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Germanischer Lloyd

nonstop

the magazine for customers and business partners

LNG

Ready to Go

SHIPBUILDING Flexibility Boosts Success

EFFICIENCY Software Wins Award

MULTI-PURPOSE GL Spells Versatility

Dear Readers,

Erik van der Noordaa

EXCITING TIMES LIE AHEAD OF US: We intend to master the challenges of the industry, to the benefit of our customers, by joining together with our Norwegian competitor DNV – and are currently hard at work preparing the merger forming the DNV GL Group. For both partners, this step represents a monumental change.

Experience, competence and innovative strength have formed GL and DNV over a period of almost 150 years into reliable partners for the maritime industry and the business fields of oil and gas, renewable energies and plant engineering. For all segments, the merger opens up an enormous vista of possibilities – and will offer the best of both worlds, particularly for our customers and business partners. This is our pledge to you!

SUBSTANTIATED RESULTS are being delivered by the GasPax project. This research programme is focused on LNG as a viable fuel for cruise liners, ferries and mega-yachts. The project partners are well on the way towards making shipping even more efficient and ecological. “Ready to build!” was the message given at GL’s GasPax Forum (page 16). The technology is there – now the infrastructure for bunkering is required. A study under GL management analyses the prerequisites needed for the safe supply of gas (page 18) in German ports.

ON THE OPEN SEA, ship crews often have to fend for themselves. High waves cause intensive sloshing within the LNG tanks, which may lead to loss of cargo and costly repairs (page 12). For this, GL offers the software solution GL SeaScout, which assists in choosing the best alternative route. On the other hand, not every ship is exposed to heavy seas. With a new class notation, GL has developed loading rules for route-dependent container stowage. Greater flexibility of loading is now possible without compromising safety (page 49).

SAVING COSTS, reducing the probability of failure, increasing operational reliability: the use of digital 3D models is a proven approach. The GL EmissionManager, for example, analyses and prepares the relevant information with great precision to yield the basis for reducing pollutant emissions. GL is currently probing further applications for 3D models (page 46).

THE QUEST FOR EFFICIENCY AND ENVIRONMENTAL COMPATIBILITY remains a key driver for innovation. In the field of hull and trim optimisation, the GL subsidiary FutureShip is a world leader: the GL software ECO-Assistant has received the Lloyd’s List Asia Award for Environment (page 42). Just as award-worthy are the new potentials for saving energy on board (page 33) that were identified by FutureShip in a study on the cooling water systems of ships. And a special commendation for the work of the GL engineers is reported in an entirely different field: the world-renowned Volvo Ocean Race will be held with a one-design class in future. The structural strength of the racing yachts will then be certified by GL (page 22).

I wish you an interesting read!

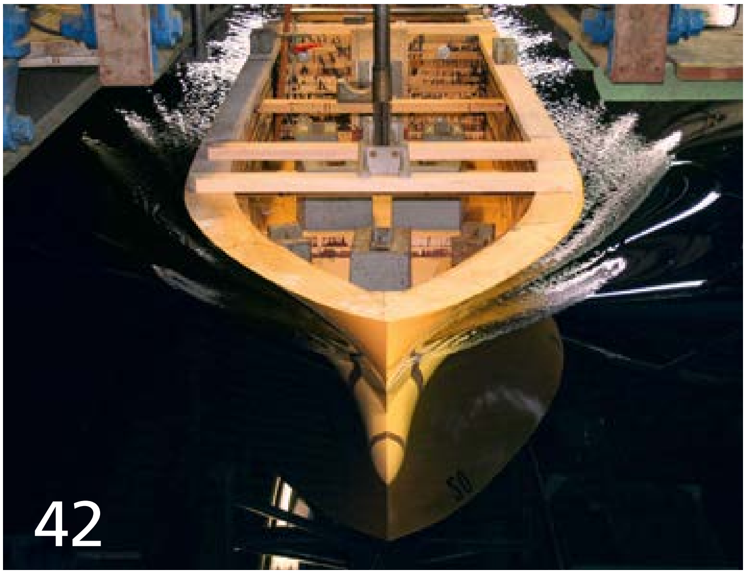
ERIK VAN DER NOORDAA
Chairman of the Executive Board, Germanischer Lloyd SE

contents

Photos: Dps.foto/Romanausks/Surz01 | Dreamstime.com

Photo: Volvo Ocean Race

Photo: Fassmer



efficiency

gl world

Cover: Mayumi Terao/iStockphoto

Høvik Ahead!

