the hatch cover and opening it again to see if a chalk mark has been left on all parts of the sealing material. Like the hose test, this method does not allow for pinpoint accuracy of weak spots.

Ultrasonic test

The use of ultrasonic equipment such as Martek Marine's Hatchtite is a modern,

viable means of testing for watertight integrity of hatch covers, access hatches, doors and ventilators. Hatchtite is a portable and lightweight instrument and is approved by ABS, fully compliant with IACS' Unified Requirement U.R.Z17 and approved by insurers and P & I clubs.

The immediate advantage of ultrasonic testing over the chalk and hose tests is the need for only one person to carry out the testing rather than two immediately realising cost and time savings as well as simplifying the procedure and making the procedure safer.

Due to the technology involved gaps can be detected at the microscopic level that cannot be seen by the chalk or hose tests. By being able to test so accurately for potential weak points the cost of repairs can be significantly reduced due to the old adage of "prevention is better than a cure" and leak locations can be clearly identified. A consistent reading can be obtained from ultrasonic testing whereas with water testing, for example, variances in water pressure coupled with the distance of the jet from the structure can affect the results.

Ultrasonic testing can also be carried out in-situ, meaning operations do not have to be put on hold. A transmitter is placed inside the cargo hold (full or empty), which emits ultrasound waves. The hatch cover is closed and a hand held telescopic microphone (which is connected to a receiver along with a set of headphones) is placed at the hatch cover interfaces and the surveyor or operator uses an ultrasonic detector to 'listen' from the outside and pick up all 'leaking' ultrasonic sounds that leak through the sealing arrangements, vents and cracks. The receiver will display the decibel level of any ultrasound leak which is also heard through the headphones.

The readings are then compared to the OHV (open hatch value), which is calculated by using an access hatch or opening the cargo hatches and taking a reading for the level of ultrasound reaching the underside of the cargo hatches. If the hatches are tightly sealed then the reading should be as far away from the OHV reading as possible. The closer they are to the OHV then the worse the leakage. A reading of 10% or more indicates a potential area exposed to water ingress and readings of over 50% of the OHV indicate significant loss of compression.

Ultimately chalk and hose testing is less reliable than ultrasonic testing and being seen by more and more authorities as an outdated method of testing. Steamship Mutual go on to say that "ultrasonic testing when the necessary equipment is available, is the club's preferred method." Further to this, classification societies have their own requirements and DNV GL has stringent requirements for the use of ultrasonic devices in hatch cover testing.

If accurate testing is not used for hatch cover tightness testing and ship condition monitoring, further incidents related to water ingress in cargo holds will occur. Ultrasonic hatch cover tightness testing will raise standards for bulk carrier safety and this can only be a good thing for the seafarers serving onboard these vessels. *NA*

Under pressure: coping with compliance on new safety regulations

Mark Jones, sales director at PSM looks at the advantages of system monitoring as an economical and effective alternative to secondary systems in ensuring compliance with new safety regulations to prevent the risk of cargo overpressure

First introduced in 1998, SOLAS II-2/59.1 and subsequent updates forced shipowners and operators to upgrade their safety systems to secure cargo tanks against the risk of overpressure. New guidance issued by the IMO (IACS UI SC 140), which took effect last summer left many vessel owners facing the prospect of yet more costs to ensure their vessels continue to conform.

Cargo overpressure is a serious complication, which can occur in port as well as in transit. The greatest risk occurs during cargo transfer as cargo tank levels change, affecting the head space above the liquid. During loading, compression of the air in the tank can cause pressures to rise unless vented to the atmosphere. At the other end of the scale, falling liquid levels during unloading may create a vacuum unless air is admitted from the external atmosphere to balance the pressure.

In transit, the fluctuating temperature of the gases and vapours in ullage spaces or liquid cargoes could also lead to overpressure. In practice the double hull design of modern cargo vessels provides a 'Thermos' effect to prevent excessive variations, reducing the risks accordingly.

