Germanischer Lloyd

nonstop

the magazine for customers and business partners

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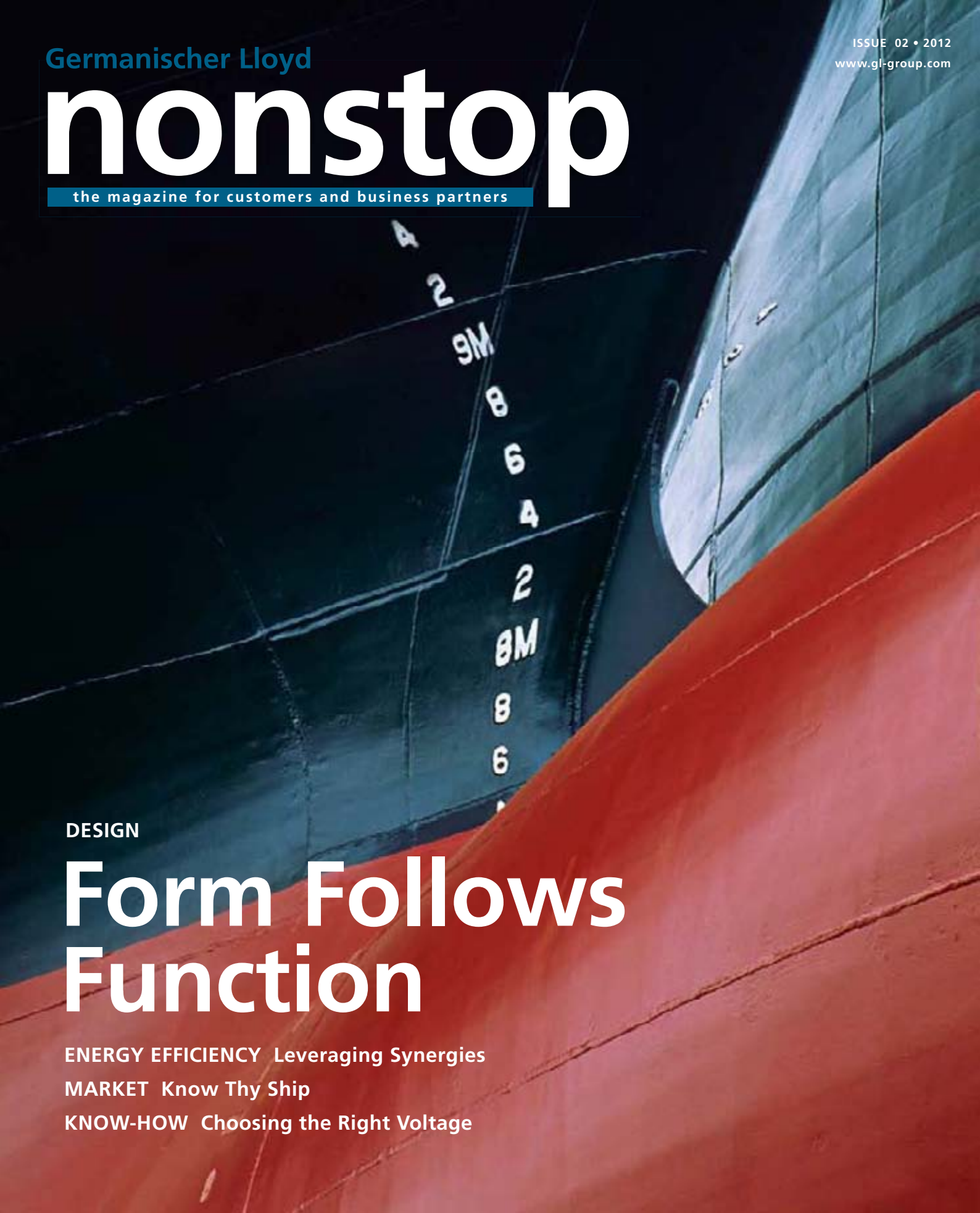

DESIGN

Form Follows Function

ENERGY EFFICIENCY Leveraging Synergies

MARKET Know Thy Ship

KNOW-HOW Choosing the Right Voltage

Germanischer Lloyd

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Source: Swire Blue Ocean A/S

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Dear Readers,

Erik van der Noordaa

RISING FUEL COSTS, STRICTER ENVIRONMENTAL REGULATIONS, overcapacities, global economic risks: the shipping industry is fighting on many fronts. In an interview with *nonstop*, Michael Behrendt gives a frank analysis of both the current position and the perspectives for the container shipping sector (page 28). The CEO of the world's fourth-largest line operator, Hapag-Lloyd, views the future with fundamental optimism. However, the "exorbitantly high bunker price" is shaking the economic foundations of shipping companies. Customers will simply have to accept higher freight rates, says Behrendt.

ONE OF THE MOST IMPORTANT TASKS of a modern classification society is to provide innovative solutions for safety, ecological operation and energy efficiency. In view of the high – and still rising – bunker costs, our experts are systematically continuing their efforts in the field of alternative fuels. A very promising direction is the use of liquefied natural gas (LNG), as shown in a joint study by GL and MAN (page 35).

THE UNTIRING SEARCH FOR BETTER ALTERNATIVES is also a guiding principle of FutureShip. Specialised in ship design and operational efficiency, this GL subsidiary will increase its impact in future – thanks to a strategic alliance with the Icelandic company Marorka. The two energy efficiency specialists are integrating their hardware and software solutions in the areas of fuel consumption, energy management and consultancy (page 14). Here the ECO-Assistant offers a solution that has proved convincing, not least for the shipping company Masterbulk in Singapore (page 20). By now, this GL software is being used on more than 200 ships worldwide. In terms of optimisation, hull design also plays a central role. For the first time ever, an inland waterway tanker was optimised for efficiency using the computational methods of FutureShip: a prominent bulbous bow untypical of inland waterway vessels, 20 per cent less steel – the work of our engineers gives Groningen Shipyard sustainable savings (page 24).

SHIP HULLS ARE SUBJECTED TO CONSIDERABLE LOADS in the course of a service lifetime. GL HullManager allows continuous condition monitoring. The shipping company Ahrenkiel was one of the first to use the software package following its introduction in 2010 – and with great success (page 32). Hull integrity management is just one building block in the process of achieving greater efficiency and safety for ships. Standards are also being set by GL with its classification rules and guidelines – for example, for piping systems (page 46) and the securing of containers (page 50).

SMARTER, SAFER, GREENER – in keeping with our corporate motto, we are pleased to assist you on the path to enhanced efficiency.

Yours sincerely,

ERIK VAN DER NOORDAA
Chairman of the Executive Board, Germanischer Lloyd SE

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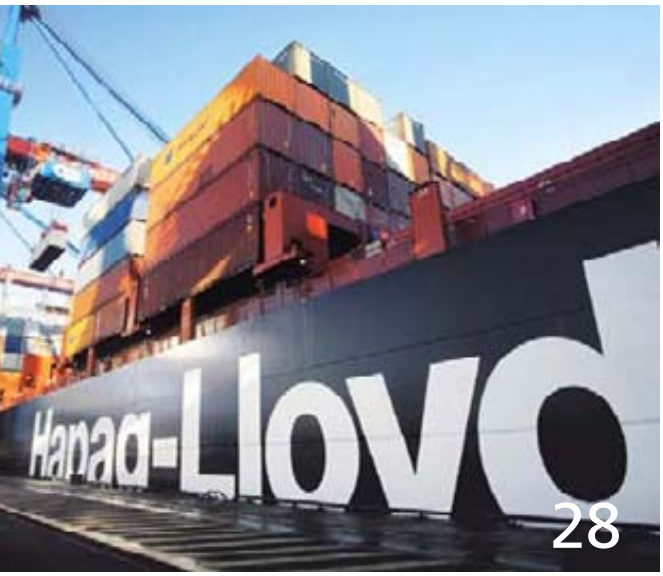

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Photo: Hapag-Lloyd

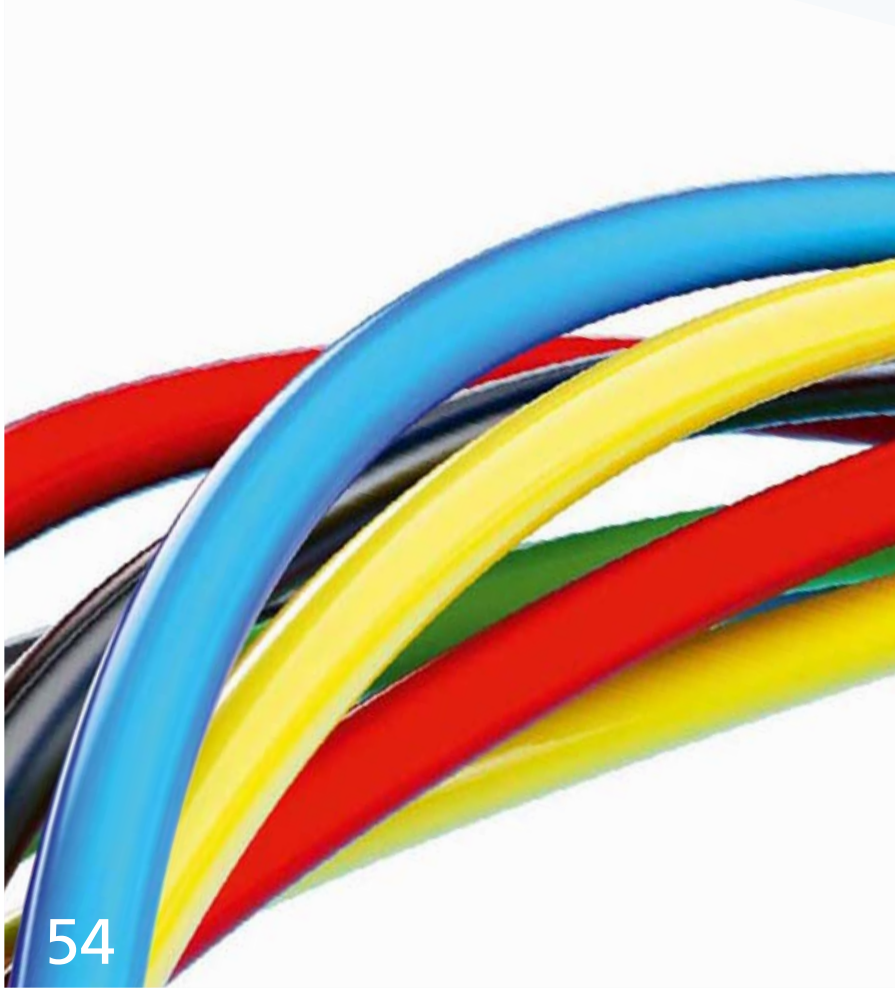

Photo: Dreamstime/3desc

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know-how

gl world

Cover Photo: Eberhard Petzold

Photos: HOCHBAHN, GL Group

Handling the Pressure

Compressed-air locks play an important role in tunnelling, allowing personnel to work in a pressurised excavation chamber. Basic compressed-air locks for personnel are subject to national minimum requirements in some countries. A European standard was introduced several years ago. But with tunnelling technology advancing into greater depths, techniques such as the use of mixed gases, extended decompression times and movable chambers increase the complexity of the technical demands.

The lack of global standards for this advanced technology has prompted Germanischer Lloyd to develop and publish its own set of new rules for the construction and certification of chamber systems for tunnelling. Applicable globally, this body of rules comprises three chapters addressing the certification procedure, manned and unmanned compressed-air locks, and pressure chambers for the treatment of decompression illness.

TUNNELLING. GL engineers monitored the compressed-air equipment used during construction of Hamburg's underground railway line No. 4.

FOR FURTHER INFORMATION:

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news

Photo: Hasenpusch

KISS ME. "AIDAmar" in the dry dock at Blohm + Voss shipyard, Hamburg.

AIDA CRUISES

Cruise Ship Protects Environment

SHE WAS BUILT by Meyer Werft, Germany, and christened on 12 May at the Hamburg Harbour Festival: AIDAmar is one of the most sophisticated and environment-friendly cruise ships ever to take to the seas. She is the 10th vessel in the fleet of AIDA Cruises and was classed by GL.

AIDAmar is the world's first ship to be equipped with the unique heat recovery system, which uses process heat from the ship's machinery to operate the air conditioning and water treatment systems. This enables the vessel to save one metric tonne of fuel per day. "With its unique design and configuration, this system is a world premiere on board a cruise ship," says Kohlmann, Director Technical Operations, AIDA Cruises. "It opens up entirely new perspectives for reclaiming waste heat." In keeping with company tradition, the cruise ship operator's sustainability report was published on occasion of the commissioning of the new ship. Titled "AIDA cares 2012", the report follows the standard of the Global Reporting Initiative (www.aida.de/aidacares).

The Rostock-based company has been progressively lowering its ships' fuel consumption and emissions by installing innovative technology and choosing fuel-saving routes. "The decreasing energy consumption of our ships tells us that we are headed in the right direction in terms of environment and climate protection," says Michael Ungerer, designated President of AIDA Cruises.

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CERTIFICATE. Christian Rist (VF Verpackungen) and Bernhard Grimm (GL).

EMS

Energy Management Pioneer

VF VERPACKUNGEN, based in Sulzberg, Bavaria, is one of the first companies of the packaging industry to have implemented an energy management system pursuant to DIN EN 16001:2009. As the precursor of the new ISO 50001 standard, EN 16001:2009 may be used for existing accreditations until 24 April 2013.

The core purpose of ISO 50001 is to continuously lower energy costs while reducing the operational environmental footprint. GL Systems Certification is among the first international certification bodies to offer audits based on ISO 50001.

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SUPPORT VESSEL

Strong Tugboat from Istanbul

SHEER POWER. The multipurpose tug "TORSTEN" at SANMAR shipyard.

READY FOR OFFSHORE DEVELOPMENT: "TORSTEN" is the name of a new NavTug®FlatTop-type multipurpose tugboat developed by NavConsult AWSS and christened at Istanbul's SANMAR shipyard. NavConsult, a member of the SCHRAMM group, is based in Brunsbüttel, Germany, and offers highly specialised, individualised maritime consulting services.

The NavTug®FlatTop is a versatile, powerful support vessel developed in close cooperation with the German transport industry employers' insurance association, BG Verkehr, and GL. On occasion of the christening ceremony, Erik van der Noordaa, CEO of the GL Group, attested to the high quality of the newbuild: "This tugboat fulfils GL's stringent design requirements. I am delighted that GL was chosen to supervise its construction and classify the new vessel. Cooperation between SCHRAMM, SANMAR and GL has been excellent."

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CHRISTENING. Erik van der Noordaa (GL Group) confirmed the high quality of the tugboat.

WINNER. Young scientist Richard Pawling (r.) and GL's Volker Bertram, organiser of COMPIT.

GL COMPIT AWARD 2012

Innovative Approaches

FOR THE FIFTH TIME a young scientist has been awarded at the prestigious COMPIT conference last April in Liège, Belgium. Richard Pawling has been announced as the winner of the GL COMPIT Award 2012. The British computer-aided design expert's paper, "The Development of Modelling Methods and Interface Tools Supporting a Risk Based Approach to Fire Safety in Ship Design", was honoured for its contribution to the promotion of innovative approaches in conceptual ship design.

The jury singled out Mr Pawling because his paper combined advanced engineering simulations with risk-based design approaches, which are widely advocated by the IMO and classification societies alike, offering the ship designer complete design freedom, as long as a certain safety level is achieved. The jury noted that Mr Pawling's contribution reflects a general trend in the ship design community and commended the paper for its direct relevance to practical applications and its clarity and precision of expression.

news

MLC 2006

"Cape Mayor" Meets the Requirements

COLUMBIA SHIPMANAGEMENT'S (CSM) "Cape Mayor" has received a Maritime Labour Statement of Compliance from GL. The classification society confirmed that the working and living conditions of the 20-strong crew on the containership meet the requirements of the incoming ILO Maritime Labour Convention. CSM is part of Schoeller Holdings and is one of the world's largest ship management companies.

The inspection as regards the "Declaration of Maritime Labour Compliance" (DMLC) was carried out on board the containership in Hamburg. "The inspectors found a ship with good working and living conditions throughout, in full compliance with the requirements of the MLC," reported Olaf Quas, GL's Global Head of Practice ISM/ISPS/MLC 2006.

CERTIFICATE. (f.l.) Andreas Horber (CSM), Gunnar Georgs (IRI), Jens Ahrenkiel and Olaf Quas (both GL).

RAYTHEON ANSCHÜTZ

Premiere for INS Type Approval

SYNAPSIS BRIDGE CONTROL, the new generation of the Raytheon Anschütz bridge system, is the world's first navigation system which has been type-approved according to IMO's new performance standards for Integrated Navigation Systems (INS). In an official ceremony, the nominated body Germanischer Lloyd (GL) handed over the type approval to Raytheon Anschütz at the beginning of May 2012.

SWATH

Latvian Patrol Boats to stay with GL in class

THE LATVIAN NAVY'S NEW SWATH (small waterplane area twin hull) patrol boats will be kept under GL class. GL surveyors will conduct periodic examinations throughout the lifecycle of the vessels to verify that the vessels continue to be fit for purpose, technically reliable and seaworthy. Five vessels are currently planned, with one, the "Skrunda", already delivered. This is the first contract ever awarded for the maintenance in class of military SWATH boats.

"SKRUNDA". The patrol boat is the first of a series of five vessels.

The five SWATH patrol boats are being built at German shipyard Abeking & Rasmussen and at the Latvian Riga Shipyard. The first of these vessels, the "Skrunda", was delivered to the Latvian Navy in April 2011. The Latvian Navy made the decision to maintain the vessels in class due to the advanced nature of the design. Following a tender process, carried out according to EU and Latvian law, GL was awarded the contract. SWATH boats are noted for their exceptional stability and motion comfort, both in high seas and at high speeds. The patrol boats' main duties will be to monitor and control Latvian and EU territorial waters and the exclusive economic zone (EEZ) and carry out search and rescue duties.

Photos: RIC

INNOVATION. Synapsis Bridge Control is Raytheon Anschütz' new generation Integrated Navigation System.

Photos: Raytheon Anschütz GmbH

HANDOVER. Harald Bluhm (GL, l.), Gunar Fiedler (m.) and Bernd Bleichert (both Raytheon Anschütz R&D department).

The INS Performance Standards are specified in the IMO resolution MSC.252(83) and came into effect on 1. January 2011 for all newbuildings where Integrated Navigation Systems are installed. According to the standards, an INS is required to integrate the tasks of collision avoidance, route monitoring, route planning, navigation control data display, status and data display and a centralised human-machine interface for alert management on multifunctional displays.

"IMO's new INS rules are focusing on two subjects: ease of operation and system safety," says Andreas Lentfer, Director of Business Development at Raytheon Anschütz. By requiring additional functions and a higher degree of system integration, the new standards help make navigation safer and bridge operations more efficient and simpler. Standardised hardware and software allow customising bridge systems for any ship's requirements in a standardised but flexible manner.

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CHINA

Successful Welding Cooperation

THE SHANGHAI JIAO TONG UNIVERSITY (SJTU) School of Materials Science and Engineering and the Welding Department of Germanischer Lloyd have been co-operating successfully in research and certification projects for more than eight years.

Major certification projects included a 15 kW CO_2 laser within the CHINLAS project, laser-hybrid welding of hull structural steels as part of GL research for the Chinese shipbuilding industry, and, following a recent extension of the scope of SJTU's certification by Germanischer Lloyd, laser powder clad welding of structural members to improve wear resistance.