The mission to merge the GL Group and DNV has been successfully started. On their way to build the new DNV GL Group, the partners are well on track with all the necessary pre-arrangements.

Announced last December, the merger will create a leading ship classification society and risk expert in the oil and gas, renewable energy and power sectors, and one of the leading providers of management system certification. The maritime business unit will be headquartered in Hamburg, Germany, while maintaining its commitment to the Norwegian maritime cluster. The DNV GL Group's global headquarters will be in Høvik near Oslo.

The parties are currently involved in the merger control proceedings of the competent competition authorities. They are confident that the merger conforms to all relevant competition rules and expect to gain the necessary approvals.

With proper planning and attention to detail throughout the merger process, from determining the strategic direction and transaction design to careful execution of the post-merger integration and branding, diligent adherence to the agreed-upon merger principles will pave the way to a successful merger of GL and DNV once all approvals have been achieved.

Photo: DNV

HEADQUARTERS. The future home of the merged DNV GL Group in Høvik near Oslo, Norway.

news

Photo: Rickmers

AUDIT. "Rickmers Singapore" has been certified to ISO 50001.

ENERGY MANAGEMENT SYSTEM

A Model for the Shipping Industry

RICKMERS SHIPMANAGEMENT becomes the first German company operating in the maritime industry and one of only a handful of shipping companies in the world to achieve certification to the ISO 50001 Energy Management System standard. GL Systems Certification (GL) issued the accredited ISO 50001 certification for the Rickmers offices in Hamburg and Singapore, as well as for ten ships from their fleet. The handover took place at the Rickmers' head office in Hamburg last January. All audits were completed successfully by GL auditors in 2012, with plans in place to add nine more ships in early 2013.

ISO 50001 is a voluntary international standard that gives companies a framework for developing targets and implementing policies with the aim of improving energy efficiency, quality of services and reduction in emissions. The successful implementation of the ISO 50001 standard within a period of just six months underlines the support and commitment from Rickmers' top management to energy efficiency. "In shipping today, making more efficient use of energy is not only a key factor in a company's strategy to reduce its impact on the environment but an essential part of remaining competitive and reducing bunker costs substantially," said Björn Sprotte, Rickmers' Global Head of Maritime Services.

CERTIFICATE HANDOVER. The GL and Rickmers audit team for ISO 50001.

FOR FURTHER INFORMATION:

Philipp Schwarmann, Product Manager Energy Management
Phone: +49 40 36149-8674
E-Mail: philipp.schwarmann@gl-group.com

IMPLEMENTATION

Condition Monitoring Survey Arrangement for Engine Pistons

GERMAN SHIPPING COMPANY NSC Schiffahrtsgesellschaft has decided to implement a Condition Monitoring (CM) survey arrangement on the main diesel engine pistons of 49 GL-classed vessels of its fleet.

"The prevention of unnecessary open-up inspections and surveys is one of the significant benefits of the CM survey arrangement," says Dr Jörg Rebel, GL condition monitoring expert. "Open-up inspections and surveys are costly and time-consuming, especially in the case of piston overhauls for large diesel engines. Dismantling and re-assembling of the engines ways holds the risk of damaging a system that is running well." GL offers the CM survey arrangement for crank-train bearings and pistons of two-stroke diesel engines, as well as for rotating auxiliary machinery, such as centrifugal pumps, electric motors, fans and purifiers.

SURVEY. Piston with piston rings seen through scavenge ports of a large two-stroke diesel engine.