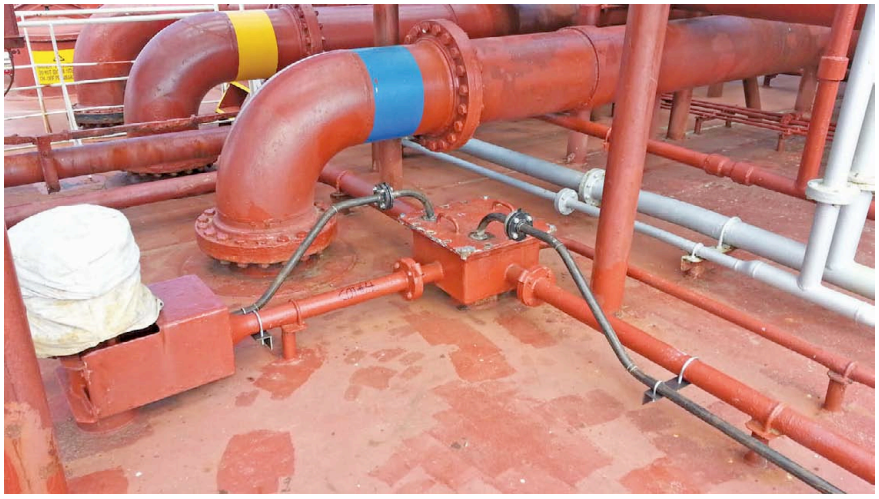
Risky business: how to handle the issue of cargo over- and under pressure

If unchecked, over- or under-pressure of cargo tanks can cause significant damage, compromising the integrity of the tank and incurring potentially costly repairs. The accidental release of dangerous liquids or gases in the event of a breach also presents a serious fire and pollution hazard.

Under the new regulations all cargo vessels carrying hazardous cargoes are required to be fitted with a secondary pressure valve system as an additional safety mechanism in the event of a failure in the primary pressure/vacuum valve. This has left shipowners and operators struggling with potentially costly upgrade programmes to ensure compliance. Major oil companies are also driving the change process by mandating the vessels they charter conform to the new regulations.

Help is at hand for beleaguered operators in the form of the latest tank pressure monitoring systems, which offer a cost-effective and practical alternative. Designed to satisfy the safety stipulations of the original Solas II regulations, products such as PSM's ict 1000 pressure transmitters are now recognised as a substitute by many marine classification societies.

The new guidance requires cargo hold pressure sensors to be fitted to each tank



A pressure transmitter and protective conduit for signal cable

The Royal Institution of Naval Architects

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Ofosu-Apeasah, E., Ministry of Defence, Salvage & Marine Operations Project Team, UK
Vermeulen, K-J., Boskalis Offshore, the Netherlands

A SUPPORT TOOL FOR ASSESSING THE RISKS OF HEAVY LIFT VESSEL LOGISTICS IN THE INSTALLATION OF OFFSHORE WIND FARMS
E. Barlowa, D. Tezcaner Ozturk, S. Day, E. Boulougouris, M. Revie, K. Akartunali, University of Strathclyde, UK

HYDRODYNAMIC INTERACTION BETWEEN FLOATING STRUCTURES DURING HEAVY LIFT OPERATIONS – IS IT WORTH ANALYSING?
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Roy Weustink, Section Head Naval Architecture, Seaway Heavy Lifting, the Netherlands

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and centrally monitored. PSM's ict 1000 pressure transmitter system, for example, enables up to 24 individual transmitters to be connected to an LCD display unit located in the ship's cargo control room, which acts as a monitoring station, providing an indication of status and displaying actual pressures for each tank. In the event of an under- or over-pressure excursion, visual and audio alarms are triggered, allowing remedial action to be taken. Connection to the ship's Voyage Data Recorder is possible via an optional RS485 data interface.

A key advantage of modern monitoring systems is their flexibility. PSM's ict 1000 package lets users assign up to four alarm setpoints to each tank over a range of -500 to +500mbar. Set to a standard configuration to suit most applications, the system allows for easy updating of setpoints, acceptance delays and hysteresis settings. Designed to be scalable, the latest solutions enable fleet owners to specify systems to meet both their current and future requirements.

Pressure management systems are attracting increasing interest from shipowners, particularly as a retrofit solution. Costing up to 80% less than a secondary pressure relief valve, they are also simpler and faster to install requiring just one small diameter pressure connection and electrical cable per tank.