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FINAL MEETING. Prof. Dr.-Ing. CME Harald Kohn (International Technology Consulting), Xing Jijun (Chinese Ministry of Science and Technology), Prof. Wu Yixiong (Dean of Shanghai Jiao Tong University), Dr Wolfgang Röhr (German Consul General), Dipl.-Ing. IWE Norbert Worm (GL), Prof. Dr.-Ing. Frank Vollertsen (BIAS Institute Bremen).

news

CERTIFICATE. Kai Fock (GL, far left) and Dr Fabian Kock (GL, far right) presenting the "Preliminary Certificate" to Ahrenkiel's Christian Suhr (centre left) and Wolfgang Kempke.

SEEMP

Energy Efficiency – Ahrenkiel Takes the Lead

"AS SCOTIA", A CONTAINER VESSEL owned by Ahrenkiel, is already in compliance with the requirements of the energy efficiency plan that will not be mandatory until January 2013. The Ship Energy Efficiency Management Plan, a regulation passed by the IMO, is designed to conserve ship fuel and lower CO_2 emissions.

"AS Scotia" is the first GL-classed ship to receive a "Preliminary Energy Efficiency Certificate", which will be converted into an "International Energy Efficiency Certificate" next year. The updated MARPOL Annex VI requires all seagoing vessels in excess of 400 GT to carry on board a Ship Energy Efficiency Management Plan (SEEMP) as of 2013. The Preliminary Energy Efficiency Certificate was issued to Ahrenkiel by the German transport industry employers' insurance association (BG Transport), while the SEEMP "Statement of Compliance" was prepared by Germanischer Lloyd. "Boosting the energy efficiency of our ships is a core element of our climate protection policy. It benefits both the environment and the competitiveness of our fleet," said Christian Suhr, Managing Director, Ahrenkiel Shipmanagement.

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CLASSIFICATION I

Updates Available

GL HAS RELEASED updates to its rules for seagoing ships and naval vessels. The updates came into effect on 1 May 2012. Changes for seagoing ships: classification and surveys, hull structures, machinery linstallations, electrical installations, automation, structural rules for container ships, and stowage and lashing of containers. Changes for naval ships: classification and surveys, propulsion plants, electrical installations, automation and ship operation installations and auxiliary systems.

CLASSIFICATION II

New Rules for Crew Boats

THE FIRST COMPREHENSIVE SET of classification rules for crew boats and offshore wind farm service craft has been released by GL. As the energy industry expands and installations are pushed ever further offshore and into more challenging environments, the vessels servicing these installations must be relied upon to operate in a wider spectrum of conditions and take on more complex challenges.

The rules, which entered into force on 1 May 2012, have been developed by bringing together, for the first time, all of the relevant GL rules and the international codes and recommendations which can be used for the classification of crew boats.

OFFSHORE. Promising business line.

Photo: iStockphoto/Arthur Preston

The rules have been developed in consultation with the flag states and will contribute to the development of international standards for crew boats. The crew boat rules can be found online in Part 6 (Offshore Service Vessels) of the GL Rules and Guidelines 2012. A printed version is also available.

Ruses against Rust

YOU NEVER REALLY GET THE BETTER OF CORROSION. But defence strategies are getting more and more effective. At the eleventh Conference on Corrosion Protection in Hamburg in February 2012, 200 experts discussed new approaches.

Corrosion is a faithful if annoying bedfellow of nearly all technical systems. Wherever metal surfaces are exposed to environmental influences, corrosion is unavoidable. Humid air is the only chemical agent it takes to cause unalloy steels to eventually rust down to powder. Salt water accelerates the process. According to estimates of the German Society for Corrosion Protection (GfKORR), the German economy suffers corrosion-induced damage of three to four per cent of its GDP per annum, or roughly 100 million euros. A good enough reason to engage in a constant dialogue about corrosion protection regulations and methods. GfKORR, Germanischer Lloyd and Schiffbautechnische Gesellschaft (German Society for Maritime Technology) regularly meet to discuss corrosion protection in maritime engineering.

Two of this year's conference presentations addressed the protection of stainless steels. Gerd Eich of the German National Institute of Military Material Sciences (WIWeB) explained that even some grades of "stainless" fail to withstand the corrosive onslaught of sea water in the long term. As a consequence, non-magnetic stainless austenitic steels used in submarine construction must be protected by suitable coatings, which must be selected carefully and applied skilfully if they are to reach their expected design life of 15 to 20 years. Proper surface preparation is essential to avoid contamination of the carrier material. Surface ship hulls commonly feature cathodic corrosion protection below the waterline.

Protection requirements have steadily increased in recent years. Matthias Roehl of coating specialist Ceram Kote International presented the typical customer wish list: extreme shear strength in excess of 30 MPa, high chemical resistance and easy processing with acceptable workability and curing times. Developers experimenting with tempering processes of several hours ultimately identified one method that achieved a significant improvement of shear strength. The formula even passed a punishing test for resistance to a highly aggressive chemical solution consisting of sulphuric acid, methanol and salt water.

"Corrosion protection begins with material processing," said Sascha Buchbach, research scientist at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials, reporting on corrosion tests conducted on 700 samples of machined material edges in ballast water tanks. "Corrosion inside ballast water tanks usually occurs around the edges," he emphasised. According to conventional wisdom, coatings tend to run away from sharp edges during application, causing low dry layer thickness. However, the experiments conducted at the Fraunhofer Institute have shown edge radii to have no major influence on corrosion. Instead, the cause of the phenomenon might be interior stresses in the material. ■ JI

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TEST. Salt water corrodes ship hulls.

Photo: Dreamstime/Nightman1965

There's More in It

Following the announcement of a strategic alliance with FutureShip, *nonstop* was able to speak with Dr Jon Agust Thorsteinsson, Founder and CEO of Marorka. Together, the two companies offer attractive solutions for improving energy efficiency to the shipping industry

FOUNDER. Dr Jon Agust Thorsteinsson, Managing Director of Marorka.

When customers ask about the best way to boost the efficiency of their ships and lower their operating costs, the first answer is: "Data – you need reliable performance data!" Dr Jon Agust Thorsteinsson, founder and Managing Director of Marorka, has repeated this sentence countless times. Meaningful analysis requires systematic data collection from all available sources. "Without a comprehensive, reliable data basis you cannot convince shipowners to invest in efficiency-enhancing technology, however powerful it may be," the Icelandic entrepreneur emphasises. Only the customers' own ship performance data can reveal how efficiently or inefficiently their ships are operated. Anyone who is serious about lowering operating costs substantially and sustainably must scrutinise all on-board equipment that consumes or produces energy, he adds.

"The purpose of our work is to generate data for further analysis," says Thorsteinsson. His company delivers value by helping customers identify areas which are likely to offer savings. "We always begin by collecting operational data from the ship to prepare the ground for achieving sustainable savings. Our services are intended for ship operators who share our holistic approach to ship and fleet operation." This is a philosophy Marorka has in common with FutureShip, who are likewise experts in ship efficiency optimisation. Early this year the two companies teamed up to integrate their product portfolios in the fields of fuel efficiency, energy management and related consulting (see box page 17).

Chilling Technology for Iceland

Having completed his bachelor's degree in mechanical engineering at the University of Aarhus, Thorsteinsson started his professional career at Sabroe, a Danish company ▷

NORDIC ENERGY RESEARCH. *Funding institution for energy research under the Nordic Council of Ministers.*

▷ specialising in freezer technology. After a three-year trainee programme, the company sent Thorsteinsson to his native Iceland to set up a local Sabroe office. Thorsteinsson succeeded in building a strong presence for Sabroe in Iceland. By 1997, roughly 50 local employees were attending to the needs of the Icelandic fishing industry. Sabroe invited Thorsteinsson back to Aarhus where he was asked to develop an innovative, more efficient freezer technology.

While working for Sabroe, he became aware that energy efficiency was a topic with direct application to the technology applied in freezing food. Since energy efficiency had been the focus of his thesis "Modelling of Fishing Vessel Operations for Energy System Optimization", he wanted to continue his research in this field. So he eventually left Sabroe and moved back to Iceland with his family to fully devote himself to his own company, Marorka, which he had established in Reykjavik in summer 2002.

The Idea

"In retrospect, it was rather a wild idea for a company to specialise in ship energy efficiency at the time. A barrel of fuel oil sold at barely 20 US dollars in those years," Thorsteinsson recalls. But he was convinced his ideas were right and his time was yet to come. He anticipated a research and development phase of at least five years, followed by a period of equal length needed do develop and implement a prototype. A third five-year period would enable him to develop and market reliable products and services.

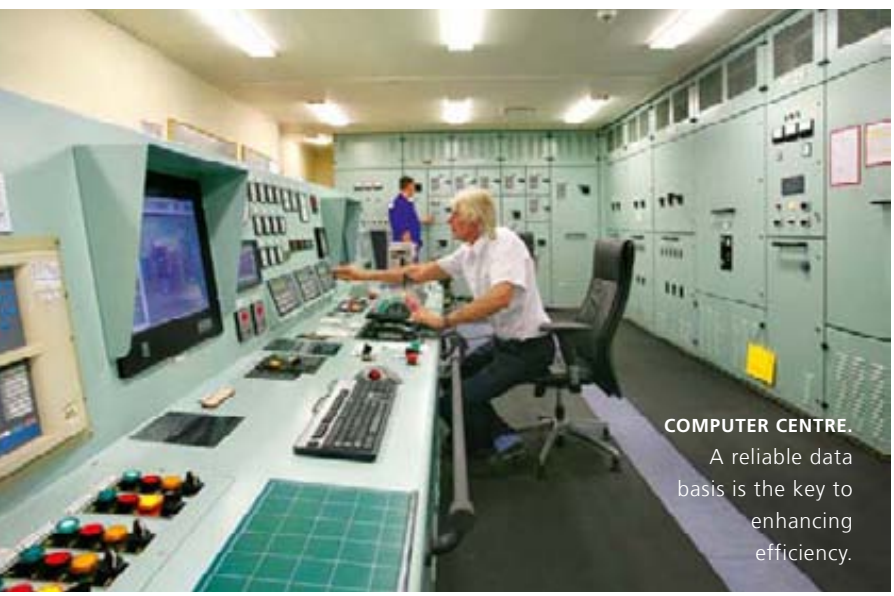
Without a comprehensive, reliable data basis you cannot convince shipowners to invest in efficiency-enhancing technology.

DR JON AGUST THORSTEINSSON
CEO, Marorka

His assumptions proved to be realistic. "Technology applications tend to have a long time-to-market," he says, "and I knew there weren't going to be any quick wins." But he found powerful supporters willing to trust his vision and share his long-term expectations. Nordic Energy Research provided crucial venture capital and played a key role in the establishment and growth of Marorka. "The idea for my company was a direct result of my dissertation. If I hadn't written it, Marorka probably would have never seen the light of day," Thorsteinsson ponders.

His idea of developing a mathematical model capable of representing all the different data sources of a complex technical environment was his starting point. He hired staff to transform his theory into practice, and his algorithms into software that fishery vessels could use to improve their energy management.

The first prototype was completed in 2004 and installed on board a fishing vessel. "The test was a disaster," Thorsteinsson admits with a chuckle. "The available computing power was simply inadequate. The method had never been tested in this type of environment, and the first version of the software had its flaws. The mathematical model was too intricate and complex. Because of insufficient comput-



COMPUTER CENTRE. A reliable data basis is the key to enhancing efficiency.

Photo: Eberhard Petzold

FutureShip Meets Marorka

MEASUREMENTS. FutureShip now offers Marorka's Energy Management Systems.

A new strategic alliance between two leading energy efficiency specialists yields potential to reduce fuel costs and emissions in shipping: FutureShip, a GL company, and Iceland-based Marorka have integrated their product portfolios in the fields of fuel efficiency, energy management and related consulting.

As energy efficiency gains ever more importance in the maritime industry, this cooperation expands the opportunity to better serve the need to monitor ship performance, raise onboard and onshore energy efficiency awareness, and enable shipowners to seamlessly manage the energy performance of entire fleets.

The cooperation with FutureShip will allow Marorka to provide the shipping industry with their long experience and advanced energy management products on a significantly broader scale.

The company, founded in Reykjavik, offers onboard and onshore energy management solutions backed by real-time monitoring and decision support, an essential aspect of operational optimisation.

Trim is one of the main factors for a ship's operating efficiency. FutureShip's **ECO-ASSISTANT**, sold to more than 200 ships to date, delivers the optimum trim angle for a specific ship. The tool regularly achieves efficiency improvements of up to five per cent.

Alongside its own solutions, FutureShip will now offer selected Marorka hardware and software products. The stand-alone **SHIP PERFORMANCE MONITORING SYSTEM** computes fuel efficiency based on fuel consumption, GPS and log speed, propeller power and main engine rpm. It displays performance values and trends on a touch panel computer that collects measurement data, creates real-time performance analyses, and records historical performance data that can be sent to shore for further analysis using **MARORKA ONLINE.**

MARORKA MAREN OPERATING PLATFORM (OP3), an advanced performance monitoring solution, can be connected to all relevant onboard systems for extensive data collection, from propulsion, navigation, machinery and cargo systems to weather and oceanic forecasts. Modular expansions based on and connected to Marorka Maren OP3, such as propulsion performance optimisation, simulation of voyage schedules and costs, monitoring of power, and steam production efficiency are also available.

In addition, FutureShip offers a fuel consumption simulation for the Marorka platform, rendering physical fuel flow meters redundant. ME and AUX fuel consumption can be simulated with even higher precision than traditional fuel meters, thereby avoiding issues of installation, maintenance, and breakdowns.

FOR FURTHER INFORMATION:
www.futureship.net

ing power we had to take out entire functional blocks, which ultimately undermined the data basis."

Staying Power

Thorsteinsson learned some important lessons from these initial experiments. He knew he had to continue his quest for better ways of compiling and processing data and for a more robust mathematical model. His second prototype was significantly better but still had its weaknesses. Users were unhappy about the complexity, volume and cost of Marorka's system.

The third generation of his system was able to draw on customer feedback. Furthermore, Thorsteinsson and his team had come up with a new product concept. The solution was subdivided into two components, a platform for capturing the required system data, and a business application layer for analysing the data to reveal potential areas of improvement and to continuously calculate an operational on ▷

INSIGHT. Real-time data delivers valuable decision support.

the basis of a mathematical model and compare it to actual operational parameters. The separate data collection platform now formed the basis for all other applications. With this concept Marorka was able to win over increasing numbers of customers. Installing the platform itself did not require a major capital expenditure, so customers did not feel trapped in a massive financial commitment; there was no need to purchase the entire software package all at once. Rather, every customer was able to choose the most promising areas for improving energy efficiency. Reliable ship operation data now provided them with a solid basis for decision making. This innovation was the right approach at the right time. Commercial acceptance coincided with skyrocketing oil prices – the market environment was right for solutions enhancing energy efficiency, with shipowners desperately searching for ways to keep their fuel bills under control.

Unique Concept

In 2008, Dr Jon Agust Thorsteinsson was awarded the Nature and Environment Prize by Nordic Energy Research. He was personally commended for his exemplary achievement of having developed an academic dissertation into a successful enterprise, demonstrating the importance of investment in research and innovation. The jury commented: "Marorka has been awarded the prize for having developed IT tools which will significantly reduce energy consumption and emissions in shipping. Marorka has managed to combine research and product development in an exemplary way which will have a positive influence on climate in a long-term perspective."

No competitor capable of producing a remotely comparable solution has appeared on the scene to date. No one has had the endurance to develop a holistic energy management model to match Thorsteinsson's, and no software product on the market could compete with Marorka's platform concept.

His customers include shipowners in Scandinavia, Greece and Singapore, as well as ship designers, universities, research institutions and machinery manufacturers in Europe and the USA. Marorka systems operate onboard a wide diversity of vessels, from fishery ships to general cargo vessels, and from cruise ships to research vessels.

Today, Marorka sells onboard and onshore fuel and energy management solutions equipped with real-time monitoring systems and decision support software. Marorka's energy management solutions for voyage tracking, inventory recording, reporting and data analysis maximise efficiency, conserve fuel, increase profitability and reduce emissions.

Thorsteinsson is guided by a long-term strategy. He envisions a global shipping industry where every new ship is equipped with an energy efficiency management system based on performance monitoring. Meanwhile, the entrepreneur has found strong supporters. Olafur Ragnar Grimsson, the President of Iceland, awakened the interest of Chinese Prime Minister Wen Jiabao in Marorka's innovative products at the recent World Future Energy Summit in Abu Dhabi.

The cooperation with GL subsidiary FutureShip harbours enormous potential by enabling both companies to build an integrated solution portfolio for fuel efficiency, energy management and related consulting services. This provides mutual customers with powerful tools to monitor ship performance in real-time, raise onboard and onshore energy efficiency awareness, and make well-informed operational decisions when managing the energy performance of entire fleets. FutureShip and Marorka jointly promote and deliver a promising holistic approach to energy management. ■ **OM**

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Photo: Dreamstime

GL Academy – Dates at a Glance

Selected seminars in 2012 – information and registration: www.gl-academy.com

JUNE

11. – 15.06.2012
Superintendent Training Course
Limassol, Cyprus

12. – 14.06.2012
Company/Ship Security Officer (CSO/SSO) Training Course
Piraeus, Greece

13.06.2012
STCW 2010 Implementation Workshop
Copenhagen, Denmark

14.06.2012
Damages to Machinery and Repairs
Hamburg, Germany

14.06.2012
ILO Maritime Labour Convention for Crewing Agencies
Genoa, Italy

15.06.2012
ILO Maritime Labour Convention Approval of Crewing Agencies
Genoa, Italy

18. – 22.06.2012
Quality Management Systems Auditor/Lead Auditor Training Course
Makati City, Philippines

19. – 20.06.2012
Designated Person Ashore (DPA) Training Course
Piraeus, Greece

19.06.2012
Fuel Saving
Gdańsk, Poland

20.06.2012
Surveys and Certificates
Limassol, Cyprus

20. – 21.06.2012
Application and Implementation of an SEEMP
Hamburg, Germany

20. – 21.06.2012
Auditor Interno ISM-ISPS para Empresas Navieras
Lima, Peru

20. – 22.06.2012
Energy Manager ISO 50001
Istanbul, Turkey

20. – 22.06.2012
Internal Auditor – Auditor Interno do Sistema de Gestão Integrado ISO 9001, 14001 and 18001
São Paulo, Brazil

21. – 22.06.2012
Vetting Inspections
Tokyo, Japan

21. – 22.06.2012
Application and Implementation of an SEEMP
Tokyo, Japan

21.06.2012
Emergency Preparedness and Crisis Management
Piraeus, Greece

25. – 26.06.2012
Application and Implementation of an SEEMP
Makati City, Philippines

26. – 27.06.2012
Implementation of an Environmental Management System according to ISO 14001 for Shipping Companies
Piraeus, Greece

26.06.2012
Flag State Regulations
Madrid, Spain

26.06.2012
Latest Amendments to Maritime Regulations
Istanbul, Turkey

26.06.2012
Company/Ship Security Officer (CSO/SSO) Refresher Course
Limassol, Cyprus

27.06.2012
The SOLAS Convention
Genoa, Italy

27.06.2012
Vessel General Permit
Madrid, Spain

27.06.2012
International Maritime Arbitration
Hamburg, Germany

28. – 29.06.2012
Application and Implementation of an SEEMP
Istanbul, Turkey

28. – 29.06.2012
TMSA Workshop – Risk Assessment, Change Management, Incident Investigation
Piraeus, Greece

JULY

01. – 02.07.2012
The IMDG Code – General Awareness Training
Dubai, United Arab Emirates

03. – 04.07.2012
Implementation Workshop ILO Maritime Labour Convention
Copenhagen, Denmark

04. – 06.07.2012
Internal Auditor of an Integrated Management System according to ISO 9001, ISO 14001 and BS OHSAS 18001
Singapore

Photo: faberbuc

"POSIDANA". The trimmimg of the open-hatch bulker was optimised by GL's ECO-Assistant.