FOR FURTHER INFORMATION:

Dr Jörg Rebel, Safety & Environmental Research
Phone: +49 40 36149-940
E-Mail: joerg.rebel@gl-group.com

Photo: LEHNKERING

PREMIERE. Hendrik Lorenz (l.), Head of Fleet Services, IMPERIAL Shipping Group, and Dr Ulrich Ellinghaus, Head of Region Germany, GL Systems Certification.

COOPERATION

Shipping Meets Space

PARTNERS. GL's Dr Pierre C. Sames (l.) and Dr Dietmar Heyland of DLR Technology Marketing signing the agreement.

THE GERMAN AEROSPACE CENTER (DLR) and GL are expanding their strategic innovation partnership first established in 2010 to jointly identify and develop new technologies for the shipping industry, such as ship emissions, indoor navigation, advanced materials and wave prediction via satellite.

"Following hydrodynamic optimisation," said Dr Pierre C. Sames, Head of GL's Department of Research and Rule Development, "the industry is now looking into optimising ship structures using modern non-steel materials, a field that can greatly benefit from this cooperation."

Dr Dietmar Heyland, Deputy Head of DLR Technology Marketing, added: "Ensuring safe and environmentally sound shipping is a common goal of DLR and GL. The skill sets and expertise of our companies are an ideal match for joint research and development projects."

FOR FURTHER INFORMATION:

Dr Pierre C. Sames, Senior Vice President

Phone: +49 40 36149-113, E-Mail: pierre.sames@gl-group.com

TANKERS

First-Ever Certification to TMSA

TWO COMPANIES of IMPERIAL Shipping Group, LEHNKERING Reederei and LEHNKERING Rhein-Fracht GmbH, are the world's first shipping companies certified to the international Tanker Management and Self Assessment (TMSA) safety standard by Germanischer Lloyd.

TMSA, introduced in 2004 by the Oil Companies International Marine Forum (OCIMF), initially relied on self-assessments by tanker operators. GL is the first certification body to offer shipping companies an optional, third-party audit. "The IMPERIAL Shipping Group meets all the requirements of the TMSA standard regarding personnel management and qualification, navigational safety and safety management, including incident investigation and improvement measures," confirmed Dr Ulrich Ellinghaus, Head of Region Germany, GL Systems Certification. The audits were held at the company's headquarters in Duisburg, Germany, as well as several other company sites and on board 17 of IMPERIAL's tankers.

FOR FURTHER INFORMATION:

Dr Ulrich Ellinghaus, Head of Region Germany, GL Systems Certification

Phone: +49 40 36149-8273

E-Mail: ulrich.ellinghaus@gl-group.com

CORROSION PROTECTION

New Research Results

NICKEL-REDUCED STAINLESS STEELS may be a suitable replacement for standard austenite steels under certain conditions. Using low-nickel alternative steels could calm some of the price turbulences in the so-called stainless-steel markets. This is the outcome of a research project presented by Mr Andreas Burkert of the German Federal Institute for Materials Research and Testing (BAM) at the 12th conference on corrosion protection in maritime engineering, Hamburg.

The conference, first held in 2001, is a recurring event jointly hosted by Schiffbautechnische Gesellschaft e.V., Gesellschaft für Korrosionsschutz e.V. and Germanischer Lloyd. The conference featured seven additional presentations following Mr Burkert's opening lecture. Topics included material properties of aluminium, thermoplastic powder coatings, rust ablation rates, and corrosion protection of steel structures.

FOR FURTHER INFORMATION:

Michael Kühnel, Head of Department Materials and Corrosion Protection, Phone: +49 40 36149-2235

E-Mail: corrosion@gl-group.com

Photo: Shiyali | Dreamstime.com

news

HANDOVER: (f.l.t.r.) Christian Ulrich Diehl, Senior Vice President Group Quality, Governance & Risk, Pekka Paasivaara, Member of the GL Group's Executive Board, Erik van der Noordaa, CEO GL Group, Götz Blechschmidt, DQS Managing Director, Dr Joachim Segatz, Member of the GL Group's Executive Board, Ramón Azúa, Head of Department Group QHSE Management, and Gert Krüger, DQS's Head of Key Account Management.