Above and beyond the cost, sensors also offer an additional margin of safety, allowing crews to see in real-time what is happening at any point during loading and unloading. This allows them to carry out further investigations into the pressure vent or inert gas blanket equipment where dangerous levels are detected. Secondary relief systems by comparison do not offer advance warnings, with the crew only alerted when the system triggers.

Responding to the potential risks to reputation and financial consequences of damage arising, many oil companies have gone one step further and may stipulate pressure measurement and alarm systems are installed even where a secondary mechanical system is in place. Such a move can only raise the benchmark for best practice and improve industry standards overall. *NA*

The Royal Institution of Naval Architects

Marine Design

3-4 September 2014, Coventry, UK

Lifelong Learning Programme

EBDIG European Boat Design Innovation Group

Coventry University

Lloyd's Register

Second Announcement

RINA Marine Design 2014 will provide a forum for reporting and discussing the design practice and technical issues associated with aesthetic design. The full spectrum of marine design from small craft to super yachts, including commercial and specialist vessels, will be examined.

An exhibition celebrating the 30th year of boat design at Coventry University will be opened at the end of the conference, which will include a virtual 3D exhibition of Coventry University students' design work. This will show the breadth of capability within the department of Industrial Design including automotive, transport and boat design.

The conference will present technical papers on a number of aspects of aesthetic marine design, including:

- ***Design Visualisation*** (including design methodologies, design practice, innovative concepts, design analysis tools, Computer Aided Design, TOI (Transfer of Innovation) from other industry sectors).
- ***Human System Integration*** (including HFE (Human Factors Engineering), Maritime Security, UCD (User Centred Design) methodologies, Emotional Design methodologies, Empathic Design methodologies, 'Ageing in Place', TOI from other industry sectors).
- ***Sustainability in construction*** (including one-off construction and series production issues, facility design, materials, joining technologies, reconstructions and rebuilds of historic craft, results of simulation).
- ***Sustainability in operation*** (including, equipment, results of sea trials, results of instrumentation, results of simulation, TOI from other industry sectors).
- ***Implementation of regulations*** in the design process (including international, national, and regional regulatory frameworks, classification, codes of practice, rating rules).
- ***Virtual work/learning environments*** (including, CPD for marine designers, networking opportunities for innovation and exchange, virtual work environments to facilitate multi-disciplinary, multinational teams).

www.rina.org.uk/marine_design2014

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Scanjet offers a breath of fresh air

Swedish-based Scanjet has launched its latest fan for cargo tanks, the SC F150W

The latest fan is designed to be used to blow fresh air in to the cargo tanks of vessels. Scanjet explains that gas freeing operations are generally carried out in conjunction with tank cleaning operations. Tank cleaning is done between cargoes to ensure that there is no contamination of the next cargo or to remove residues which could build up and reduce cargo carrying capacity.

Another reason for changing the atmosphere in the tank would be allow staff to safely enterin order to carry out in-tank maintenance/repairs. Personnel have to ensure that not only is the tank gas free, but also to maintain a supply of fresh air during the time they are in the tank.

Scanjet introduces its latest fan to the market

"There are no specific rules regarding gas freeing operations but it is recommended that they are carried out as quickly and safely as possible. A high performance fan with a large throughput and deep penetration capabilities is therefore essential. Our new fan is designed to meet both criteria with a throughput up to 15,000m^3/hour and is designed with a stator which straightens the air and means it can reach the bottom of most tanks," says Duncan Marshall, managing director, Scanjet.

The SC F150W is a portable water-driven gas freeing fan suitable for use on all size and types of vessels. It is constructed from stainless steel and aluminium and is lightweight and can be easily moved around the deck, the company says. *NA*

RINA-QinetiQ Maritime Innovation Award

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

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

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

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

QinetiQ

- Nominations may be up to **750 words** and should describe the research and its potential contribution to improving the design, construction and operation of maritime vessels and structures,
- Nominations may be forwarded online at **www.rina.org.uk/MaritimeInnovationAward**

  or by email to

  MaritimeInnovationAward@rina.org.uk
- Nominations should arrive at RINA Headquarters by **31 December 2014**
- Queries about the award should be forwarded to the Chief Executive at **hq@rina.org.uk**

Imtech brings remote possibilities to reality

Imtech Marine has been developing a more comprehensive approach to the use of systems onboard and how they can help make ships run more efficiently

Imtech Marine has been focusing its developments on the monitoring and optimisation of performance equipment onboard ships, which is backed by three global technology assistant centres (GTAC) in Houston, Singapore and Rotterdam.