Payback Guaranteed

Careful trimming is a great way to conserve energy and improve the efficiency of a ship. Masterbulk's CEO Rune Steen found FutureShip's ECO-Assistant to be the perfect solution for this purpose

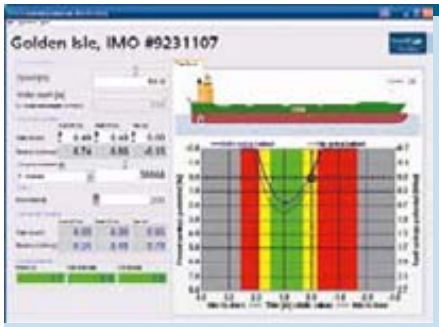
No matter how the test trial on trim optimisation ended, Masterbulk was in a "no-risk" situation. There was no risk for FutureShip either, since its ECO-Assistant trim optimising software had already proved its ability to deliver savings. This win-win situation was echoed by the Maritime Singapore Green Initiative that promotes clean and green shipping. All ingredients for a successful programme were at hand. "To us, ECO-Assistant was an easy decision," confirms Masterbulk CEO Rune Steen. "It was attractively priced, even subsidised, easy to install, easy to use and low-risk."

FutureShip offered a full refund of Masterbulk's advance payment if the expected fuel savings failed to materialise. In line with the Singapore's Maritime and Port Authority's "Green Pledge", which seeks to promote clean and green shipping in Singapore while reducing the environmental impact of shipping and related activities, it was agreed that an effectiveness assessment would be conducted by an independent surveyor after 180 days of using ECO-Assistant.

Masterbulk Private Limited was established in Singapore in July 1995 as a major spin off of Westfal-Larsen & CO. A/S in Bergen, Norway. The fleet of 23 open-hatch bulk carriers operates in the dry-bulk, multipurpose and unitised cargo sector worldwide. The design features of the openhatch ships, such as removable tween decks, gantry cranes, rain protection over unobstructed holds allow for fast and ▶

Rune Steen

The naval architect has been CEO of Masterbulk since February 2010. Mr Steen has an extensive technical and management background from his work in the Norwegian and international shipping and offshore industry. Before his current assignment, he was Chief Executive of Oslo-listed Standard Drilling. He also held various positions at Beiden Shipping and Kristian Gerhard Jebsen Skipsrederi AS (KGJS). Mr Steen now lives in Singapore.



ECO-Assistant is an advanced trim optimisation software tool based on a comprehensive database of ship-specific resistance data for a variety of different operating conditions. This information, compiled by performing a thorough analysis of the hull and a digital model of its shape, must be entered only once.

ECO-Assistant is a stand-alone programme requiring no interfaces with the vessel's systems. It can be installed on any computer. The only input it needs during a voyage is the current speed, displacement and water depth, which can be entered manually. An optional acceleration sensor may be installed to provide dynamic trim feedback data.

ECO-Assistant offers an efficient, accurate means of instructing a vessel's crew as to how to adjust the trim of their ship based on the given operating conditions. ECO-Assistant thereby achieves instant fuel savings without vessel design modifications.

OHGC. *Open Hatch General Cargo is a vessel type typically fitted with two gantry cranes for self-loading and unloading.*

▷ safe handling of project cargo, pipes, wind turbine parts, metals, newsprint, containers and dry bulk. Masterbulk's primary routes run between Brazil and Europe as well as Asia.

Masterbulk operates a fleet of fairly young multipurpose vessels averaging 13 years. The company frequently carries pulp, paper, forest products, pipes and steel. "We specialise in this trade segment because there is stable demand for safe and reliable transportation," explains CEO Rune Steen. "The ships are more expensive than ordinary vessels due to the shape of the cargo hold and the on-board gantry cranes. These cranes offer a number of advantages, such as a high driver position, which greatly improves the loading procedure since the driver can actually see with his own eyes what he is doing." The company completed its newbuild programme in 2010. Its most recent acquisitions, a series of eight ships, were build by Oshima Shipbuilding, a shipyard in Japan specialising in open-hatch bulk carriers. They are specifically designed for fuel efficiency.

Comfortable Position

Independent market analysts predict double-digit trade growth in the project cargo segment over the next few years, fuelled by the emerging economies. At the same time, however, bulk transport will experience fierce competition from numerous handy bulkers due to be delivered in the short term. In conjunction with the ever increasing containerisation of goods, trade growth could slow down noticeably in the medium term after having reached reasonable growth rates of five to ten per cent in the next few years.

But Rune Steen remains optimistic. True, the overall market conditions are challenging, in part due to slowing economic growth in China. "We are operating in a niche market," Steen explains. "Our business model is to build up and maintain solid relations with our clients. Most of our contracts are long-term." Masterbulk is in a comfortable position in this respect but faces the same operational challenges as all shipowners: rising fuel prices.

"Fuel is the biggest cost we have," says Steen. "While we normally have an escalation clause in our Contract of Affreightments, we normally are keen to realise any savings regarding our fuel bill. Considering the number of external factors such as weather, wave height or wind, it is not always possible to verify the amount of savings achieved with a given solution. There is no single solution for energy efficiency. Many captains take a conservative approach to speed and passage management. They prefer to ensure their arrival time by speeding up at the beginning and slowing down or even waiting towards the end of a trip. This is expensive and burns more fuel than necessary. At Masterbulk, we decided to introduce systematic trim management. We considered ECO-Assistant an easy decision."

Fuel efficiency can be increased by ensuring sufficient immersion of the rudder and propeller. Optimising trim at maximum speed with a given mean draft and engine power can reduce fuel consumption by 0.1 to 1 per cent. A ship's dynamic trim should be adjusted at sea based on sea-going conditions, using speed tracking to obtain the best speed at the particular engine power output. "We were prepared to spend money

Photo: Dreamstime/Slovegrove

Greener Shipping

Singapore is developing into a green maritime cluster, promoting sustainable shipping and a clean maritime environment. With its Maritime Singapore Green Initiative, the Maritime and Port Authority of Singapore (MPA) encourages Singapore-flagged ships to adopt energy-efficient ship designs that reduce fuel consumption and carbon dioxide emissions. Ships exceeding the requirements of IMO's Energy Efficiency Design Index will enjoy a 50 per cent reduction of the initial registration fees and a 20 per cent rebate on annual tonnage tax.

to improve efficiency and to purchase the ECO-Assistant trim optimisation solution. FutureShip made us aware of the opportunity to get a 50 per cent discount from the Green Technology Programme of the Maritime Port Authority (MPA) of Singapore. FutureShip even helped us apply for the subsidy."

Convenient Handling

Masterbulk knew that even the best software would not produce the desired results without a change in onboard culture. The crews needed to be made aware of, and accept the need to improve energy efficiency. "We have one-nationality crews with a high retention rate," reports Rune Steen. "Our Philippine crews are well treated, well paid and well trained. It is in the interest of the company to maintain good working conditions on board. We involve our crews in the operation of our ships and conduct officer conferences on a regular basis to share experience. Our crews are very motivated to use ECO-Assistant. We have offered incentives, and now it is actually fun for them to monitor the ideal trim. The operation of the software is convenient. The crew enters the operational parameters of speed, displacement and water depth. ECO-Assistant then calculates the optimum dynamic trim for the specific operating condition. The software also computes the static trim for the scheduled voyage, which is adjusted by the crew while loading the vessel."

The effectiveness of the software and the savings achieved were certified by an independent third party as required by the MPA. The audit confirmed Masterbulk's observations: "We were impressed by the short payback time," says Steen. "During a twenty-day voyage from Hamburg to Brazil we saved roughly three per cent on fuel, or 10,000 US dollars. That is a windfall profit of 500 US dollars a day." ■ **OM**

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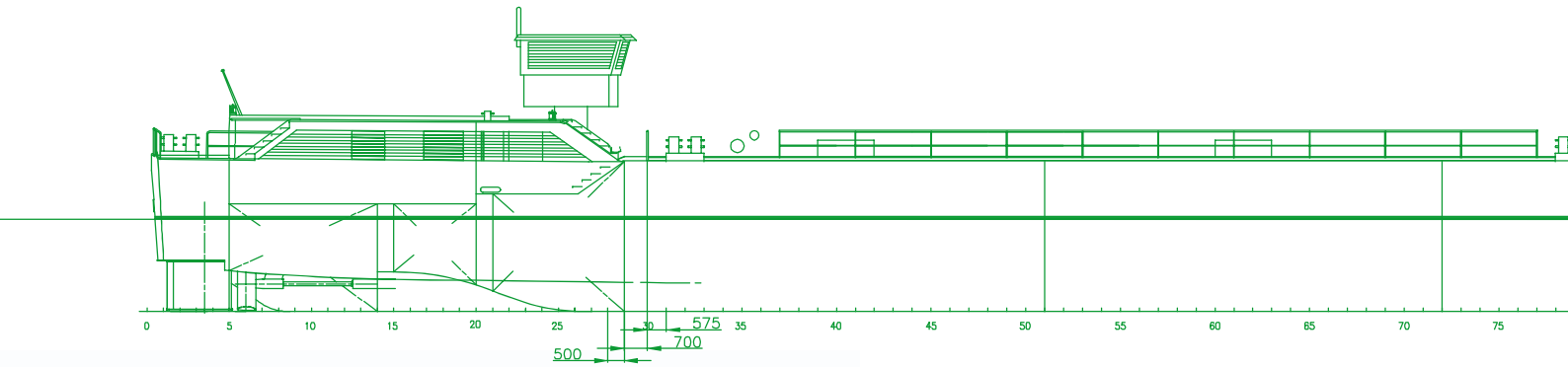
Green Ships from Groningen

GS of the Netherlands is making waves with energy-efficient ships for inland waterways. Also on board: the GL subsidiary FutureShip



AFTERBODY. Wave pattern – Postmodel02.3

It is the latest and most ecological inland vessel concept of Groningen Shipyard (GS) in the Netherlands: Sunrise – this project name stands for the first inland waterway tanker to be optimised by the computational methods of FutureShip. "The market is asking for green ships," says CEO Daniel Gausch. "We wanted to cut the fuel consumption without changing the stowage capacity – because that is what generates the cash for the captain.

The result is impressive: after undergoing sweeping modifications, the hull design offers a 20 per cent reduction in steel weight. Instead of a large main engine, two small units propel the vessel at the same speed of 20 km/h. The ship is designed for shallow water, because "this is where the money is earned," says Gausch. The biggest change is to be seen on the slipway: the bulbous bow – something a "normal" inland tanker has to do without.

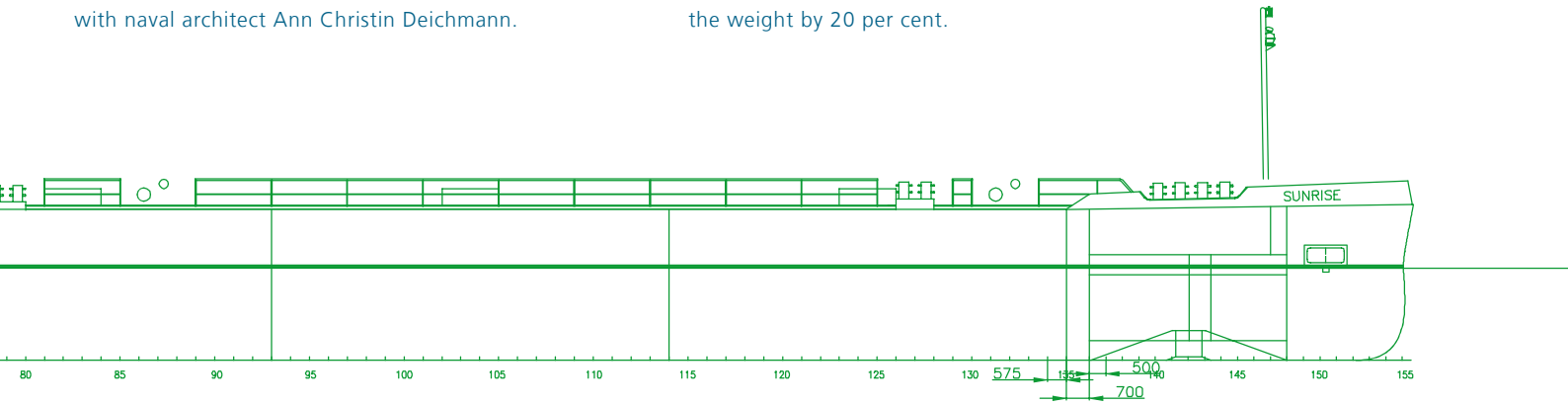
Hard Requirements, High Energy Efficiency

The new design will be able to take on significantly more cargo while remaining in the same draught range. It was optimised for the demanding specifications set by the yard: open water with a draught of 3.20 m and a speed of 20 km/h, and canal transit with 2.80 m at 13 km/h. Here the main focus lay on the hydrodynamic and hydrostatic performance. The flow around the ship's hull was simulated in a computer model, with the aim of reducing the wave-induced drag and decreasing the engine power needed as a result.

"Our initial assessments showed optimisation of the design could save five per cent in fuel," says Dr Karsten Hochkirch of FutureShip. The consulting firm belongs to Germanischer Lloyd (GL) and offers the services of design

TEAM. CEOs Christian Hochbein (l.) and Daniel Gausch with naval architect Ann Christin Deichmann.

STEELWORK. The enhanced hull design reduces the weight by 20 per cent.



optimisation and energy-efficiency improvement for both newbuilds and ships already in service. Depending on the particular vessel, consumption can be typically reduced by four to five per cent, and more than ten per cent may even be possible with newbuilds.

Optimised Hull, Financial Benefits

Apart from the massive reduction in emissions of carbon dioxide, sulphur oxide and nitrogen oxide, substantial financial benefits are obtained over a service lifetime of 25 years or more. "In the first year of operation, the Sunrise concept already leads to savings of 17,000 euros," says Hochkirch. Reason enough for Groningen Shipyard to decide in favour of optimising the design.

For this process, the hull is described by a parametric model: the complex shape can be defined with sufficient accuracy using about 75 parameters. An optimisation algorithm then controls the selection of the various parameters and works through the many thousands of possible hull shapes, where the potential of each variant is determined by the laborious flow simulation. From this large pool of candidates, the two most promising designs are picked out and examined in detail. After completion of the assessments, the fuel savings in relation to the original design amounted to approximately nine per cent. Until now, the design optimisations of FutureShip had been performed exclusively on seagoing ships. Now, with "Sunrise", FutureShip has shown that even the proven designs of inland waterway vessels can be made more efficient by FutureShip's methods.

The young shipyard in Groningen is certainly not short of good ideas. Shipowner and ship broker Daniel Gausch had ordered two ships from what was then the Maas Shipyard. ▷

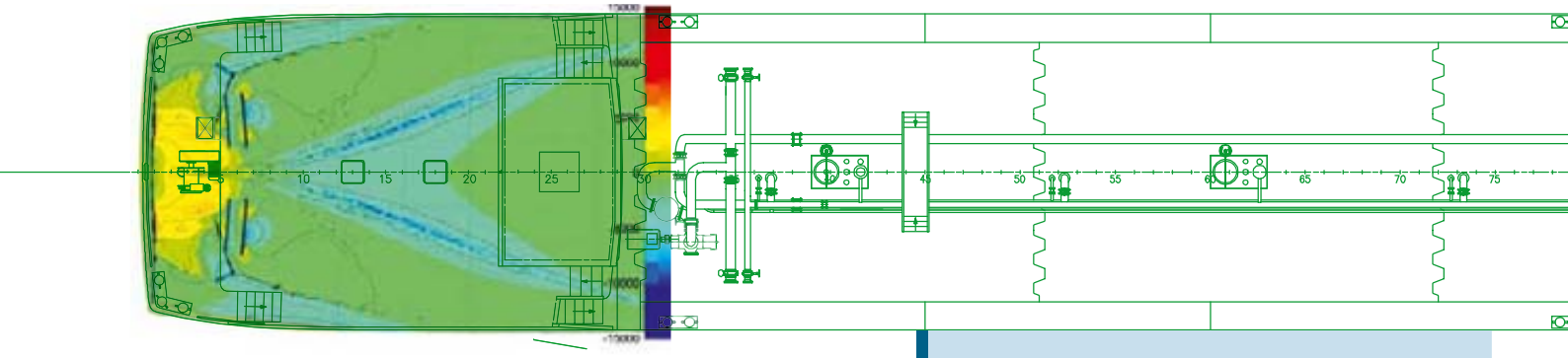
BOW. Wave pattern – Postmodel02.3

GRONINGEN SHIPYARD. *Established in 2007, four locations in Groningen (NL); www.groningen-shipyard.nl*

▷ When the company, located near the North Sea port of Delfzijl, found itself in troubled financial waters, he and Christian Hochbein took over the yard in 2007. In its first year of business, the newly established firm in Waterhuizen near Groningen delivered five ships; today, the output has grown to become twelve to 14 units a year. The repertoire of the yard also includes seagoing ships, split barges, gas tankers and yachts. The foundation of its success is the continuous optimisation of the production methods, a holistic concept, and innovative ship design.

"We have greatly expanded our steel construction capacity and hired a lot of qualified personnel," says CEO Gausch. Currently some 250 employees are working in four shipyard areas, subcontractors included. The production of several ships can therefore be controlled concurrently over the various yard facilities. As Daniel Gausch puts it: "From keel-laying to delivery, the average building time is 21 weeks."

CROSS SECTION. Steel cutting and the forming of the sheets and profiles all take place on the firm's own premises.



More than Just a Yard

Groningen Shipyard offers more than newbuilding, repair and technical supervision – even beyond the warranty period. The service portfolio also include affreightment and accounting and, if required, GS will also arrange the financing for its shipowners and owner-operators. About 75 per cent of the customers accept the offer of financing assistance, Gausch reveals. "For the owner-operators, we offer the 'All-Round Carefree Package' and even take old ships as trade-ins." This option is a great benefit for clients: the ships are to some extent converted with a double hull – without losing too much cargo capacity – and then sold again.