ENERGY EFFICIENCY

EFNAV Presentation Marks 1,000th SEEMP for GL's FutureShip

SAVING FUEL, LOWERING CO_2 emissions during operation: effective January 2013, the amended MARPOL Annex VI requires all seagoing ships larger than 400 GT to carry a Ship Energy Efficiency Management Plan (SEEMP) on board. FutureShip GmbH, GL's maritime consulting arm, offers an SEEMP solution and recently presented its 1,000th SEEMP certificate to EFNAV COMPANY LTD (EFNAV), Athens.

"Excellent service and the shortest lead time, alongside a competitive price, were the main reasons to go with FutureShip as our partner for implementation of an SEEMP," said EFNAV's Technical Manager, Mr Pantelis Chondros.

The FutureShip SEEMP solution allows the energy manager of a shipping company to select appropriate measures and convert them into vessel-specific SEEMPs. Every single SEEMP is checked by FutureShip to minimise the chance of error. The SEEMP solution comes with a vessel-specific Energy Efficiency Operational Indicator (EEOI) calculator.

"Vessels with an SEEMP in place have already shown marked improvements in fuel consumption, especially so in conjunction with a comprehensive continuous improvement system," said Till F. Braun, Managing Consultant with FutureShip GmbH.

On-demand energy efficiency management consulting support is available from FutureShip. Many customers have already taken advantage of this service.

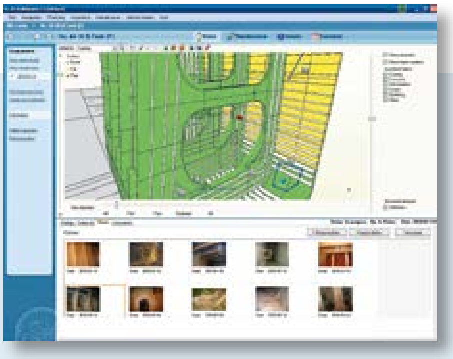
The FutureShip SEEMP solution is currently available in Russian, English and Spanish.

FOR FURTHER INFORMATION:

Till F. Braun, Managing Consultant FutureShip
Phone: +49 40 36149-337
E-Mail: till.braun@gl-group.com

Photo: Horst Rahmelow

SPITHA. One of the vessels of EFNAV Company Ltd.



3D MODEL. HullManager visualises every detail.

SOFTWARE

Seaspan to Roll out GL HullManager across Fleet

SEASPAN SHIP MANAGEMENT LTD. (Vancouver), a leading container vessel manager, has chosen GL HullManager to upgrade its in-house hull integrity management system. The condition-based monitoring software will be implemented across Seaspan's entire fleet of 76 vessels over the next several years.

"After reviewing three different systems, we selected GL HullManager as the software most closely meeting our needs," explained Peter Jackson, Director of the Projects and Technology Department at Seaspan Ship Management Ltd.

GL HullManager uses a vessel-specific 3D model to store and visualise hull condition data gathered through crew inspections and thickness measurements. It enables ship owners, managers and operators to spot potential problems early on, minimise downtime and streamline inspections. The software integrates easily into existing maintenance processes.

FOR FURTHER INFORMATION:

Ryan Bishop, Vice President Business Development Area Americas
Phone: +1 832 320-4658, E-Mail: ryan.bishop@gl-group.com

CERTIFICATION

Safer, Smarter, Greener – DQS Certificate Confirms GL Group Vision

ONE STEP AHEAD – The GL Group is the first technical consulting, assurance and classification society to have its integrated management system certified. After successfully passing an integrated management system audit conducted by the German certification body DQS, the GL Group received a combined certificate of compliance with the BS OHSAS 18001, ISO 9001 and ISO 14001 standards.