Imtech Marine told *The Naval Architect* in 2012 that it was developing its competence centre that would look at combining the latest green technologies (systems) and develop them further for specific customer needs. Further to this, Imtech announced last year that it was developing its Energy Management system that would monitor, give advice and have fully automated control for the energy generating plant.

Nico van Leeuwen, Imtech Marine Director Global Service Sales, positions the Imtech Marine of today as a "systems integrator plus", taking a "cables to data" approach.

Leeuwen claims that the system: "combines expertise on shipboard systems with benchmarked performance analysis undertaken ashore. Having and analysing the right information through our global service database at the right time means we can make informed decisions on how, where and when to execute routine maintenance, software installations, hardware replacements or upgrades," he says.

In addition to these developments, Imtech Marine is re-launching Radio Holland as the brand to identify its entire navigation and communications service portfolio, including remote monitoring.

Frank Berends who heads a team of engineering specialists at Imtech Marine says: "With remote monitoring, potential problems will be signalled pro-actively and in many cases before they actually happen. At the same time, advice offered online can cover anything from routine maintenance to software upgrades, to operator error. If direct intervention is not required, remote support is enhanced via a Customer Portal that gives access to all technical information, such as drawings, manuals, circulars, FAQ's, Trouble-shooter, updates and software updates."

One clear benefit is that fault-finding can be done remotely, avoiding both the costs and inevitable time lags involved in sending, lodging and briefing a field service engineer. In addition, Van Leeuwen stresses, when direct intervention is required by service engineers: "GTAC will inform the Service Coordination Centre with all essential background information and full diagnostics for the attending Field Engineer. The 'First Time Fix' percentage of field service will increase, reducing repair time."

Remote monitoring is therefore a critical component that supports the optimisation of ship efficiency because it enables expert advice to be given to shipboard engineers immediately on how to adjust operating processes to get the most out of working equipment, says Berends.

Rising expectations

In fact, he describes fast-rising expectations from customers for remote monitoring, its predictive capability and its ability to identify root causes in fault-finding, while continuing to stress that the ability of Imtech Marine's GTACs to respond quickly to incoming calls for assistance remains critical.

"At one level, our most pressing calls will come from customers with a problem that needs to be dealt with immediately. However, owners are increasingly seeking preventive capability, with equipment and systems monitoring backed by expert advice to optimise asset utilisation."

Berends describes a common scenario, where a ship's master might be tempted to reset some or all systems when suspecting impending satellite connectivity outage, when the right course of action is to identify the source of the signal compromising connectivity and isolating the issue.

"Sometimes it is a case of helping the master with the problem he has by identifying that it is not the problem he thinks he has," he says. "By monitoring equipment remotely, we can establish that the basic problem is a signal feeding into the network, not the network itself, and thus avoid time-consuming reconfiguring."

Keeping close oversight of shipboard equipment temperatures is also essential, Berends says. "If shipboard equipment is left to operate at too high a temperature, the first warning can be when it burns out." Imtech monitoring provides the basis for recommendations on preventive action.

"Increasingly, we are also working in close collaboration with engineers onboard ship to enhance their own working processes, based on our performance analysis of the systems they are supporting," adds Berends. "We can also establish accurately the exact moment when it becomes most effective for both Imtech and its customers to dispatch a service engineer to the vessel. We identify the point when saving costs in one area has cost implications elsewhere."

Remote delivery

Berends points out that progress towards full condition-based monitoring has been slow, partly because owners have been unable to invest through economic downturn. Maximising equipment availability, optimising operating costs and minimising maintenance costs are self-evidently desirable, but realising these goals will rely on collaboration that involves operational-, IT- and financial managers in an integrated business case, he says.