From the very beginning, the managing directors Gausch and Hochbein with production manager Günter Schmidt focused on a reassessment of the shipbuilding process. As a

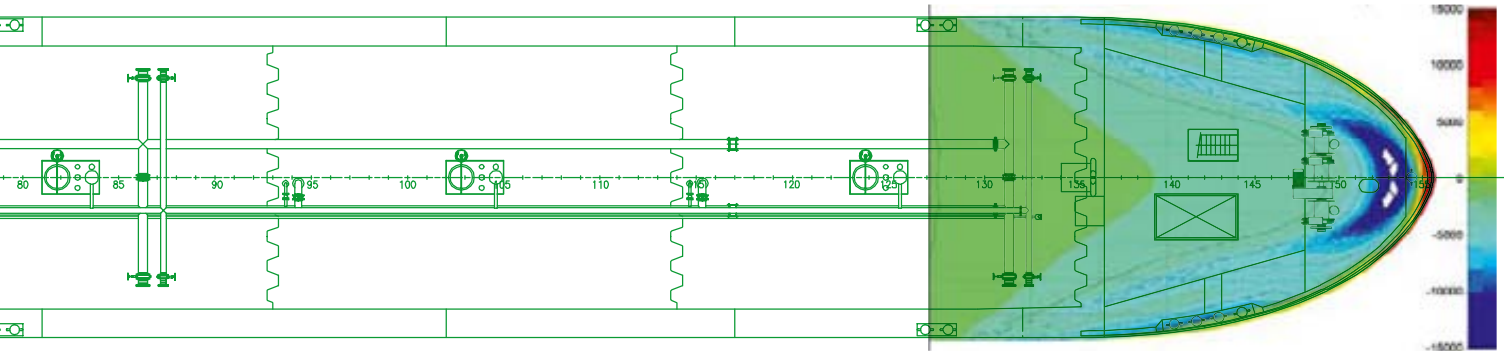
"Georg Burmester"

Type: Inland waterway tanker
Length: 86 m
Beam: 9.80 m
Draught: 2.80 to 3.20 m
Speed (fully loaded): 20 km/h
Engine: 2x Volvo D16 MH
Power: at 400 kW 1,800 rpm each
Tonnage: approx. 2,080 t
Optimisation: Fuel savings of 9% on the original design
Design: Ingenieur Technik KWL, Erlenbach (D)

TUNNEL. Bow thrusters improve the vessels' manoeuvrability.

duction system, also compete on price against Eastern European and Chinese yards. It is not necessary to order finished, floatable hulls – so-called cascos – from Asia. Another welcome side effect for GS: very short production cycles.

In mechanical engineering too, which according to Günter Schmidt mainly comprises pipework, price stability and punctual delivery of the material are important for the yard. "To build a ship at as low a cost as possible, many components must already be considered in the steel construction phase for the later technical outfitting," Schmidt points out. He also places great emphasis on controlling the workflow himself. In the course of the past year, the yard included preservation in its service portfolio and integrated it into the



result, Groningen Shipyard is one of the few to carry out the entire material preparation itself. Steel cutting and the forming of the sheets and profiles all take place on the firm's own premises. This is a cost-intensive process, because machines and also the working space are needed, but there are clear advantages: "In this way, we ensure that the required material is available in the corresponding quality exactly when it is needed. We build 'just in time' ships!" says Schmidt.

Today, the innovative shipbuilder processes 16,000 tonnes of steel a year and can, thanks to this efficient pro-

shipbuilding production processes. Set-up times are reduced to an appreciable degree. "We do all the paintwork ourselves, both on the outer shell and in the tanks," Schmidt is proud to say. This is not really common in shipbuilding, because the "Performance Standard for Protective Coatings (PSPC)" of the IMO sets stringent requirements for the coating of ballast water tanks. Although the PSPC applies to seagoing ships, "we are already 100 per cent compliant with the IMO regulations," reports the production manager.

The first ship from Groningen optimised with the support of "Sunrise" was launched on 3 May 2012 and will be officially delivered in June as the "Georg Burmester". Orders for three sister ships have already been received by Groningen Shipyard. The optimised inland ship seems to be making waves. ■ **SNB**

FOR FURTHER INFORMATION:

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Higher Freight Rates Are the Only Option

Hapag-Lloyd CEO Michael Behrendt on the trailblazing role of the Hamburg shipping company in improving energy efficiency, on the economic perspectives for shipping, and on the battle against piracy

Vita

Michael Behrendt has been Chairman of the Executive Board of Hapag-Lloyd AG since 2002.

Born in Hamburg, he studied law and started his career in 1985 at VTG. In 1994, he was appointed Managing Director and in 1999, Chairman of the Executive Board of VTG-Lehnkering AG. Michael Behrendt has also been President of the German Shipowners' Association (VDR) since 2008.

NONSTOP: Mr Behrendt, the topic of environmental protection is playing an increasingly important role in shipping. How is Hapag-Lloyd positioning itself here?

MICHAEL BEHRENDT: For Hapag-Lloyd, environmental protection has always been an important factor. We took a large number of voluntary steps before they became compulsory for the entire industry. A recent example is the issuing of EEDI certificates. As the first shipping company worldwide, we had our own fleet certified last February in accordance with the IMO's new EEDI. We were the trailblazers for "slow steaming" and therefore also with derating of the main engines. And we have concrete plans to reduce the CO_2, sulphur dioxide and nitrogen oxide emissions of our ships to a considerable extent. If you want to sell yourself as a modern and innovative company, you simply have to go this route. Whatever we save also goes towards improving the ecological footprints of our customers.

NONSTOP: Didn't the introduction of "slow steaming" represent a risk for you?

BEHRENDT: It certainly may be rather confusing for a customer when a shipping company advocates "slow steaming", while others are offering so-called express services and have their ships cruise at 26 knots. But, considering the economical aspect, this turned out to be the right decision – for our customers also. The alternative would have been to levy a bunker surcharge for high speed. But nobody wants that either – and so the customers have accepted this solution. Besides, the service does not become any worse through "slow steaming": you have to organise the schedule differently, but in exchange you have at least one more ship in the loop.

Photos: Hapag-Lloyd

NONSTOP: What is the significance of energy-efficient ship designs for freight rates and customer loyalty?

BEHRENDT: The customer is not really interested in the design. First and foremost, he wants to have his goods transported from A to B in the most cost-effective way. That said, he may be willing to pay a slight premium for a more environmentally-friendly and sustainable product.

NONSTOP: Liquefied natural gas (LNG) is being touted as the ecological ship fuel of the future. Has Hapag-Lloyd already addressed this alternative concept?

BEHRENDT: At the present time, LNG is not yet an option for us. In fact, the entire market still regards it as a "pie-in-the-sky" innovation. Using LNG now would hamper us greatly, because there is a lack of the necessary infrastructure, for example. We must remember that a ship is actually the most flexible transport medium. It must be able to call at any port in the world – with the maximum draught being the only limit. Someday when the prerequisites are in place worldwide for the deployment of LNG, this approach could be of real value.

NONSTOP: Talking of the future, what topics will shape the world of shipping for the next ten years?

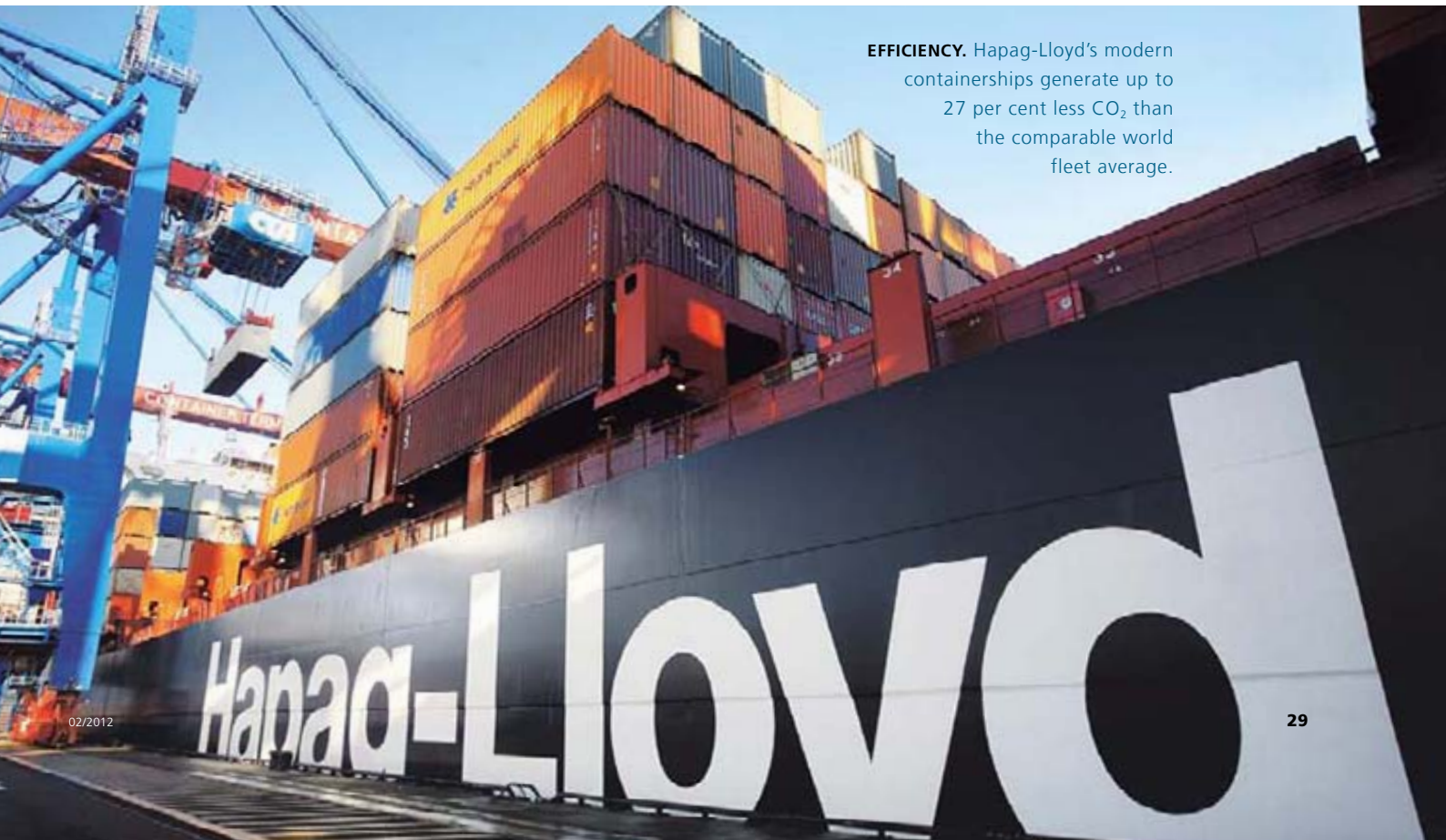
BEHRENDT: It is certain that tighter environmental regulations and new technical standards will be among the main factors exerting a major influence on shipping in the coming decade. As with all measures that may be taken, however, it is always important that they are enforced about an international scale, as may be seen from the discussion on shore electrical power supply. We are already fitting out our ships for this, but the European requirements must not lead to a competitive disadvantage for Europe itself.

Another main topic is the financing of ship newbuilding. I believe that the fleet growth and the number of newbuilds will decrease considerably in the long run. The world merchant fleet should only grow to meet the demand from the shipping lines. The ship tonnage that is really needed will come onto the market – but not any more than that.

NONSTOP: Are you concerned about the development of the global economy?

BEHRENDT: No, I am worried neither about global growth ▷

EEDI.
The Energy Efficiency Design Index will become mandatory for all newbuilds beginning, 2013. The Index is a measure of the CO_2 emitted by a ship in comparison to the existing world fleet.



EFFICIENCY. Hapag-Lloyd's modern containerships generate up to 27 per cent less CO_2 than the comparable world fleet average.

"COLOMBO EXPRESS". 150 ships sail under Hamburg's container-shipping company Hapag-Lloyd.

Hapag-Lloyd

In 2011, Hapag-Lloyd transported almost 5.2 million TEU and achieved a turnover of some 6.1 billion euros.

The total fleet (including charters) includes about 150 ships with a total capacity of almost 680,000 TEU. At present, this makes Hapag-Lloyd the world's fourth-largest line operator. The company is represented at 300 locations in 114 countries and has 6,900 employees.

▷ over the next ten years nor about world trade. We most probably will no longer see the double-digit growth rates we experienced during the first years of this century, but even conservative projections are pegged at six to seven per cent. What other transport sector can expect such growth?

NONSTOP: What is on the horizon for the maritime industry over the short to medium term?

BEHRENDT: The greatest burden at present is the exorbitantly high bunker price, which has risen substantially in the last three years – with the peak representing almost a four-fold increase in price. By now, Hapag-Lloyd has to foot a bunker bill of 2.5 to 3 billion euros per year. The additional costs, made up of almost 450 million euros in 2011, will have to be borne by the customers of shipping lines in future. For this reason, there will be an increase in the freight rates, to ensure that shipping companies can operate economically.

SLOW STEAMING. *Decreasing the speed of a container carrier from 26 to 18 knots reduces its bunker consumption by 40 per cent.*

NONSTOP: Do you think that the economic developments will change the structure of the maritime sector to any large degree?

BEHRENDT: There has been talk of consolidation for 30 years now. However, if you look at the specific cases of take-over and consolidation over the past 15 years, most did not happen because of a financial emergency. Either the parent company wanted to sell, or the partners did not fit together and a third stepped in to do the deal. There generally was no real economic reason as the basic motivation. In any case, consolidations are a difficult matter when you consider the ownership structure of our industry. To a large extent, the market players are private owners or the companies have strong majority shareholders, who then are always individual investors. For this reason, I am very sceptical about the likelihood of sweeping consolidation.

NONSTOP: But there has been an increased occurrence of cooperations and alliances in shipping recently. Does this not raise the question of how large a line operator needs to be today in order to survive in the global competition?

BEHRENDT: First of all, cooperations are not consolidations as such. In fact, cooperations are traditional in the shipping sector – in the final analysis, everyone cooperates with everyone else in various areas. This can begin at the lowest level, for example the swapping or offering of slots. With regard to Hapag-Lloyd, I would welcome a genuine business merger. Of course, this will only work if both partners are completely satisfied with the new arrangement. On the other hand, there can be only one boss after such a merger. That cannot always be implemented easily and smoothly, but it is the only efficient way. When a merger fails, the consolidation fails too. There must always be a partner who is willing to buy everything, or play second fiddle.

NONSTOP: What steps are you taking for Hapag-Lloyd to ensure that the company remains competitive in this tough market?

BEHRENDT: We will grow with the market. We have the best

IT in the entire industry and have already conducted a major cost-cutting programme. Our procedures are efficient, and our standing with customers is excellent. The prerequisites for economic success are all in place, because we have implemented all possible efficiencies. Nevertheless, this also means that we do not have any more elbowroom left over with regard to bunker costs. After the three- or fourfold increase in prices, the only option remaining open to us is to increase the freight rates.

NONSTOP: What contribution can a classification society make?
BEHRENDT: Hapag-Lloyd finds itself in a strongly competitive environment. However, we have been working together with GL so effectively for so long that we have few reasons for criticism. We do expect a classification society, as our partner, to point out innovative directions in the development of the ships – especially in ecological matters. The ships must be state of the art. Apart from that, we expect support in every phase of the ship's lifecycle – which we hope will be a long one. We want a partnership from the drawing board right up to sale or scrapping of the ship. This "all-inclusive" service is very important and we need a personal point of contact to coordinate it, in order to keep the organisational effort as low as possible, even with complex issues.

NONSTOP: What are currently the greatest challenges for the German Shipowners' Association (VDR)?
BEHRENDT: The key task is securing the future of Germany as a local point for shipping. In a tour de force with the alliance partners, the VDR has managed to extend the Maritime Alliance for the tonnage tax. Beginning in 2013 at the latest, the shipowners will furnish an additional solidarity contribution totalling 30 million euros to fund the training of German seafarers. The decision was taken unanimously, because the shipowners all agree that the country's attractiveness must be strengthened. The Maritime Alliance is indispensable for this; it has transformed Germany into a growing centre for shipping again.

NONSTOP: What progress has been seen in the defence against piracy?
BEHRENDT: German politicians have demostrated their commitment to this cause. Agreement has been reached that private security companies will have to be certified and that this procedure must be completed relatively quickly. We would of course prefer sovereign forces, but this is not possible – at least not in the medium term. We hope that the process of changing the law will be completed in the second half of this year and that private protection on German ships will be legalised.

NONSTOP: Would this be sufficient from your vantage point?
BEHRENDT: Basically, yes. No ship with an armed security force on board has been attacked as yet. That would escalate things to a new level, but there is no evidence that the pirates are gearing up to do so. For us, it is important – and apparent already – that we are well on the way to giving our ships proper protection. ■ **SNB**

SHIPPING. The prospects for world trade are still good.

Photos: Hapag-Lloyd

"AS VALDIVIA". The seventh unit in a series of eight bulk carriers Ahrenkiel Group took over in 2011.

Know Thy Ship

Keeping track of a ship's hull condition in a highly corrosive environment is a challenge every shipping company can sing a song about. The GL HullManager solution makes the job much easier, as ship-owner Ahrenkiel discovered

The timing was perfect. Ahrenkiel Shipmanagement had just launched a bulk carrier newbuilding programme. Knowing the harsh conditions these ships are exposed to, the opportunity to install a sophisticated tool to track every new ship's hull condition over its entire lifetime was highly welcome. Ahrenkiel was among the early adopters of GL HullManager, Germanischer Lloyd's hull integrity management solution, when it was first introduced in 2010. "The solution has many benefits for us", says Captain Mirko Schroeder, Marine Superintendent at Ahrenkiel. "It helps us build a lifelong record of each ship's condition that is easy to access and read. It also enables us to extend the routine docking intervals, which boosts the profitability of our bulker fleet."

Always One Step Ahead

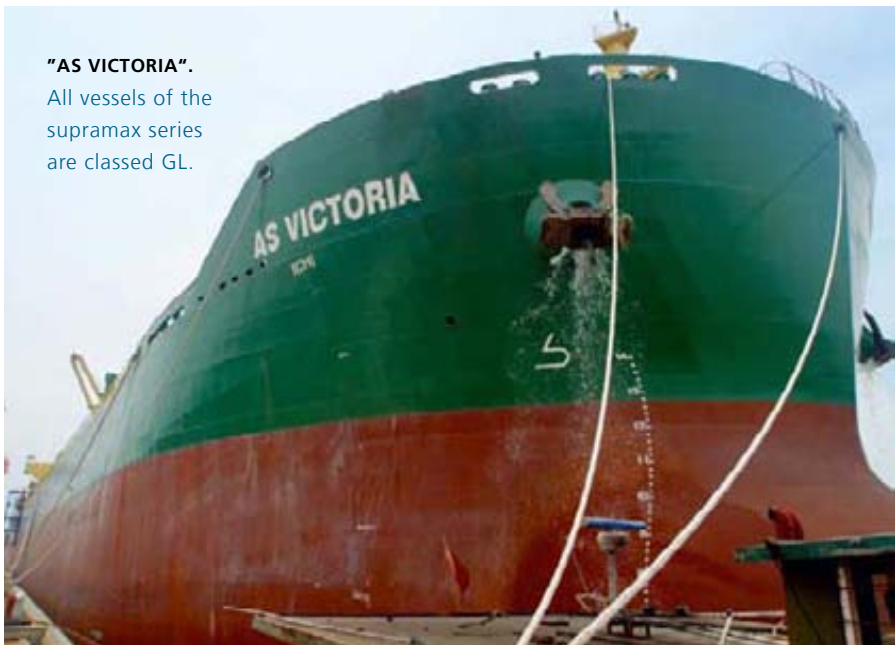
GL HullManager addresses a key concern common to ship-owning companies, operators and classification societies: Keeping abreast of the structural health of their ships and pre-empting potential integrity problems before they occur. "The key to successful preventive maintenance is condition monitoring," says Dr Torsten Büssow, Vice President Maritime Software at GL. "We support this concept wherever we can. GL offers a comprehensive solution programme for ship

Photos: Ahrenkiel

Company Profile

Ahrenkiel Shipmanagement GmbH & Co. KG is a company of the Ahrenkiel Group, which is headquartered in Hamburg, Germany and Bern, Switzerland.