Erik van der Noordaa, CEO of the GL Group, received the certificate from DQS Managing Director Götz Blechschmidt at the GL Group Head Office in Hamburg. "This combined certification reflects the GL Group's ambition to become safer, smarter and greener. It encourages us to continue developing our services, processes and methodologies in pursuit of this vision."

The CEO thanked the DQS team for its dedication and cooperation in working with the GL team to attain this certification. "Both companies invested several months of intensive planning, training, documentation and internal audits to reach this successful conclusion." The DQS certificate proves that the GL Group's management systems comply with the international standards for the assessment of occupational health and safety management systems, BS OHSAS 18001, the quality standards for products and services, ISO 9001, and the environmental compatibility of processes, products and services, ISO 14001.

FOR FURTHER INFORMATION:
Ramón Azúa, Head of Department Group QHSE Management
Phone: +49 40 36149-126
E-Mail: ramon.azua@gl-group.com

WINDMADE™

LABEL. GL embraces renewable energy.

PARTNERSHIP

Confirmed Commitment to Wind Energy

GL SYSTEMS CERTIFICATION has joined WindMade as an accredited verifying partner. The GL Group's certification body thereby commits to supporting the WindMade label and its continued development.

The WindMade label, which is backed by international organisations, requires participating companies to obtain at least 25 per cent of their electricity from wind power. It was created to allow companies to communicate their commitment to renewable energy.

FOR FURTHER INFORMATION:
Markus Weber, GL Systems Certification
Phone: +49 40 36149-9051
E-Mail: markus.weber@gl-group.com

ELEMENTS.
Sloshing is a risk for tankers in heavy weather. Violent fluid motion can cause hull damage.

Strong Forces

Persistent sloshing in partly loaded LNG carrier tanks can cause extensive damage to the tank walls. The software solution GL SeaScout helps navigators find alternative routes to avoid excessive sloshing

In heavy seas, vessels can roll by up to 30 degrees. With vessels getting larger and faster and crews often lacking experience, there is a need to forecast ship behaviour more reliably rather than leaving it up to the navigator to assess the situation when he, or she, is stationed some 50 metres above the waterline. This is especially critical at night.

Vessels and their cargoes are subject to heaving, pitching, slamming, wave loads on deck, and in certain cases, parametric roll, which can also adversely affect deck cargoes of containerships. Dr Torsten Büssow, GL's Vice President Maritime Software, explains that sloshing produces strong forces acting against the tank wall, which could destroy or severely damage a tank; once started, it is often even audible to the crew. Repairs can be extensive, taking three or more weeks, not to mention the costly offhire time. Damage induced by sloshing could also cause loss of cargo due to gas boil-off. "These are valuable ships and cargoes. Sloshing is a concern for owners," Büssow says.

Photos: Dps.foto@gmail.com/Romanausks/Surz01 | Dreamstime.com

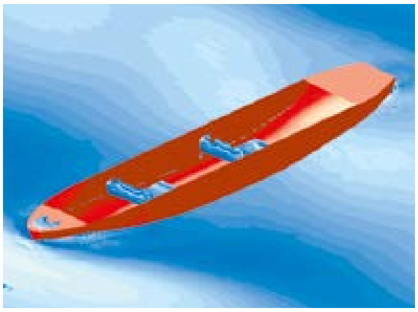
Seakeeping Qualities

During the voyage of a laden LNG carrier (LNGC), the cargo volume in the tank will gradually shrink due to gas boil-off. This provides the cargo with increasing space to slosh in response to the movements of the ship. Impact pressures can be very high but of short duration, mainly affecting the tank corners, the tank dome and internal piping.

Over the years, GL has gained considerable experience in the study of ship seakeeping qualities. "What was lacking in the past," says Büssow, "was an onboard component, such as a fleet management guide, to help navigators react appropriately to certain sea conditions: Navigators need help in judging the seakeeping behaviour of their vessels so they can answer questions such as: If my ship swings ten degrees to port, how will this affect its rolling motion?"