"Life-cycle management of vessels is surely available, but owners are sceptical about making investments based on promises that there will be savings later on. They are more receptive to straightforward propositions that are economical, rather than complex proposals whose benefits are hard to measure. Our position is that we can do pretty much anything the owner requests, but our experience is that it is better to offer gains that are simply understood and tangible."

Berends cites Imtech Marine's Advanced Support Agreement with Seaway Heavy Lifting (SHL), covering all of the systems onboard. He offers the example of the vessel *Oleg Strashnov*, where crew working offshore in the Indian Ocean discovered issues with the telephone system, but Imtech Marine was able to carry out a remote repair. This avoided a six week application process covering service engineer permits to get onboard.

Berends points out that remote monitoring of equipment is, by now, an implicit expectation when it comes to meeting the agenda set by regulators. "Regulatory compliance and environmental protection, such as the verification of CO_2 emissions, rely on this type of reporting capability. Data collection is also simply the first step of the staged approach for further measures to increase ship efficiency as proposed at IMO."

However, to bring home the true potential of the remote approach, one of Imtech's recent initiatives has been to offer customers an audit after one year. He believes any owner resistance will be best addressed by offering solutions that can be proven to work every step of the way.

Planning potential

"At the newbuild stage, where the equipment still has to be delivered, we not only include lay-out and cabling specifications that will facilitate Remote Monitoring; we are prepared to agree a MoU that includes key performance indicators," says Berends.

"Once the capability is in place, after an agreed period, we as supplier and the end user are in a truly informed position. After 12 months, for example, we take the opportunity to sit down with our customer to evaluate and discuss the way forward, and whether their experience persuades them to include more vessels/other types of vessels in the programme."

Earlier this year, Imtech put another building block in place to enhance remote capability by taking its VDR-connectivity concept live, working with Danelec to offer real time communications between ship systems and shipping offices on the safety critical information harvested from real operations.

"All VDR data from ship to shore are presented via a web interface to the customer's office, for scrutiny by superintendents, fleet managers and so on," explains Berends. "This provides an overview of navigation equipment data and performance, and the ability to check operational performance such as speed vs. fuel consumption on a random basis. Safety is also enhanced; as well as the chance to review compliance using precise data, Imtech offers an option for real time alerts on non-compliance.

Van Leeuwen believes the building blocks have been put in place to overcome owner scepticism on the benefits of the remote service offer. "Identifying problems using consistent data that can be interrogated in the right way, having the right processes in place and having the right people available at our GTACs brings direct cost savings," he says. "It also ensures that when our service engineers are required to board a ship they do so fully informed and ready to act." *NA*

Lilaas gets to ergonomic grips

The Norwegian lever developer Lilaas has announced the latest generation of its LO1 lever controls

Having recently secured type approval from DNV-GL, Lilaas is lifting the lid on its latest lever technology solution that it believes will impact the entire control lever sector, through the developments that have been made.

Lilaas says that the main difference between this latest version and the previous design is the integrated L-shaft system, force feedback, IP66 for display versions, software setting (direct on the lever) of brakes and detents.

Espen Hoff, Lilaas manager research & development, explains: "From a mechatronics point of view, the space available for the lever has been a major obstacle. The space/volume below the panel plate, inside the desk is limited. One of the challenges has been to make the motor compact while at the same time ensuring the haptic feedback solution is strong enough. Normally a smaller motor would not be strong enough."

The solutions says Hoff, has been to design a control lever interface where the friction from internal components is reduced while the motor is running, but reverts to a normal lever when the motor is not running. "Reducing the friction has allowed us to select a smaller motor that is still strong enough for its operating environment. The haptic feedback solution is an integrated part of friction control," he adds.

By the very action of handling the lever, the operator controls the level of friction when the motor is running because the system digitally adjusts the friction and detents generated.

The design rethink on LO1 also opened up opportunities to reduce the number of components needed, with the computer numerical control (CNC) machining department at Lilaas tasked with integrated more functionality in the remaining components.

"Fewer components mean faster assembly and less parts being stocked, while there is also maintenance dividend just because fewer parts require less service. We have also designed in easier maintenance because many of the mechanical parts have been located above the panel plate, inside the barrel/cylinder at the top of the lever," Hoff says.