With a staff of approximately 1600 land-based employees and sailors, Ahrenkiel Group currently operates 25 container ships, 5 chemical tankers, 8 product carriers, one crude oil and one LNG tanker as well as 13 bulk carriers. All ships are certified to ISO 9001:2008 and the ISM/ISPS Code. The Ahrenkiel Group has another branch office in Cyprus.



"AS VICTORIA".
All vessels of the supramax series are classed GL.

condition monitoring, with GL HullManager as the structural integrity component."

The application is by no means an off-the-shelf product. "Prior to installing the software, the GL experts gathered comprehensive vessel documentation as a data basis for customising the tool," Captain Schroeder reports. "Since we are building a number of ships identical by design, this adaptation needs to be done only once for the entire fleet of newbuilds."

Market acceptance of the tool was excellent from the very beginning. In the course of the first year alone, the GL HullManager client software was installed on board more than 150 ships. Owners like Ahrenkiel are highly interested in reducing maintenance uncertainties and avoiding bad surprises. "Knowing ahead of time what needs to be done helps us prepare accurate yard tenders," Schroeder points out. "Many minor coating or corrosion issues detected can be repaired while the ship is sailing. Furthermore, the ready availability of ship condition data is a great advantage for us when we communicate with charterers, inspectors or the classification society, and it speeds-up the hull and tank inspection process during class surveys." ▷

"The GL HullManager software delivers an instant, clear picture of the ship's current condition and maintenance history."

CAPTAIN MIRKO SCHROEDER
Marine Superintendent at
Ahrenkiel Shipmanagement

"AS VINCENTIA". In 2010, the contract was signed with GL to equip the series of eight supramax bulkers with the GL HullManager.

GL PEGASUS. *Thickness measurement results can be easily integrated by GL HullManager.*

The Ahrenkiel staff soon began to enjoy some very direct benefits of GL HullManager, says Schroeder. "In the past, hull condition monitoring and maintenance involved numerous individual files and hardcopy documents," he recalls. "That was tedious and time-consuming. The new software with its 3-D ship model combines text and visual information and displays it exactly at the hull location it relates to. This makes compliance with our strict maintenance standards that much easier."

The crews and on-shore staff received comprehensive training and have been very positive about the application, Schroeder emphasises: "The software delivers an instant, clear picture of the ship's current condition and maintenance history; any section can be viewed in detail at any time both on board and on shore since the client and the main application are synchronised automatically."

Another key advantage from a user perspective is the fact that tank inspection reports, photos and annotations are combined on the same user interface. "Having all this information available at once helps our crews assess hull health and detect damages and failures early and easily," says Captain Schroeder.

"As owners of several sister vessels we can use GL HullManager to harmonise the hull maintenance schedules of all of these ships," Schroeder explains. "We can compare sister vessels and monitor their hull maintenance status much more easily. And thanks to the comprehensive recordkeeping functionality that tracks all maintenance and repair activities, we have access to full documentation at any time for anyone who needs it."

User Support

But it is not just about advanced technology. "To us the human touch is just as important," says GL's Torsten Büssow. "We make sure the users of our software receive the best possible support." Captain Mirko Schroeder can attest to that: "The GL software experts are always within reach, highly competent and exceptionally service-oriented. Co-operation has been very professional and effective. I appreciate that a lot." ■ **SNB**

FOR FURTHER INFORMATION:
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Phone: +49 40 36149 5237, E-Mail: torsten.buessow@gl-group.com

SOFTWARE. The vessel-specific 3-D model enables interactive use and reduces the range of interpretatios of any defects.

GL HullManager: Monitoring and Assessing

GL HullManager, Germanischer Lloyd's hull integrity management solution, was first introduced in 2010.

Through its intuitive, user-friendly graphical user interface the GL Hull- Manager software application helps crews record and keep track of hull inspection and condition information using a three-dimensional computer model of the vessel. GL HullManager can integrate thickness measurement data gathered with the GL Pegasus tool. The overall solution, now an integrated offer for all newbuilds with GL class, includes a Hull Survey Guideline as well as an introductory seminar and software maintenance and support services.

The software package comprises an on-shore application and an on-board client that reports data back to the main application.

Photo: Ahrenkiel

Key results from a GL and MAN joint study

Costs and benefits of LNG as ship fuel for container vessels

by Dr Pierre C. Sames,
Senior Vice President, Research and Rule Development at GL

Photo: Dreamstime/Rwb

Attractions of Using LNG as Ship Fuel

Using liquefied natural gas (LNG) as ship fuel has recently gained more attention not only in Europe, but also in Asia and the USA. There are three notable drivers which, taken together, make LNG as ship fuel one of the most promising new technologies for shipping.

1. using LNG as ship fuel will reduce sulphur oxide (SO_X) emissions by 90 to 95 per cent (Fig. 1). This level of reduction will also be mandated within the so-called Emission Control Areas (ECAs) by 2015. A similar reduction for worldwide shipping is expected to be enforced by 2020.
2. the lower carbon content of LNG compared to traditional ship fuels enables a 20 to 25 per cent reduction of carbon dioxide (CO_2) emissions (Fig. 1). Any slip of methane during bunkering or usage needs to be avoided to maintain this advantage.
3. LNG is expected to be less costly than marine gas oil (MGO), which will be required to be used within the ECAs if no other technical measures are implemented to reduce the SO_X emissions. Current low LNG prices in Europe and the USA suggest that a price – based on energy content – comparable to heavy fuel oil (HFO) seems possible, even taking into account the small-scale distribution of LNG (Fig. 2).

Objectives of the study

Shipowners interested in LNG as ship fuel are currently analysing a number of questions regarding the costs and possible benefits of using such technology. They wish to learn whether exhaust gas treatment systems could be the preferred technical solution. At the same time, increasing ship efficiency through advanced waste heat recovery systems be-

Fig. 1. Emissions Components (100% load)

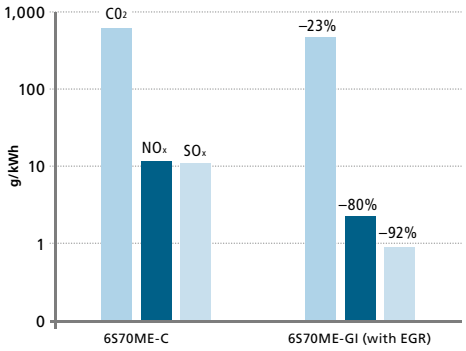
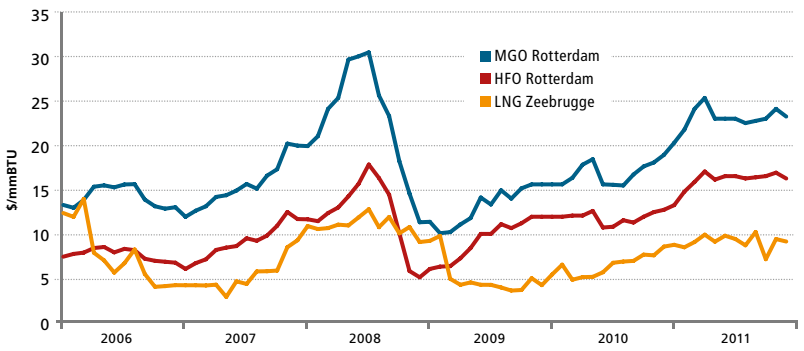


Fig. 2. Gas and Ship Fuel Prices (Monthly Averages)



CONTAINER VESSELS. LNG enables greener shipping.

Fig. 3. Ship Size Variants and Route Profiles

TEU	Speed (knots)	Main Engine Power (kW)	Roundtrip (nm)	default ECA share
2,500 TEU	20	14,500	5,300	65.1%
4,600 TEU	21	25,000	13,300	11.0%
8,500 TEU	23	47,500	23,000	6.3%
14,000 TEU	23	53,500	23,000	6.3%
18,000 TEU	23	65,000	23,000	6.3%

comes feasible. This suite of technologies is the focus of the GL and MAN joint study on container vessel power generation systems.

Status of Regulatory Framework

The IMO Interim Guidelines for gas as ship fuel (Resolution MSC.285(86)) contain state-of-the-art safety concepts for using gas as a ship fuel. These are voluntary for the flag states. GL issued its own guidelines, in April 2010, adding its own interpretations. The IMO BLG subcommittee is working on the International Gas as Fuel Code (IGF), which will supersede the interim guidelines and which is planned to enter into force with SOLAS 2014. Parallel work has started at ISO TC 67 on standards for LNG bunkering.

Approach

The study makes cost assumptions for key technologies applied to five different sized container vessels and predicts the benefits in comparison to a reference vessel, which uses marine fuel oil as required by existing and upcoming regulations depending on time and location of its operation. For example, the reference vessel uses MGO when inside an ECA in 2015 or within EU ports. Outside an ECA, HFO is used and a low-sulphur heavy fuel oil (LSHFO) with maximum 0.5 per cent sulphur content in 2020.

Costs for implementing the technologies are compared with expected benefits that are driven by fuel cost differences. The model assumes that the fuel with the lowest cost is always used, if a choice is possible. Space required by the technologies is taken into account by reducing the benefit.

Four technology variants were investigated in the study:

1. Exhaust gas cleaning by "scrubber"
2. Scrubber plus Waste Heat Recovery (WHR)
3. LNG system (bunker station, tank, gas preparation, gas line, dual-fuel engines)
4. LNG system plus WHR

For each technology variant, costs and space requirements are estimated and specific fuel oil consumption is based on current knowledge. Estimates were independently made for each selected container vessel size.

The same measures to reduce NO_x emissions to IMO Tier-III levels are assumed for the reference vessel and each technology variant. Therefore, these have no effect on the cost differences between the reference vessel and the variants.

Ship Size Variants and Route Profiles

Five representative container vessel sizes were selected for the study (Fig. 3). Assumed design speeds account for the current trend towards lower speeds.

Round trips were selected for three trades: intra-European, Europe–Latin America and Europe–Asia. The ECA exposure was used as primary input parameter. ▷

Fig. 4. LNG Tank Volume (Half-Round-Trip Endurance)

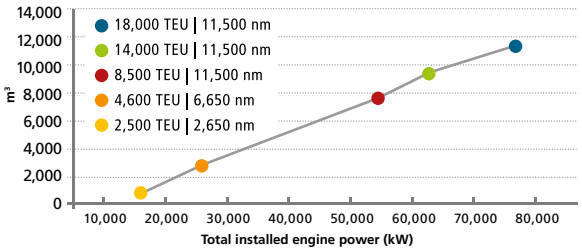
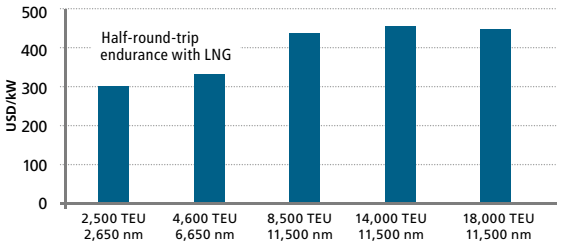


Fig. 5. Specific Additional Costs for LNG Installation



LNG Technology and Modelling Assumptions

The main engine installed power is based on specific designs with given design speeds. Auxiliary engine power is taken as a fraction of the main engine power. Additional auxiliary engine power necessary for reefer containers is based on estimated reefer share. Engine loads are varied for port stays, approaches and open-sea transit, which in turn depend on the route profile.

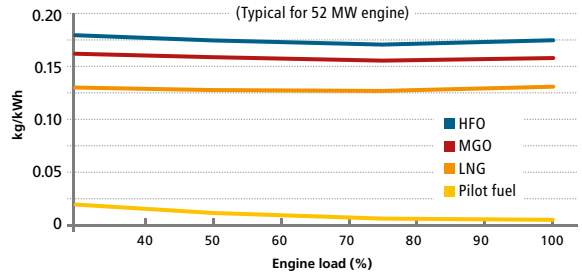
The LNG tank volume is selected to give the vessel half-round-trip endurance (Fig. 4). This controls investment costs but increases exposure to volatile fuel prices. Costs for the LNG system include costs for the tanks, bunker station, gas preparation, gas line, main engine and generator sets (Fig. 5). LNG tanks are assumed to consume TEU slots, resulting in lost earnings, assumed only for every second voyage. The medium-sized container vessels (4,600 TEU and 8,500 TEU) have the largest losses with a maximum of about three per cent of the total available TEU slots. Other operation costs such as crew, spare parts and maintenance are assumed to be ten per cent higher than the reference vessels.

Main Engine Technology and Modelling Assumptions

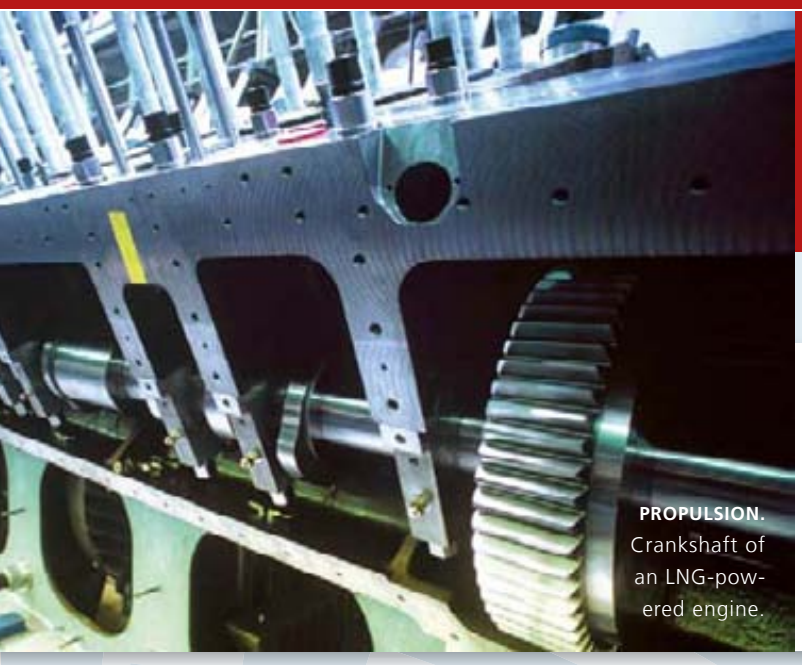
The MAN ME-GI engine series, in terms of engine performance (output, speed, thermal efficiency, etc.), is identical to the well-established ME engine series. This means that the application potential for the ME-GI system applies to the entire ME engine range.

Specific fuel oil consumption is specified for different engine sizes, fuels and engine loads (Fig. 6). The control concept of the ME-GI engines comprises three different fuel modes:

Fig. 6. Specific Fuel Oil Consumption



TREND. LNG is an alternative to conventional ship fuels.



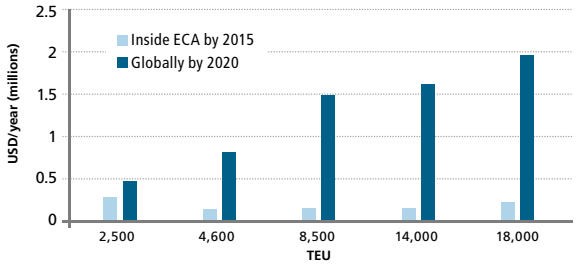
PROPULSION. Crankshaft of an LNG-powered engine.

EXHAUST. Wet scrubber systems reduce SO_x emissions.

- **THE FUEL-OIL-ONLY MODE** is well known from the ME engine and, in this mode, the engine operates on fuel oil only. The engine is considered to be "gas safe".
- **THE MINIMUM-FUEL MODE** has been developed for gas operation. In this mode, the system controls the amount of gas fuel, combined with the use of a minimum preset amount of fuel oil (pilot oil) set at five per cent approximately. Both heavy fuel oil and marine diesel oil can be used as pilot oil.

  The minimum pilot oil percentage is determined from 100 per cent engine load. When the engine passes through the lower load limit, the engine returns to fuel-oil-only mode. If a failure occurs in the gas system, this will result in a gas shutdown and a return to the fuel-oil-only mode.
- **SPECIFIC FUEL MODE**, where any mix of gas and fuel oil is possible.

Fig. 7. Scrubber Operating Costs



Scrubber Technology and Modelling Assumptions

This study assumes usage of wet scrubber systems to reduce SO_x emissions by scrubbing the exhaust gas from the engines with seawater. After the turbocharger, the exhaust is led into a large scrubber placed downstream from the exhaust gas boiler in the exhaust stack of the ship. The exhaust is led through an array of seawater droplets which washes the sulphur out of the exhaust gas. The washwater is collected, purified and discharged into the sea.

Scrubbers are assumed to be used only when needed to meet the emissions values corresponding to the low sulphur fuel limits, i.e. inside ECAs, in EU ports and globally by 2020. Their operating costs depend on operation time and engine loads (Fig. 7). An average cost for open and closed loop scrubbers of 5 $/ MWh was used. Lost TEU slots depend on the space required for the scrubber installation. Up to 0.3 per cent of the total available TEU slots are assumed to be lost. This is assumed to apply only every second voyage. Other operating costs such as crew, spare parts, and maintenance are assumed to be 20 per cent higher than with the reference vessels.

The cleaned exhaust gas is then passed through a reheater to prevent steam formation being visible when leaving the funnel. If the ship is sailing in an area where it is not allowed to even discharge the purified washwater into the sea, there is an option to apply a closed-loop wet scrubber system using freshwater and caustic soda (NaOH) as a ▷

Fig. 8. Fuel Price Scenario

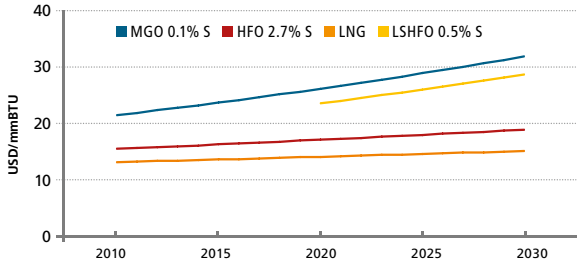
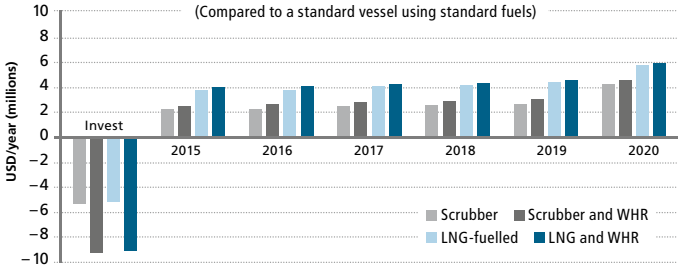


Fig.8 9. Annual Cost Advantage for 2,500 TEU Container Vessel



▻ reactive agent, neutralising the sulphuric acid formed during the exhaust gas washing process.

Waste Heat Recovery technology and Modelling Assumptions

The waste heat recovery (WHR) system consists of an exhaust gas-fired boiler supplying steam to a steam turbine to boost the electrical output. The system can be enhanced by a gas turbine utilising the energy in the exhaust gas not used by the turbocharger. To obtain the highest electrical production, the optimal solution is to use a dual-steam-pressure system or even a triple-steam-pressure system if the engine is equipped with a system for exhaust gas recirculation. Waste heat recovery systems are modelled to reduce specific fuel consumption. Savings depend on engine load and ship size. Maximum benefit of 13 per cent was assumed for the largest vessels at 75 per cent MCR.

Lost TEU slots depend on the space required for the WHR installation. For the smaller vessels (2,500 TEU and 4,600 TEU), up to 0.4 per cent of the total available TEU slots are assumed to be lost. This is assumed to apply only every second voyage. Other operating costs such as crew, spare parts, and maintenance are assumed to be 15 per cent higher than with the reference vessels.