Top-Performing Software Solution

To provide a tool for assessing gas carrier and containership behaviour patterns, Germanischer Lloyd introduced GL SeaScout, a hydrodynamic integrated software solution for navigational decision support. Marketed mainly to the LNGC sector, the new software applies computational fluid ▸



TOOL. CFD-based simulation helps to predict sloshing occurrence in certain sea and sailing conditions.

dynamics (CFD) to analyse and predict vessel behaviour under specific sea conditions.

Risk Identification

While it is impossible to predict sloshing accurately in ship operation, CFD-based simulation can be used to determine the likelihood of sloshing in certain sea and sailing conditions. GL SeaScout models the underwater part of the vessel and subjects it to a virtual, CFD-based tank trial. The simulation result can give an operator a 360-degree view of the vessel's behaviour. In addition, an infinite number of parameters can be introduced into the simulation for further analysis.

GL SeaScout relies exclusively on computational means for sloshing prediction. "The less hardware you put on board a vessel, the less maintenance you will need on board," Büssow explains. "The CFD computations used by the application match up well with data validated by experiments," he adds.

"It is important to monitor the motion of the vessel continuously," Büssow stresses, "especially at night-time when sea conditions are not so apparent to the navigator." When GL SeaScout indicates conditions making sloshing appear likely, a course change can quickly be planned. A weather routing system will only tell the crew about possible forthcoming weather conditions, whereas GL SeaScout will warn of the consequences of wave lengths, frequencies and heights under certain sea conditions at specific vessel speeds. The central display unit of the system is colour-coded for easy identification of risks (see picture next page).

"Furthermore, the software integrates easily with weather routing systems such as Applied Weather Technology (AWT),

LNG SHIPPING. Almost 80 newbuilds are on order or under construction.

Photo: Oleksandr Kalinichenko | Dreamstime.com

The Future Has Started

Interest in LNG carriers (LNGCs) has ballooned in the past few years since the price of natural gas dropped well below that of crude oil, triggering a virtually unprecedented construction boom in receiving terminals, plants and vessels

Several factors have contributed to making gas more attractive as an energy source, especially in Asian countries but also, if to a lesser extent, in Europe. Price is still a key factor, but the Fukushima earthquake and tsunami led to a fundamental change in the way most countries think about energy resources: nuclear power plants are losing support in favour of conventional, cheaper power sources, such as gas and coal.

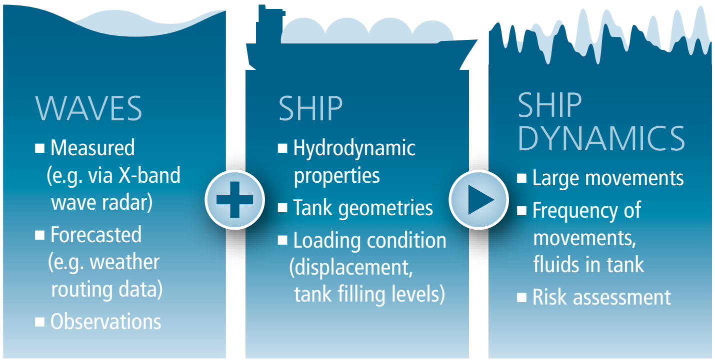
With the US all but closed to LNG imports due to the rise of domestically produced shale gas, Asian energy concerns have closed that gap. A number of countries are ramping up their gas power plants and building new ones. While Japan and South Korea used to lead the way in Asian gas consumption, Chinese energy companies have now joined the so-called "dash for gas". Much of the Asian imports derive from Asian suppliers such as Indonesia and Australia and of course Qatar, which has emerged as one of the largest gas producers and exporters in the world.

The future bodes well for LNG shipping, as Russia has started exporting gas from Sakhalin in Asia, and in a few years will commence exporting gas from Yamal in the Russian Arctic. In fact, the world recently witnessed the first LNGC travelling the Northern Sea Route (NSR) across the Arctic. This vessel loaded LNG in Hammerfest (Snøhvit) in Norway for delivery to Japan.