Lilaas updates its control lever

Every electronic function is also integrated in the lever, including the motor drive's printed circuit board, L-shaft follow-up system, CAN bus and graphical display (among others).

In terms of control, Hoff points out that the graphical display can show both the set point and feedback (actual rpm or angle) at the same time. The system is also electrically redundant, he says. "Sensors are redundant and digital and analogue outputs are redundant. Functionality includes both the L-shaft that controls one propeller from different levers in relation to steering position, and the "one lever mode" (controlling several propellers from one lever), making the LO1 a very flexible solution."

The flexibility extends to future-proofing, he says, because LO1 levers are digitally configurable, meaning that their functionality can be upgraded by resetting the software parameters in the software. "All functions are tested in our factory before delivery, so that new functions that may be required later on for upgrades that are already tested."

Lilaas highlights that the current market demands for this product are control levers with controller area network (CAN) interface and or other bus interface opportunities. Terje Akerholt, sales & marketing manager, Lilaas says: "The end user requests motorised versions, but the price has so far been too high. With our new technology, the price for complete motor and L-shaft (control system) will be reduced by approx 30%."

Hoff also explains that: "The LO1 communicates through a standard CAN opening protocol. CAN opening can be connected to the customers CAN bus for reading of set points sending feedback signals, etc. There is also an analogue output for the set point. That can often be an easy way to the read lever set point."

The development of this latest generation lever was carried out in 2013/14, along with recent type approval, Lilaas says that this product will be suitable for all vessel types and is expecting deliveries of the first lever units in October. *NA*

The Royal Institution of Naval Architects

Damaged Ship III

25-26 March 2015, London, UK

First Notice & Call for Papers

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

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

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

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

- Initial damage assessment and verification
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- Stability in waves, extreme motions, capsize dynamics
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www.rina.org.uk/IPR_Seminar_2014.

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www.cruiseshippingevents.com

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September 17-18, 2014
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New Orleans Workboat, international exhibition, New Orleans, USA.
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www.euromaritime.fr/en

February 22-26, 2015
NAVDEX, international conference, Abu Dhabi, UAE.
www.navdex.ae

February 26-28, 2015
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www.cruiseshippingevents.com/miami

March 11-14, 2015
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www.europort-istanbul.com

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www.cruiseshippingevents.com/miami

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OFFICIAL MAGAZINE IBI International Boat Industry

SYP OFFICIAL MAGAZINE The Superyacht Report

MYP OFFICIAL MAGAZINE Marina World www.marinaworld.com

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MARINE EQUIPMENT TRADE SHOW

METS

18 - 20 NOVEMBER 2014
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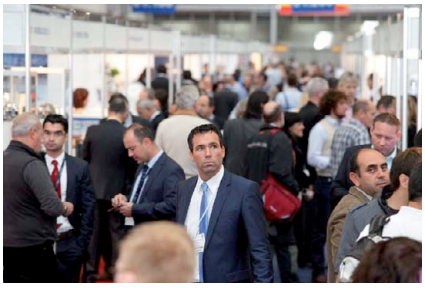

METS 2013 Visitors:

- 20,500+ visitor attendance
- 105+ countries represented
- 94% intend to visit again
- 99% recommends visiting
- 67% decision makers
- Visitor appreciation: 8.4

"Great opportunity to find out what is new in the industry from a worldwide perspective."

Julian Smith from BIG BEAR SUPPLIES LTD, United Kingdom – Visitor of METS 2013

"METS is the best event to meet leading boat builders and to get updated on the most innovative marine project and trends."

Laura Fabi from RESINTEX TECHNOLOGY SRL, Italy - Visitor of METS 2013

METS 2013 Exhibitors:

- 1,320 exhibitors
- 95% intend to exhibit again
- 95% recommends exhibiting
- Exhibitors appreciation: 8.2

"METS gives you an opportunity to meet the most influent people in our industry. It also gives you the chance to meet all your existing customers as well as being able to get to know new customers - at one great place!"