Use of distillate fuels

Running on distillate fuels for a long period of time is the straightforward solution to comply with the forthcoming

Fig. 10. Payback for an LNG system (starting in 2015)

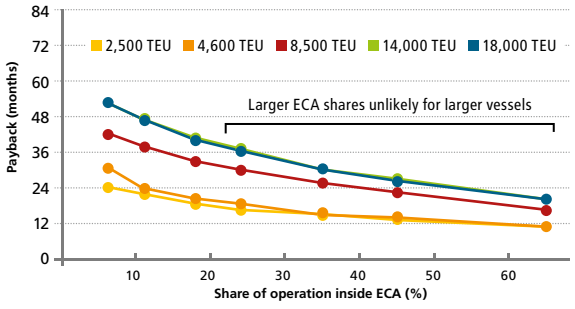
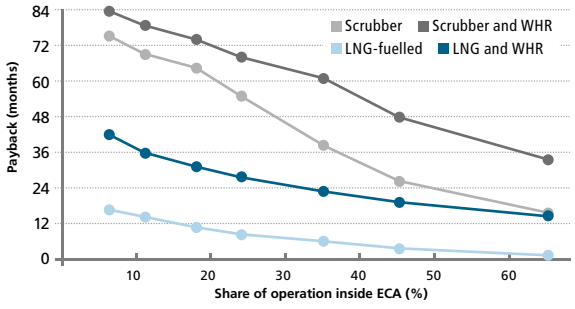


Fig. 11. Payback for 2,500 TEU vessel (starting in 2015)



emissions regulations on maximum allowable sulphur content in the fuel oil. The fuel system needs to be fitted with a cooler or a chiller arrangement to meet the fuel viscosity requirements for safe operation of the engine's fuel system. Suitable cylinder oil will also be required. For running in non-ECA areas, the fuel system must also be able to cope with the new fuel (LSHFO, with 0.5 per cent sulphur) that might be introduced in 2020.

Fuel Price Scenario

The basic assumption for the fuel price scenario is a continuous price increase due to expected increase in oil and gas production costs. MGO and LSHFO are expected to increase faster than HFO and LNG with stronger increase in demand. Starting year for the fuel price scenario is 2010. 650 $/t (=15.3 $/mmBTU) is set for HFO and 900 $/t (=21.2 $/mmBTU) for MGO. LNG is set at 13 $/mmBTU, which includes small-scale distribution costs of 4 $/mmBTU. It is assumed that these distribution costs do not increase over time (Fig. 8).

Results

Annual cost advantages, compared to the reference vessel using the required fuels depending on time and location, can be computed using the assumptions described above for each technology and vessel size. Cost advantages are the sum of fuel cost savings, additional operating costs and lost (negative) earnings. For a 2,500 TEU regional vessel operating 65 per cent inside European ECAs, significant cost advantages are predicted using LNG or scrubber by 2015 when strict fuel quality requirements enter into force. Payback time is shorter for solutions without WHR due to their relatively high investment costs (Fig. 9).

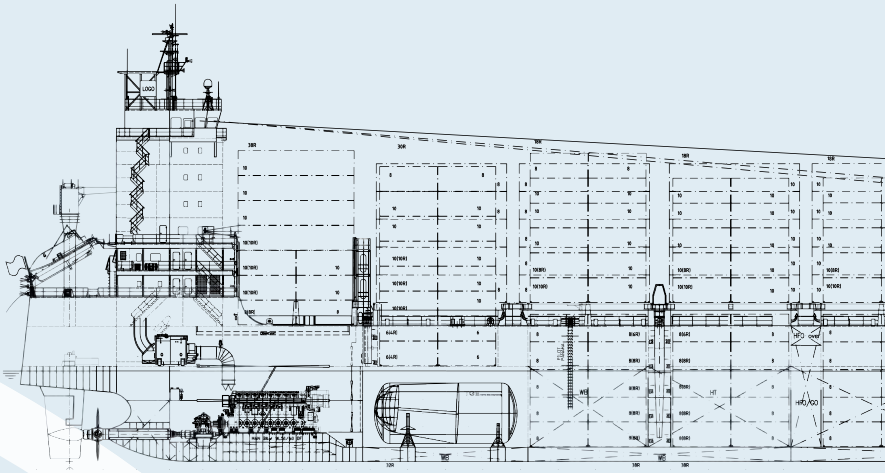


Illustration: NSD – Neptun Ship Design

LNG TANK. Location of the equipment.

Results – Payback Time

Benefits of technologies such as LNG or scrubber depend strongly on their usage. The higher the ECA exposure, the shorter the payback time for all variants, with operation ▷

Fig. 12. Payback for 4,600 TEU vessel (starting in 2015)

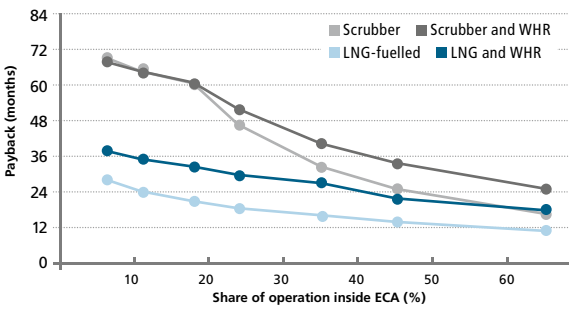
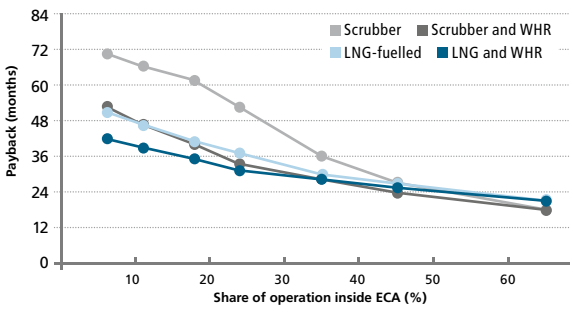


Fig. 13. Payback for 14,000 TEU vessel (starting in 2015)



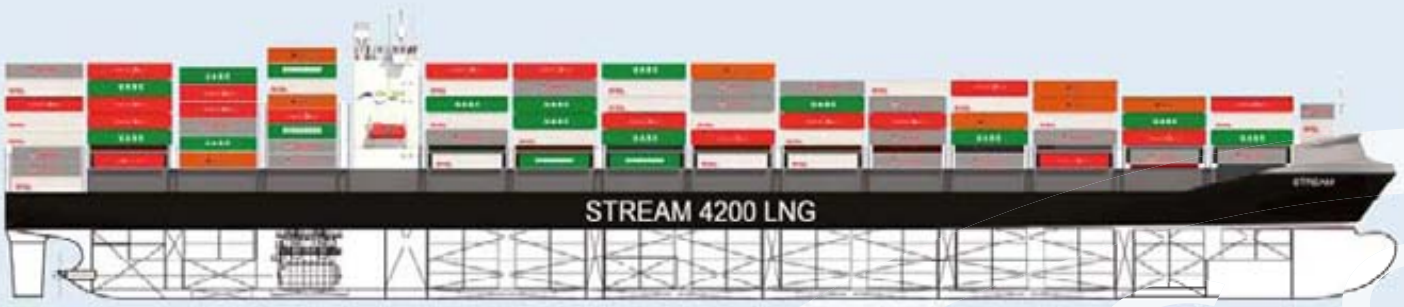


Illustration: TECHNOLOG

FUTURE. GL-approved design for an LNG-powered containership from German engineering company IPP.

▻ starting in 2015 (Fig. 10). Payback time is shorter for the smaller container vessels (2,500 TEU and 4,600 TEU). This is caused by their relatively smaller investment for the LNG system compared to the large vessels. With 65 per cent ECA exposure, LNG system payback time below two years can be achieved for smaller vessels. Comparing the different technologies with each other shows that the LNG system offers a shorter payback time than a scrubber for the 2,500 TEU vessel (using standard fuel price scenario). Payback time is longer for variants with WHR due to higher investment costs (Fig. 11).

At ECA operation shares lower than 20 per cent, the scrubber system payback time is longer than 60 months, which indicates that payback is achieved only after the introduction of the LSHFO quality standard in 2020. The 4,600 TEU vessel, operating eleven per cent inside ECAs, offers shorter payback time for LNG systems compared to the scrubber installation, too. Similar to the 2,500 TEU vessel, a WHR system does not shorten payback time (Fig. 12). WHR systems offer larger benefits for large vessels with high-installed engine power and associated savings. Therefore, payback time for an LNG system or scrubber when applied to a 14,000 TEU vessel is shorter when a WHR system is implemented (Fig. 13).

The LNG system offers shorter payback time than a scrubber system for the large vessel (using the standard

Fig. 14. Payback for LNG System (starting in 2015)

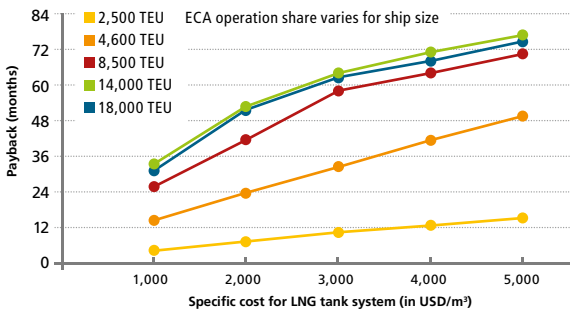
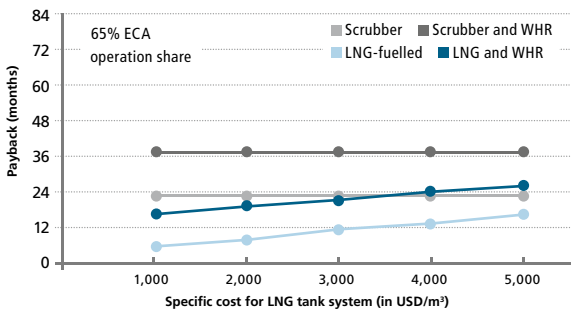


Fig. 15. Payback for 2,500 TEU Vessel (starting in 2015)



fuel price scenario). Only at higher ECA operation shares (which are unlikely) does the scrubber solution have a shorter payback time than the LNG system. This demonstrates that, when standard assumptions are used, LNG systems offer shorter payback times than scrubber systems.

The driving Factors – LNG Tank Cost and LNG Price

The largest share of the additional investment is related to the LNG tank (Fig. 14–17). In this study, a type C tank is assumed to be fitted for the 2,500 TEU vessel and type B prismatic tanks are assumed for the larger vessels. Smaller type C tanks are expected to have higher specific costs than larger type B tanks (which also depends on the underlying different ECA exposures). Payback for the larger vessels shows a stronger dependency on the specific LNG tank costs than for the smaller vessels. Comparing LNG and scrubber systems' payback for the 2,500 TEU vessel shows that even at high specific LNG tank costs, payback time is shorter for the LNG system (when the standard fuel price scenario is used) than for the scrubber. Although not shown here, specific tank costs above 3,000 $/m³, result in unfavourable payback times compared to the scrubber system for the larger vessels.

Considering the limited LNG supply infrastructure for ships, changes in LNG distribution costs are expected to influence payback for LNG systems. In general, payback for the larger vessels with their relatively larger LNG system costs depend, strongly on the LNG price (delivered to the ship). At price parity of HFO and LNG, based on energy content, payback time for the larger vessels is longer than 60 months (indicating that breakeven is possible only if the 2020 fuel standard is in force.)

For the 2,500 TEU vessel, a comparison of payback times for the LNG and scrubber systems, with varying LNG prices, shows that the LNG system is attractive as long as LNG (delivered to the ship) is as expensive as or cheaper than HFO when the fuels are compared on their energy content. (In January 2012 the LNG wholesale price in Zeebrugge was 10.6 $/mmBTU and HFO in Rotterdam was 15.7 $/mmBTU, indicating that LNG appears commercially attractive as ship fuel vs. compared to HFO in Europe.

Conclusions

Using LNG as ship fuel promises lower emissions and, given the right circumstances, lower fuel costs. The attractiveness of LNG as ship fuel compared to scrubber systems is dominated by three parameters:

- Investment costs for LNG tank systems
- Price difference between LNG and HFO
- Share of operation inside ECAs

Fig. 16. Payback for LNG System (starting in 2015)

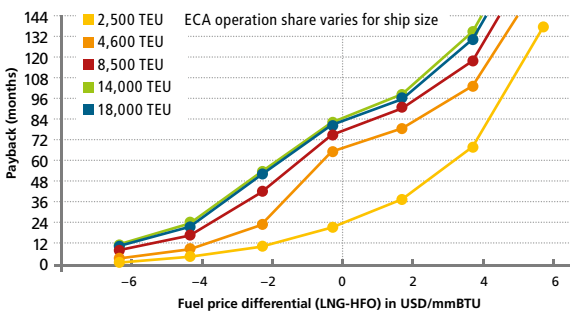
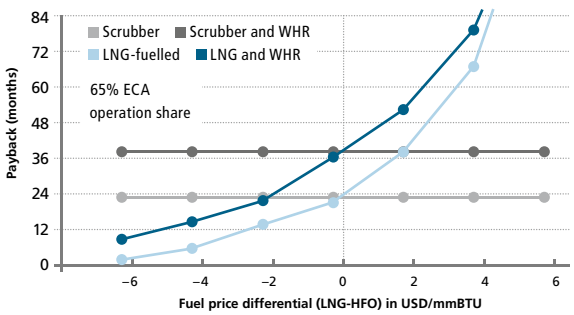


Fig. 17. Payback for 2,500 TEU Vessel (starting in 2015)



ME-GI ENGINE
- Highest efficiency
- Lower environment impact
- Simultaneous dual-fuel combustion (HFO + FG)

DF/GAS ENGINE GENERATOR
- Dual-fuel combustion
- Lower environment impact

ACTIB LNG TANK
- Independent tank of IMO type B
- High volume efficiency
- Structural integrity
- Partial secondary barrier

HIVAR FUEL GAS SUPPLY SYSTEM
- Very low power consumption
- Compact size and skid design
- HP liquid pumping and vaporizing
- BOG utilisation

Illustration: DSME

▷ With 65 per cent ECA exposure, LNG system payback time below two years is predicted for the smaller vessel sizes (using the standard fuel price scenario).

For the 2,500 TEU vessel, a comparison of payback times for the LNG and scrubber systems, with varying LNG prices, shows that the LNG system is attractive as long as LNG (delivered to the ship) is as expensive as or cheaper than HFO when the fuels are compared on their energy content.

For larger vessels typically operating at smaller ECA shares, e.g. the 14,000 TEU vessel, the LNG system has the shortest payback time (when the standard fuel price scenario is used). The use of a WHR system further reduces the payback time. The price of LNG delivered to the ship is difficult to predict. Base LNG prices from the USA to Japan vary by a factor of four. European base LNG prices appear attractive at around 10 $/mmBTU even with small-scale distribution costs added. An LNG price of up to 15 $/mmBTU could give LNG systems a competitive advantage against scrubbers in terms of payback for the smaller vessels considered in this study.

Small-scale LNG distribution is just starting to become available in Europe (beyond Norway) and it remains to be seen what LNG price levels will be established.

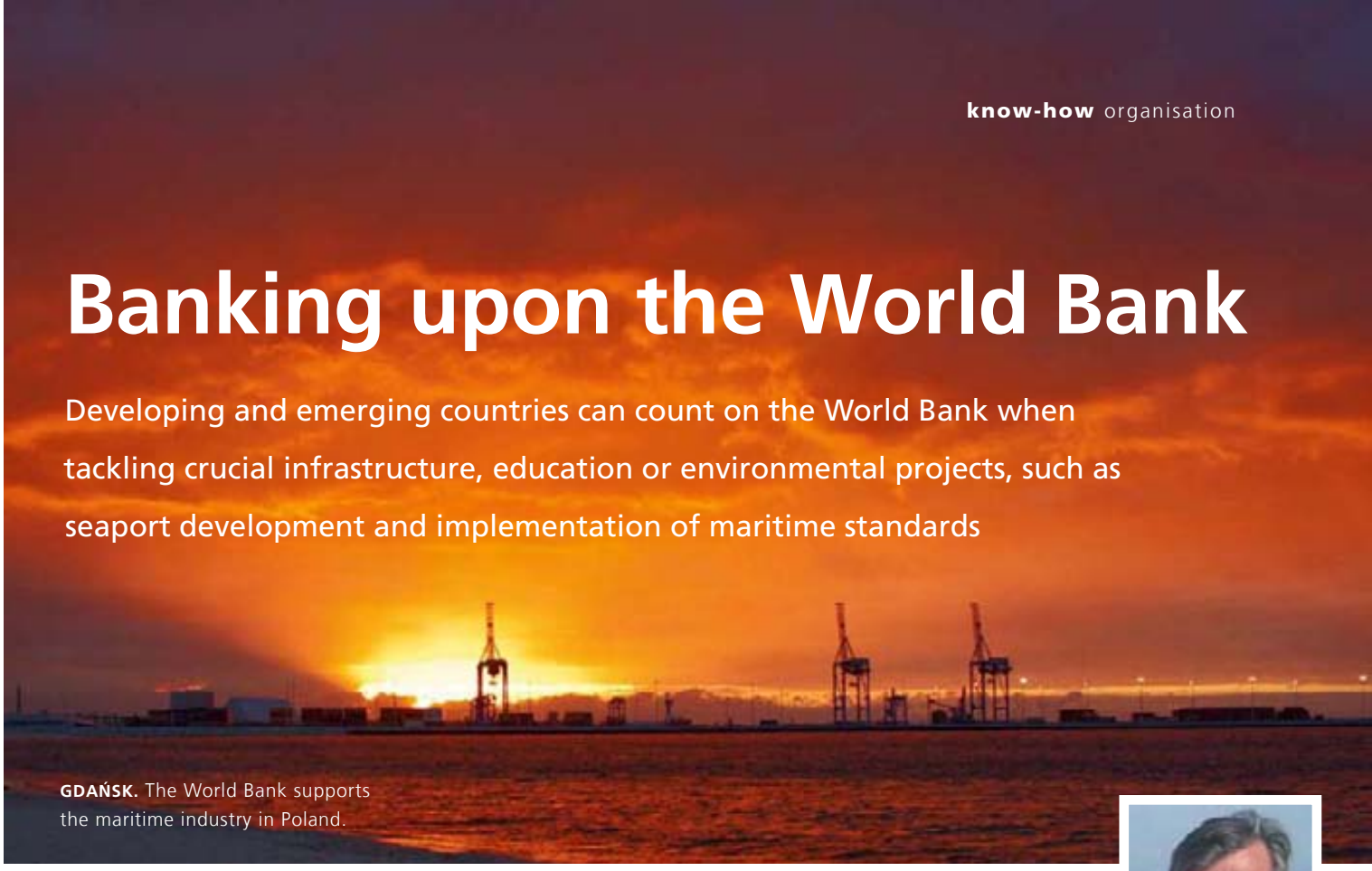
The model to predict cost and benefits for LNG systems, scrubbers, and WHR systems onboard container vessels offers extensive flexibility to study additional variants. Options include different vessel size, route profiles incl. ECA operation shares and other LNG tank configurations. Targeted analysis is offered on request.

Acknowledgements

This study was jointly performed by GL and MAN in 2011. The work was performed by Mr Mads Lyder Andersen (MAN), Mr Niels B. Clausen (MAN) and Dr Pierre C. Sames (GL).

Banking upon the World Bank

Developing and emerging countries can count on the World Bank when tackling crucial infrastructure, education or environmental projects, such as seaport development and implementation of maritime standards



GDAŃSK. The World Bank supports the maritime industry in Poland.