All of this activity has galvanised interest in LNG shipping. By the turn of the year, there were almost 80 newbuilds on order or under construction, each capable of carrying in excess of 10,000 m³. Most of them are being built at South Korean, Japanese or Chinese shipyards. Today, the active fleet stands at around 360 vessels.

Navigational Decision Support System

GL SeaScout helps calculate the likeliness of sloshing for all vessel speeds and headings. In addition, it identifies safe vs. hazardous speed and course combinations.



MONITORING. GL SeaScout mitigates the risks of vessel and cargo damages.

X-BAND. *These radars are used for studies on cloud development because they can detect the tiny water particles. X-band radars provide very short-term weather information.*

There has been very little scrapping of older units down the years, with owners preferring to convert their redundant tonnage into storage units, including the fitting of regasification plants on board in some cases.

Charter rates took off a couple of years ago, hitting 200,000 dollars per day at their peak. However, they have since dropped back to around 100,000 dollars and higher per day, which is still allowing a healthy return on investment.

The revival of interest in this niche sector will no doubt spur more technological innovations in the future as new challenges arise, not least with the LNG floating production storage and offloading (FPSO) units planned for Australian and Brazilian waters. A key question remaining is that of ice navigation, as the Arctic LNG exporting terminals will come on-stream in a few years.

as weather routing technology plays an important part in avoiding sloshing," Büssow says. For example, GL SeaScout will use weather forecasting during an entire voyage for ship behaviour and safety assessments to support route planning. X-band wave radar information and other on-board measurement systems may also be integrated into the system to provide a broader information basis and improve accuracy.

Two Trends

As the interest in LNG as a ship fuel continues to grow, sloshing is likely to become a more common concern with onboard fuel gas tanks gradually emptying in the course of each voyage. GL expert Büssow says there has been wide-spread interest in GL SeaScout, especially from Greek owners who have been active in the LNGC newbuilding market recently.

"GL's software business grew substantially in the past three years, and was mainly driven by two trends," Büssow adds: Quality-minded shipping companies continued to invest in new technology to stay ahead of the competition; and while there were many software systems available during the boom years, there has been significant consolidation in the shipping software sector since, which will likely continue. "Small companies cannot invest in their future," Büssow concludes. ■ IC

FOR FURTHER INFORMATION:

Dr Torsten Büssow, Vice President Maritime Software
Phone: +49 40 36149-5237, E-Mail: torsten.buessow@gl-group.com

ROPAX FERRY CONCEPT. Equipped with dual-fuel engines, this vessel could transport 600 passengers.

Laying the Groundwork for LNG

The GasPax project has shown that the time is right for shipowners to adopt LNG as a fuel for future cruise ships, RoPax ferries and other types of passenger vessel

The message from the speakers at GL's GasPax forum was clear: "If you are ready to order it, we are ready to build it!" The event was held to celebrate the completion of the GasPax project and award approval-in-principle certificates.

Sponsored by the German government (BMWi), GasPax was designed to get German shipyards and manufacturers ahead of the game in terms of LNG-fuelled vessels. The project partners set out to examine the technical challenges associated with the use of this fuel in three types of passenger vessels – a cruise ship, a mega yacht, and a RoPax ferry – and to come up with market-ready designs. The forum in Hamburg was organised and chaired by GL's Hans-Günther Albers.

Short Payback Time

LNG is already a well-established fuel in the ferry industry in Norway, with a growing infrastructure and uptake from many operators. Rolf Nagel from Flensburger Schiffbau-Gesellschaft presented the company's RoPax design for a dual-fuel, 199 m vessel designed for 600 passengers. Utilising LNG requires adjustments due to the size of the tanks, Nagel said, but the design succeeded in minimising the impact on the cargo hold, engine room and endurance of the vessel.