Anders Bergström from True Heading AB, Sweden – Exhibitor at METS 2013

METSTRADE.com

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The work will be varied, ranging from model testing and other experimental projects, through software development to theoretical and numerical analysis. Whilst the range of applications may be in any field of engineering, with industrial aerodynamics and sports science being significant areas, the Wolfson Unit specializes in yachts and small ships so a good understanding of naval architecture will be essential. This is a particularly exciting time for us, with a new 140 metre towing tank under construction at the University, and this is an opportunity to take part in its development.

You should have at least a degree in naval architecture or equivalent, and a higher level qualification will be an advantage. The work is expected to involve a significant amount of physical, laboratory and workshop activities, so it will be helpful if you can demonstrate a range of practical skills. You will need to be confident to take the initiative, with a flexible approach to problem solving and work schedules which are qualities for which we are recognised. An interest in sailing or other marine activities will be an advantage and will make this enviable post even more enjoyable.

To apply online, please visit www.jobs.soton.ac.uk. Alternatively please call 023 80595507 for an application form. The closing date for applications is 26th September 2014. Please quote reference number 443214LH on all correspondence. At the University of Southampton, we value diversity and equality.

www.wolfsonunit.com

RINA - Lloyd's Register
Maritime Safety Award

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

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

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

- safety of life or protection of the marine environment, through novel or improved design, construction or operational procedures of ships or maritime structures
- the advancement of maritime safety through management, regulation, legislation or development of standards, codes of practice or guidance
- research, learned papers or publications in the field of maritime safety
- education, teaching or training in maritime safety issues

Lloyd's Register

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

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

Queries about the Award should be forwarded to the Chief Executive at **hq@rina.org.uk**

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By Chris Thomas
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Price: UK £9.00 EUR £10.00 OVS £12.00
AMAZON PRICE: £12.74

SHIPS AND SHIPBUILDERS: PIONEERS OF SHIP DESIGN AND CONSTRUCTION
By Fred Walker FRINA
Ships and Shipbuilders describes the lives and work of more than 120 great engineers, scientists, shipwrights and naval architects who shaped ship design and shipbuilding world wide. Told chronologically, such well-known names as Anthony Deane, Peter the Great, James Watt, and Isambard Kingdom Brunel share space with lesser known characters like the luckless Frederic Sauvage, a pioneer of screw propulsion who, unable to interest the French navy in his tests in the early 1830s, was bankrupted and landed in debtor's prison. With the inclusion of such names as Ben Lexcen, the Australian yacht designer who developed the controversial winged keel for the 1983 America's Cup, the story is brought right up to date.
Price UK £12.50 EUR £16 OVS £18
AMAZON PRICE: £21.25

THE ROYAL INSTITUTION OF NAVAL ARCHITECTS 1860-2010
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IJME - is published in March, June, September & December. The IJME provides a forum for the reporting and discussion of technical and scientific issues associated with the design, construction and operation of marine vessels & offshore structures

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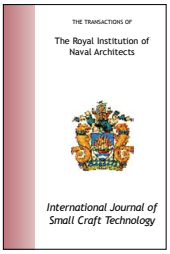
2014



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IJSCT - is published in June & December. The IJSCT provides a forum for the specialist reporting & discussion on technical & scientific issues associated with research & development of recreational & commercial small craft.

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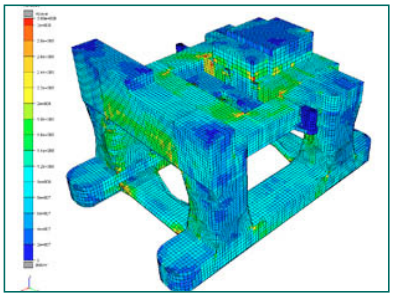
The Royal Institution of Naval Architects

Structural Load & Fatigue on Floating Structures

25-26 February 2015, London, UK



First Notice & Call for Papers

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

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

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

- Advanced numerical modelling methods
- Load analysis and the associated structural analysis
- Rules, guidance and recommended practice
- Assessing environmental data and loading, including ice loading
- Effects of deployment and re-deployment
- Life extension
- Stress load monitoring, inspection & maintenance strategies

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

www.rina.org.uk/Structural_Load_2015

☐ I would like to offer a paper and attach a synopsis of no more than 250 words

Please submit your abstract before 26th October 2014

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