ADVISOR. Reynaldo Bench is working in the World Bank's Ports and Waterborne Transport division.

As a consequence of the ongoing worldwide economic crisis, the demand from developing countries for financial support will continue to grow. They all hope for help from the World Bank, which was created in 1944 to fight poverty through financial assistance, policy and institutional support, as well as transfer of technical knowledge. The World Bank serves as a point of contact for national governments, NGOs and citizens worldwide, providing assistance and supporting projects to help them build a better life.

Advice and Money

Reynaldo Bench has been a senior shipping and ports specialist with the World Bank's Ports and Waterborne Transport division since 2009. His department cooperates with partner organisations to assist developing countries in identifying financial resources and raising capital for projects such as improving their national port strategies, developing hinterland connections, ensuring proper administration and inspections and building an adequate ownership and management structure.

Bench advises public administrators on behalf of private investment companies and port operators. He manages transactions in the areas of modernisation and restructuring of maritime transportation, logistics and seaport management. "My work days are filled with research, analysis and publication of maritime and port data and indicators with a focus on aspects such as the financial crisis, climate change and piracy as reflected in the port and maritime news," Bench explains his range of tasks. "Our sector provides developing countries with information to help them ensure that their maritime transport and port sector remains efficient and competitive. We have supported Croatia, Pakistan and Nigeria in privatising ports, and assisted China, Poland and Morocco with peer reviews."

For years, ports have opted for larger facilities and deeper waterways as well as for the adoption of modern standards in terms of safety, security, environmental protection and social responsibility. Bench assists several countries and entities with advice on ISPS and Supply Chain Security (SCS) implementation and security policies of port operators and terminals. This cooperation enabled integration of ISPS in Nigerian and Pakistan projects.

The World Bank also offers training programmes to help ship crews be prepared for pirate attacks. "While there is always a certain risk in such a situation," Bench says, "arming the crew is not considered an adequate solution, and there are alternative techniques of responding to the threat of piracy." ■ **SG**

Photo: Dreamstime/Maksudkr

Complex Networks

Intact piping systems are indispensable for the safe and reliable operation of seagoing ships. The Construction Rules of GL help to keep things flowing smoothly

PIPING SYSTEM. Enormous quantities of piping are installed on ships. IACS defines the minimum requirements.

Fuel, lubricating oil, cooling water and starting air systems, cargo lines, aeration/de-aeration of service and ballast water tanks, and the sanitary system: the list of applications for pipelines on ships is long indeed. Depending on the ship type, the various piping systems can add up to a total length of more than 20 kilometres.

The large number of machines and propulsion systems on board ships with their diverse media, operational parameters and installation environments lead to a need for classification of the piping systems. The minimum requirements regarding material selection and quality, sizing and the scope of non-destructive tests are defined for three pipe classes by the International Association of Classification Societies (IACS) in its guideline "IACS UR P2". The subdivision is based on the medium carried, the working pressure and the operating temperature. The design pressure PR is, as a rule, the maximum allowable working pressure (activation setpoint of the safety valves) and is decisive in determining the require-

TECHNOLOGY. The requirements for the welding workshop vary according to the material used.

ments for material quality (material certificates as per EN 10204 3.1, 3.2 or 2.2).

Welding

The minimum requirements for welding as the classic method of connecting pipes are defined in UR P2.5 and P2.6. These refer to Class I and II piping systems and the treatment of steels with critical welding characteristics.

One of these requirements specifies that joints in Class I or II piping systems must be effected by approved procedures, and that the welding consumables and welders must also be certified. These requirements are covered in the Rules of Germanischer Lloyd (GL) by the corresponding approvals of welding workshops and filler metals.

Pressure Tests

UR P2.8, 2.9 and P2.10 define the requirements for the pressure tests of piping systems and integral fittings; these requirements are derived from SOLAS II-1, Part C, Regulation 26. Class I and II piping systems as well as steam pipes, feedwater pipes, compressed air pipes and fuel oil pipes having a design pressure PR > 3.5 bar must be subjected to a hydrostatic test at 1.5 times the design pressure PR. Here it should be noted that, in the case of fuel oil lines, the design pressure PR exhibits a temperature dependence.

UR P2.10 specifies a minimum testing pressure of 5 bar for valves and cocks fitted on the ship side below the load waterline.

Approved Pipe Connections

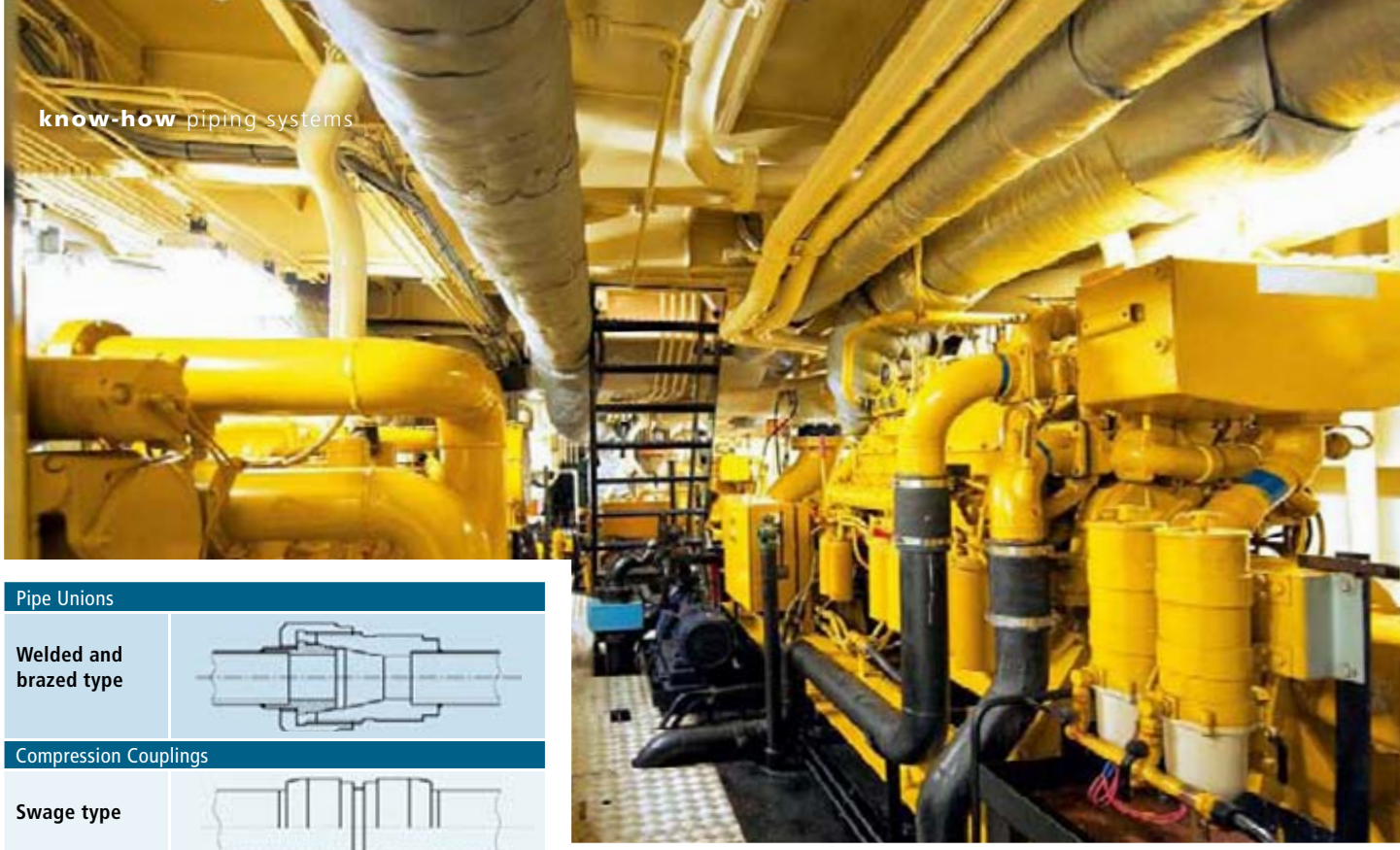
IACS UR P2.7 lists the types of pipe joining elements that are approved for connecting pipelines on board seagoing ships. As an alternative to welded pipe flange/socket connections or threaded connections, mechanical joints have gained wider acceptance thanks to their advantages in assembly and the associated cost savings. In addition to the classic pipe unions for high-pressure applications, slip-on joints and ▷

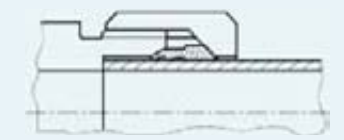
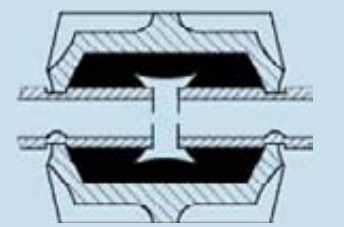
Medium/type of pipeline	Design pressure PR [bar] Design temperature t [°C]		
Pipe class	I	II	III
▪ Toxic media	all		
▪ Corrosive media ▪ Inflammable media with service temperature above the flash point ▪ Inflammable media with a flash point of 60 °C or less ▪ Liquefied gases (LG)	all	[1]	–
▪ Steam	PR > 16 or t > 300	PR ≤ 16 and t ≤ 300	PR ≤ 7 and t ≤170
▪ Thermal oil	PR > 16 or t > 300	PR ≤ 16 and t ≤ 300	PR ≤ 7 and t ≤150
▪ Air, gas ▪ Non-flammable hydraulic fluid ▪ Boiler feedwater, condensate ▪ Seawater and fresh water for cooling ▪ Brine in refrigerating plant	PR > 40 or t > 300	PR ≤ 40 and t ≤ 300	PR ≤ 16 and t ≤ 200
▪ Liquid fuels, lubricating oil, flammable hydraulic fluid	PR > 16 or t > 150	PR ≤ 16 and t ≤ 150	PR ≤ 7 and t ≤ 60
▪ Cargo pipelines for oil tankers	–	–	all
▪ Cargo and venting lines for gas and chemical tankers	all	–	–
▪ Refrigerants	–	all	–
▪ Open-ended pipelines (without shutoff), e.g. drains, venting pipes, overflow lines and boiler blowdown lines	–	–	all

1) Classification in Pipe Class II is possible if special safety arrangements are available and structural safety precautions are arranged.

PRESSURE. Extract from the GL Construction Rules I-1-2, Machinery Installations, Section 11 – Table 11.1

Photos: Dreamstime/Afby71/Anthony Villalon



Pipe Unions	
Welded and brazed type	
Compression Couplings	
Swage type	
Press type	
Bite type	
Flared type	
Slip-on Joints	
Grip type	
Machine grooved type	

CONNECTIONS. Extract from the GL Construction Rules I-1-2, Machinery Installations, Section 11 – Table 11.13

▷ compression couplings have become standard practice for the low-pressure sector. UR 2.7.4 defines the types, acceptable use, and test requirements.

The table entitled "Application of mechanical joints" defines the scope of application in relation to the kind of connection, i.e. pipe unions, compression couplings and slip-on joints. The requirements for fire resistance are also specified here with regard to the type of piping system and the place of installation. As a matter of principle, mechanical joints are subject to type approval by the corresponding classification society.

Type Approval Needed

The test scope is set out in UR P2.11 and has been mandatory since 1 January 2007 for first submissions and also for any renewal of the type approval for existing designs. The type approval of mechanical pipe joints includes assessment of the documentation on the basis of the applicable construction rules or codes, at least the product tests prescribed by IACS UR P2.11, and inspection of the production facilities in accordance with quality assurance standard ISO 9001, with a view to verifying the quality system implemented by the manufacturer.

For the benefit of the user, the scope of application and any limitations are to be specified in the type approval certificate.

PROPULSION. Proper fuel feed requires intact piping systems.

Photo: Dreamstime/36clicks

Flexible Hoses

The last and most recent section of UR P2 defines the requirements that apply to flexible connection elements, i.e. hose assemblies. Here too, there is a fundamental obligation to obtain type approval. The approval of metallic hoses is based on tests performed in accordance with ISO 10380, whereas the product testing of non-metallic hoses must be conducted in line with EN or SAE standards. For use in fuel, lubricating oil, hydraulic oil, bilge and seawater systems, fire resistance must be demonstrated by testing to ISO 15540/15541.

Type approval of the flexible hose assemblies, comprising mainly hydraulic hoses, also includes approval of the associated end fittings. Manufacturers of hose end fittings must provide evidence of the impulse test as per ISO 6802 or 6803 with the approved hose assemblies. In both cases, the type approval certificate must specify the primary structural feature of a hose assembly, and the impulse testing and fire resistance testing of the combination of hose and fitting type.

Besides the type approval of hose and end fitting, another important aspect of function and safety must be observed: the manufacture of flexible hoses. The GL Construction Rules for Machinery Installations I-1-2, Section 11U, specifies that the manufacturers of hose assemblies must be recognised by GL. The producers of metallic hose assemblies are required to have approved welding shop. For non-metallic hose assemblies, the production facility must be inspected with regard to storage, pressing procedures as well as final testing and marking. Moreover, the production facility must possess its own pressure testing equipment and marking tools.

IACS UR P2. *International Association of Classification Societies – Unified Requirements, Pipes and Pressure Vessels, P2 Rules for piping design, construction and testing.*

IACS UR P2 presents the basis for the requirements applying to piping systems on board seagoing ships, and as such provides the basis for the construction rules of the individual classification societies. The active participation of the classification societies in the standardisation bodies and the many points of contact to the manufacturers established within the scope of the type approval of components, and also during the evaluation of damage events on board seagoing ships, ensures the continual revision and updating of UR P2 to reflect the state of the art. ■ **HM**

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Max. working temperature / Max. working pressure	T ≤ 60 °C	T > 60 °C
PB ≤ 7 bar	3 bar or max. working pressure, whichever is greater	3 bar or max. working pressure, whichever is greater
PB > 7 bar	max. working pressure	14 bar or max. working pressure, whichever is greater

TEMPERATURE. Extract from the GL Construction Rules I-1-2, Machinery Installations, Section 11 – Table 11.4

Systems	Kind of connections: Pipe Unions	Compression couplings [6]	Slip-on joints
Flammable fluids (Flash point < 60 °C)			
Cargo oil	+	+	+ [5]
Crude oil washing	+	+	+ [5]
Vent	+	+	+ [3]
Inert gas			
Water seal effluent	+	+	+
Scrubber effluent	+	+	+
Main	+	+	+ [2, 5]
Distributions	+	+	+ [5]
Flammable fluids (Flash point > 60 °C)			
Cargo oil	+	+	+ [5]
Fuel oil	+	+	+ [2, 3]
Lubricating oil	+	+	+ [2, 3]
Hydraulic oil	+	+	+ [2, 3]
Thermal oil	+	+	+ [2, 3]
Sea Water			
Bilge	+	+	+ [1]
Fire main and water spray	+	+	+ [3]
Foam	+	+	+ [3]
Sprinkler	+	+	+ [3]
Ballast	+	+	+ [1]
Cooling water	+	+	+ [1]
Tank cleaning	+	+	+
Non-essential	+	+	+

1) Inside machinery spaces of category A – only approved flame resistant types [7]. 2) Not inside machinery spaces of category A or accommodation spaces. May be accepted in other machinery spaces provided the joints are located in easily visible and accessible positions. 3) Approved flame resistant types [7]. 5) In pump rooms and open decks – only approved flame resistant types [7]. 6) If compression couplings include any components which readily deteriorate in case of fire, they are to be of approved fire resistant type [7] as required for slip-on joints. 7) Flame resistance test according to ISO 19921

SYSTEMS. Extract from the GL Construction Rules I-1-2, Machinery Installations, Section 11 – Table 11.14

SAFE STOWAGE.
To anchor the containers on deck, thick rods of high-tensile steel turnbuckles are used.

Photo: Eberhard Petzold

Understanding the Design of Lashing Positions

To provide some assistance based on the knowledge and experience, GL outfitting department have prepared the following basic illustrations and requirements regarding the design of lashing positions:

FIG. 1. Distance lashing eye – container on deck/hatch cover

Enhancing Cargo Handling Safety

The IMO is upgrading the Code of Safe Practice for Cargo Stowage and Securing (CSS) to bring down accident rates among stevedores. Shipbuilders and shipping companies are facing new deck design requirements

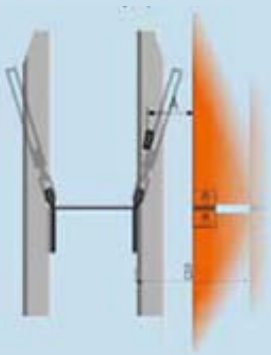
Stevedores falling from unfenced lashing positions onto the pier or into cargo holds – the risk for such lethal accidents should be minimised by the latest safety regulations. The amendments to IMO's CSS Code Annex 14 will apply to all containerships with keels laid down on or after 1 January 2015. Even existing vessels should be able to implement the amendments as long as no major structural modifications are necessary. "The IMO wants to ensure safe working conditions for personnel carrying out container-securing operations," says Jan-Olaf Probst, GL's Executive Vice President Ship Newbuilding. "I am sure the organisation has no intention of being a nuisance to shipowners. There will have to be more free space available on deck instead of using every square inch for storing containers. The new regulations require intelligent ship design changes."

Research has shown that a considerable percentage of injuries suffered by cargo handlers on marine terminals occurs on board the ships being worked, on containerships most of that is associated with lashing. All too often, the accessibility of lashing positions has not been considered in the design of the vessels. Mike Compton, chairman of the International Safety Panel of ICHCA International, says: "Applying or removing deck lashings is not an easy task, and it has been made considerably more difficult by the lack of proper, safe places to work on board some ships."

Avoidable Fatalities

This is hardly surprising, considering the small number of national regulations in existence, some of which aren't even mandatory. The IMO's CSS Code was revised in ▷

FIG 2. Distance lashing eye – container to lashing bridges

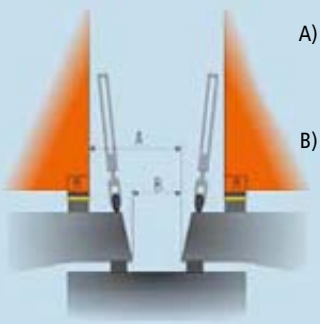


A) Minimum distance: 220 mm
B) Maximum distance: 1,100 mm

FIG. 3. Edge of hatch covers with fencing

A) Distance container to opposite top rail: 750 mm
B) Width between railing or any obstructions: 600 mm

FIG. 4. Edge of hatch covers without fencing



A) Distance container to opposite h/c: 750 mm
B) Width between hatch covers or any obstructions: 600 mm

PROTECTION. Bolt-on cross braces are attached from the ends of the lower two containers to the hatch covers.

Photo: Dreamstime/Ltreat

ICHCA. *The International Cargo Handling Co-ordination Association has NGO status with IMO and International Labour Office, among others.*

▷ response to a submission by the United Kingdom to the Maritime Safety Committee (MSC). "Safe access to cargo during loading and discharging has been compromised over the years through the minimising of deck areas for highest possible intake of containers," Compton argues.

Over the last few years, some terminal operators have launched safety programmes of their own. A shining example is Hutchison Ports in Felixstowe: The UK's premier container port was able to bring down accident rates during lashing operations by one-third through a comprehensive accident prevention programme introduced in 2002.

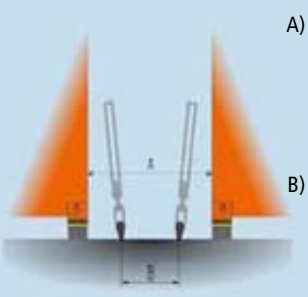
The updated IMO safety code will enforce safe lashing practises on all containerships. All ships carrying cargo that needs to be stowed and secured are required to carry on board a Cargo Securing Manual approved by the ship's flag state. These manuals must be based upon the CSS Code. "The amendments are not limited to container vessels," explains Jörg Seel, Deputy Head of GL ASEA Shanghai. "With reference to the scope defined in IMO MSC.1/Circ.1352 the requirements will apply to the GL class sign 'containership' as well as the class notation 'equipped for carriage of containers'."

Ships May Become Longer

The upgraded safety standard is accompanied by a number of new requirements regarding design, operation and maintenance. Some of them may even affect basic ship design. A key dimension is the new minimum clearance for transit areas, which must be no less than two metres high and 600 mm wide. "But the rules are not always very explicit," cautions GL safety expert Jörg Seel, "and a unified interpretation from IACS is not available as yet. GL is receiving many requests for clarification from designers, shipyards, suppliers and owners." To provide some assistance, *nonstop* delivers GL's basic interpretations regarding the design of lashing positions, based on the expertise of GL outfitting experts Daniel Abt and Ansgar Gorissen (see also figures 1 to 9):

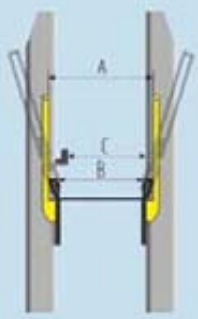
- Lashing positions should be designed to eliminate the use of three high lashing bars.
- Horizontal operating distance from the securing point to the container must not exceed 1,100 mm and be no less than 220 mm for lashing bridges and 130 mm for all other positions.

FIG. 5. On deck/hatch covers in way of gap



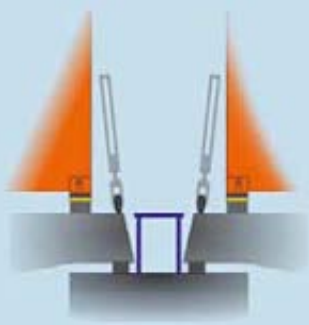
A) Min. width of container gap: 750 mm (min. gap: 860 mm for lashing eyes on both sides 600 + 2 x 130 mm)
B) Width of lashing eye plates: 600 mm (measured between centres on deck)

FIG. 6. On lashing bridges



A) Between top rails of fencing: 750 mm
B) Clear width between lashing eye plates: 600 mm
C) Between any other obstructions: 600 mm

FIG. 7. Level of platforms between hatch covers etc.



Lashing positions between hatch covers have to be at the same level as hatch cover top plates. Deviations have to be accepted by the flag state case by case

Important Definitions

- **FENCING** is a generic term for guardrails, safety rails, safety barriers and similar structures that provide protection against persons falling.
- **LASHING POSITIONS** include positions
  - in between container stows on hatch covers;
  - at the end of hatches;
  - on outboard lashing stanchions/pedestals;
  - outboard lashing positions on hatch covers;
  - any other position where people secure containers.
- **SECURING** includes lashing and unlashing.

- The lashing positions should preferably be 1,000 mm wide, but no less than 750 mm.
- The minimum width of container gaps (e.g. on hatch covers) should be 750 mm; 860 mm if lashing eyes exist on both sides (600 mm + 2 x 130 mm).
- The width of permanent lashing bridges should be 750 mm between top rails of fencing, and a clear minimum of 600 mm between storage racks, lashing cleats and any other obstructions.

Various Interpretations

To what extent do the new requirements influence ship design? "Quite profoundly," says Jan-Olaf Probst. "The increased minimum width requirements for transit areas and lashing positions may result in increased ship lengths if you want to maintain the same container capacity." And that is by no means all: Lighting plans will have to be rewritten. Ladders, fences and manholes will need to be resized. Lashing rod design will have to be modified to eliminate extension rods, which will affect container securing manuals. With extension rods prohibited, there will be less flexibility in accommodating different container sizes in stacks. "GL is helping clients develop intelligent solutions to reconcile the conflicting goals of efficiency and safety," promises Probst. "We are willing to sit down with each and every one of our customers to explain and discuss our interpretation of the code."

Consensus is that the new CSS Code will improve occupational safety for stevedores and crews, notwithstanding the need to clarify some of the stipulations. All major classification societies are being asked for interpretation by shipyards and suppliers. Since interpretations of some rules differ significantly, arriving at a unified interpretation before the code enters into force is a concern of paramount importance. Nevertheless, Probst is pleased to say: "While there are still a few open issues regarding application of the amendments for existing ships, a regulatory framework for safe securing of containers will be coming into force – and we will gladly help implement it. The result will be improved cargo handling safety." ■ **UT**

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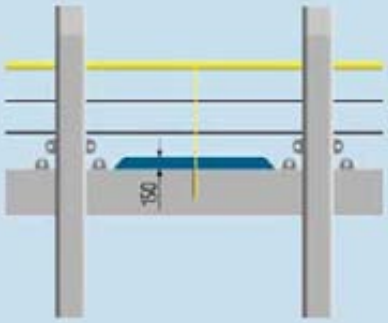
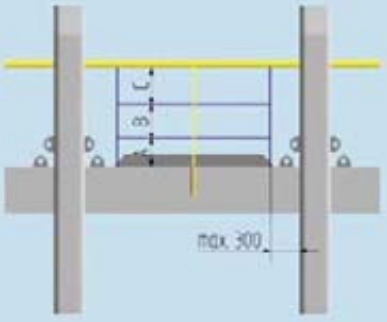
FIG. 8. Requirement for toe boards



Toe boards have to be steel plates with a minimum height of 150 mm

FIG. 9. Requirement for railings



A) Maximum distance: 230 mm
B = C) Maximum distance: 380 mm
Maximum railing gap: 300 mm

High Tension

Larger ships, more reefers: the electricity demand on board container carriers is rising. Low-voltage ship supply systems are reaching the limits of performance and safety. The trend towards medium voltage is growing

Containerships need increased amounts of electrical power – not least because of their increase in size. Although more containers on board make for more efficient transportation, the requirement for electrical energy increases as well. Reefer containers are growing in number and are especially power-hungry. The thrusters needed for manoeuvring in port also demand copious amounts of electrical energy. Added to this are the powerful pumps, drives, ventilation systems, fuel processing units and other electrical loads. In a nutshell: without electrical power, everything on a container carrier would grind to a halt.

As a rule, electricity is generated on board by means of several auxiliary installations. On a 14,000 TEU containership for example, these would normally comprise four separate diesel engines, each driving a main generator. In addition, shaft generators powered directly by the main engine, or generators driven by an exhaust gas turbine or through a waste heat recovery system can contribute to the ship's electricity supply. Running in parallel, these generators provide a peak output of some 23 megawatts (MW) – enough to supply a small town with a population of about 25,000 people.

Like the electricity distribution in a town, a large number of cables lead from the power generators via the main switching equipment through subdistribution to the electrical loads. Unlike power distribution systems on land, however, low-voltage switchgear is generally installed on ships for the low power range. This is still the case at present, but owing to the rising power demand, medium-voltage technology is increasingly establishing itself on containerships.

Instead of the 450-volt alternating current tension commonly used in low-voltage ship power systems, the generators in a medium-voltage system produce a voltage of typically 6.6 kilovolts (kV) and directly feed the main switching equipment and the major loads. The higher system voltage offers a significant advantage: "We increase the voltage in order to reduce the current for the same power draw," says Christoph Kutzner, staff member of the newly established Ship Service Delivery unit at GL in Hamburg.

Reduction in Short-Circuit Current

The goal here is primarily to mitigate the potential hazard for the crew due to high current flows. First and foremost, Christoph Kutzner sees problems with high installed generator capacities to the event of a short circuit in the low-voltage network. For approximately. 10 MW of generator output, the initial symmetrical short-circuit current would

amount to approximately 135 kiloamperes (kA) at the point of fault. This enormous figure results from the sum of the short-circuit currents of all generators on line as well as of the motor loads, which must likewise be regarded as suppliers of current owing to their rotational energy.

This approximate figure of 135 kA represents the extreme of the zone in which low-voltage switchgear assembly can still be operated safely. If a higher generator output is installed, steps must be taken to limit the short-circuit current in case of fault – or, as a logical consequence, the system voltage must be raised from low (450 V) to medium (6,600 V). This change reduces the expected short-circuit current in proportion to the voltage increase, i.e. by a factor of 15. This may not appear to be much, but the decrease by an entire order of magnitude reduces the expected short-circuit current and its negative effects quite substantially in case of fault.

Selective Isolation against Blackout

"Mitigating the potential danger to the crew from the effects of low-voltage switchgear installations that are thermally and dynamically overloaded in the event of a short circuit, is not the only goal," says Christoph Kutzner. High availability of power is also important. Would any ship operator be willing to sacrifice the power supply for his valuable reefer cargo? A ship power supply network must be able to withstand the short-circuit current safely over a certain period. This requirement means that the shipboard mains must be designed to be selective, so that only the load that is closest to the fault is switched out by protection devices. For this, it is necessary to stagger the short-circuit release devices. It is then possible to ensure that only the faulty loads are disconnected and there is no blackout of the entire power supply on board the ship.

Photos: Dreamstime/3desc/Corepics Vof

AT BERTH. A reliable power supply is needed onboard when loading and unloading.

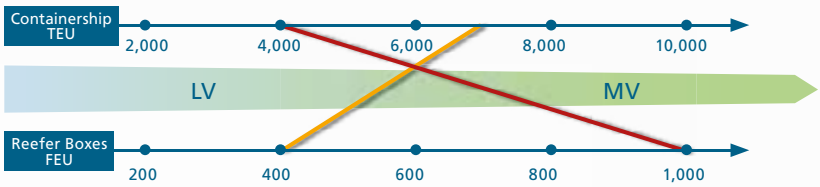
Reliability of Ship Operation

The short-circuit actuation of a generator circuit-breaker is therefore delayed by up to 500 milliseconds (ms) and subsequent actuations by approximately 150 ms each. This cascade of delays results in important selective isolation in the ship's electrical network. If there is any doubt as to whether the designer has chosen appropriate delays, the settings can be tested onboard the ship. It is obvious that adequate control of the ship's network can be achieved more dependably at low short-circuit currents, thus resulting in a higher availability than a low-voltage network with high short-circuit currents.

The requirements that essential equipment such as propulsion, steering gear and safety arrangements onboard are always available and functioning reliable must be met in case of any fault. Ensuring power supply to non-essential equipment, such as the reefer containers, is not relevant to this class of equipment. They are ▶

Ship Size and Reefer Containers Take Their Toll

The point it is at which advisable to change from low-voltage (LV) to medium-voltage (MV) technology is simply a matter of the total power demand.



REEFER. *Refrigerated containers are essential for the transportation of perishable goods. The temperature inside has to be kept constant. Large amounts of electrical power are needed.*

POWER CONTROL CONSOLE. The ship's engineers are also responsible for the electrical power supply.

▷ hence not certified. "However, with the class notation 'RCP', we offer our shipowners certification of the power supply for reefer containers. What is more, our examination also covers adequate ventilation of the hold and proper accessibility of the reefer containers for maintenance purposes," says Kutzner.

More Transformers Needed

SHORE POWER. *The shoreside power connection to ships during their stay in port ("cold ironing") is intended to reduce air pollution.*

The point at which it is advisable to change from low-voltage (LV) to medium-voltage (MV) technology is a matter of the power demand. A small vessel of approximately 4,000 TEU with 1,000 slots for reefer containers is a candidate for medium voltage. By contrast, a 7,000 TEU container carrier with only 400 reefer containers is adequately well supplied with low voltage (see diagram, page 11). "There is no clear-cut dividing line," says GL expert Kutzner. "But the distinct trend towards medium voltage continues." Since 2000, Christoph Kutzner and his colleagues have certified over 420 container ships with medium-voltage switchgear. This large number demonstrates the trust that shipowners have placed in GL with regard to this technology.

Nevertheless, a shipboard medium-voltage network increases the need for transformers, as there are still many low-voltage loads to be served. Transformers must be placed before each group of such loads to step the generator voltage down from 6,600 V to 450 V. Transformers take up space and cost money. And medium-voltage equipment itself adds a premium to the price. "For this reason, the yards have to quote higher prices for comparable ships with medium voltage than for ships with low voltage," Kutzner points out.

In view of the rising copper prices, however, the situation is likely to shift in favour of medium voltage. Christoph Kutzner provides some figures to illustrate this point (see table, top right). For a generator output of 3,100 kVA, two medium-voltage cables running in parallel with a cross-section of 70 mm² each are sufficient, whereas low voltage needs 17 (!) cables of 150 mm² each. What this actually means becomes clear when the total cable weight per metre is compared: 10.8 kg as op-

Software Helps with Choosing the Right Voltage

GL is working on a simulation tool to help shipowners make the decision in the borderline cases as to whether a low-voltage switch installation is sufficient or whether it would be better to change to medium-voltage technology.

It is based on fault tree analysis (HiP-HOPS), a safety analysis standard used in the automobile and aviation industries.

Undesirable events are systematically implied and then a search is made for critical elements that could trigger them. In this way, yards and shipowners can identify rapidly and precisely what type of installation would be most economical and safe in their particular case. A key role in developing the software was played by Erich Rüde of GL's Strategic Research Department: "We thoroughly tested the two software building blocks from ITI GmbH and the University of Hull, and optimised the user interface. Using this tool, we systematically and semi-automatically examine a large number of components and can consider design changes and variations at little effort – a very economical service for our customers."

Photos: Dreamstime/3dcs; Eberhard Petzold

Copper Requirement: Advantage of Medium Voltage

Using the example of a generator output of 3,100 kVA, much less cabling is needed for a medium-voltage ship network.

Voltage	Current	Conductor cross-section	Number of conductors	Cable weight
6,600 V	271 A	70 mm² (150 A)	2 (300 A)	2 x 5.40 kg/m = 10.80 kg/m
450 V	3,977 A	150 mm² (243 A)	17 (4,131 A)	17 x 4.46 kg/m = 75.82 kg/m

posed to 75.8 kg makes a compelling case for medium voltage – even considering that a metre of medium-voltage cable is fundamentally heavier because of the multi-layer insulation and extra sheathing.

Easy Shore Connection

For a medium-voltage ship power supply, approximately 1000 m of medium-voltage cable and 3,700 m of low-voltage cable must be laid on a 7,000 TEU containership designed to carry 500 reefer containers. This covers only the power distribution lines, and does not include the many metres of control, data, and signal cables. The same 7,000 TEU vessel with a low-voltage system would need 350 m of medium-voltage cable (for the bow thruster) and 8,300 m of low-voltage cable.

Time to crunch the numbers. With a copper price currently of 6.50 euros per kilogram, the cost advantage of medium voltage reaches seven figures. If one also considers the labour savings, since the yard workers have to install much less cabling, the higher costs for the medium-voltage technology will probably at least balance out. In times when yards have to compete for customers, it may be hoped that this price benefit will be passed on to the purchasers.

The shipboard electricians have to be trained in the operation of medium-voltage switching equipment. Unfortunately, the requirements for qualification vary from one flag state to another. For ships flying the German flag, BG Verkehr (the responsible body in Germany) merely prescribes a training course that leads to an MV switching permit. "The ship's electrician should also learn that a medium-voltage installation is safer than its low-voltage counterpart with high short-circuit currents, and that there are numerous safeguards to protect the operator," says GL expert Kutzner. In contrast to low-voltage units, medium-voltage installations are subdivided into individual sections, with access doors that are interlocked and can only be opened when the equipment is safe. Furthermore, it is necessary to verify that these systems are able to withstand internal faults and will not endanger the operators. Special voltage testers and safety equipment must also be carried onboard.

Another benefit of medium voltage on ships is its "future-proofing": to an increasing degree, containerships in port are required to switch off their diesel engines for generating electricity and to use a shore connection instead. The high power demand of the reefer containers and the obligation of the shipowner to ensure an unbroken chain of refrigeration for the charterer are met by the medium-voltage supply at the pier. Ships with this technology clearly enjoy an advantage. With the same voltage level, the shore connection can be hooked up to the ship's mains quickly and reliably without any need for transformers.

The use of medium voltage on board is nothing new. On some large vessels, high-performance bow thrusters have been powered by medium voltage in the past – the low voltage of the shipboard generators was stepped up (e.g. to 3,300V), in order that only one or two cables had to be laid from the engine room to the bow section. What is new, however, is using medium-voltage technology for the entire process of energy generation, distribution and connection. ■ **DH**

FOR FURTHER INFORMATION:

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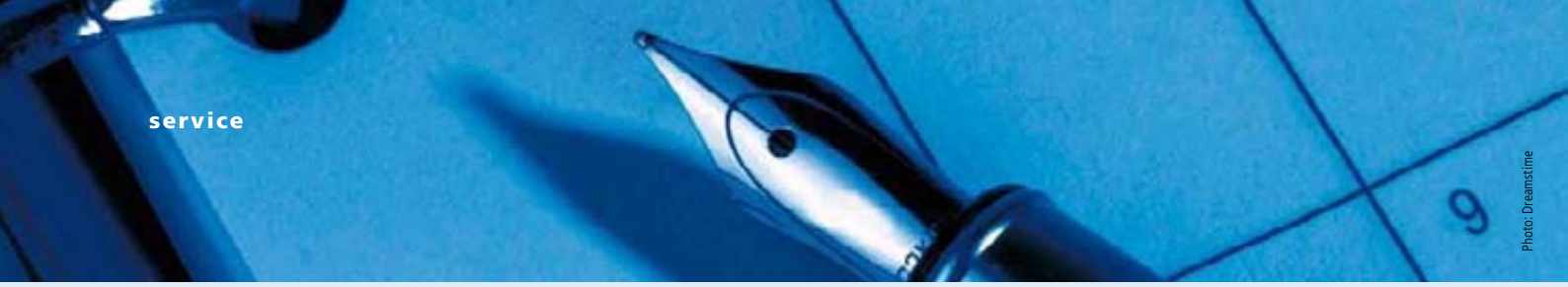

Photo: Dreamstime

Rules for Classification and Construction

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05.06. – 07.06.2012
Transport Logistic China
GL participation:
Stand No. 382/460, Hall N2
Shanghai, China

August

01.08. – 03.08.2012
Navalshore Marintec South America 2012
Rio de Janeiro, Brazil

12.08. – 15.08.2012
Milnavshow
Constanta, Romania

September

04.09. – 07.09.2012
SMM
GL participation:
Stand No. 105 in Hall B4,EG
Hamburg, Germany

19.09. – 22.09.2012
Monaco Yacht Show
Monaco

October

23.10. – 26.10.2012
Shiptec China
GL participation:
Stand No. 1107
Dalian, China

24.10. – 26.10.2012
SNAME Annual Meeting & Expo 2012
Providence, Rhode Island, USA

November

13.11.2012
Turkish Shipping Summit 2012
Istanbul, Turkey

27.11. – 29.11.2012
Intermodal Europe
Amsterdam, Netherlands

27.11. – 29.11.2012
Seatrade Middle East Maritime
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Stand No. Q7, Halls 5, 6 and 7
Dubai, U.A.E.

December

04.12. – 07.12.2012
Exponaval 2012
GL participation:
Stand No. 76N
Valparaíso, Chile

05.12. – 07.12.2012
International WorkBoat Show
New Orleans, Louisiana, USA

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