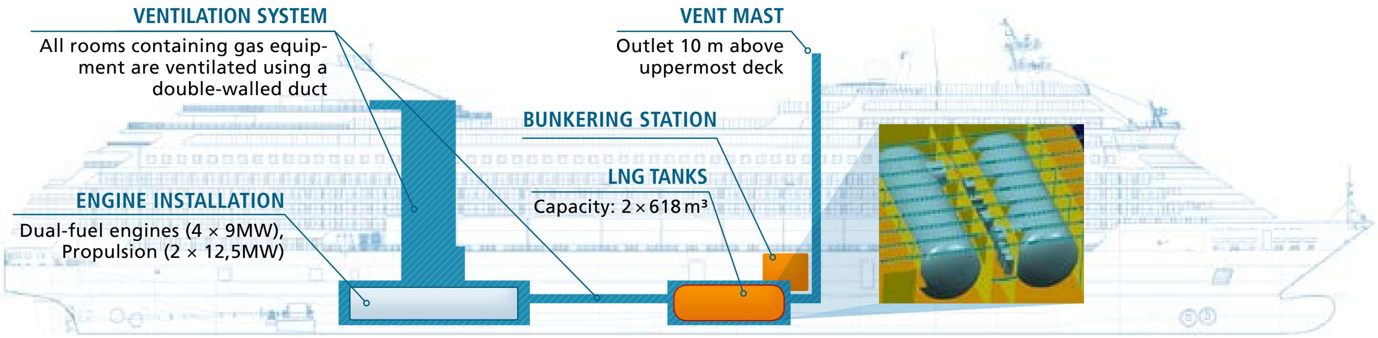
Although passenger ferries are not yet subject to the incoming EEDI (Energy Efficiency Design Index) regulations, Nagel pointed out that LNG enjoyed a significant advantage over fuel oil in the formula's conversion factor – some 26 per cent in attained EEDI. The extra costs of an LNG installation had a payback time of one and a half to two years, he continued, and the reduced emissions to air saved considerable external costs compared to using conventional fuels – an important factor in an increasingly stringent regulatory environment.

The cruise industry is also likely to move towards LNG, with newbuilds planned for the near future. With a North American Emission Control Area (ECA) entered into force last year, LNG offers cruise lines a cleaner fuel both in protected marine environments and during port visits. Gerhard Untiedt, Meyer Werft, presented a mid-sized, 2,000-passenger cruise ship design with dual-fuel engines (see next page).

Unlike the cruise ship and RoPax designs, the mega yacht from the Lürssen shipyard uses vertical tanks: two 180 m^3 type C tanks situated amidships in front of the engine room with a cofferdam in-between and behind the accommodation. Lürssen's Dr Bernhard Urban presented the concept,

LNG-Fuelled Cruise Ship

Meyer Werft's cruise ship concept with a dual-fuel engine includes two 618 m³ tanks that would enable the vessel to undertake a typical one-week cruise running on LNG alone.



based on the conversion of an existing 110 m, 3,600 t motor yacht, as well as the results of a CFD-analysis related to the air circulation in the engine room. The dual-fuel system gives the yacht owners the same flexibility and usability as the conventional-fuel design. The vessel can run on LNG for 2,000-3,000 nm, with a total range of 6,000 nm between bunkering.

Various Tank Solutions

The gas fuel systems in all of the GasPax project's designs were developed by TGE Marine Gas Engineering. Hans-Christian Haarmann-Kühn examined the fuel gas systems,which present a variety of solutions for different ship types. Existing Norwegian Ferries typically use very similar systems with a highly efficient vacuum tank operating at 6 – 8 bar, with a design pressure of typically 10 bar, he said. This was a potential solution for tanks up to 1,000 m³, although it would not fit perfectly to any vessel configuration.

All of the LNG containment systems used by LNG carriers today could be used as fuel storage under current regulations, Haarmann-Kühn said, from small high-pressure tanks to massive 50,000 m³ membrane tanks – a theoretical possibility for the largest container vessels. The type C tanks used in the GasPax designs offered the advantage of being considered inherently safe under the IGC code, he noted, and cylindrical, 8 – 10 bar type C tanks could easily hold up 3,500 and more m³.

CELEBRATION. GL's Dr Pierre C. Sames (left) presents the GasPax project partners with approval-in-principle certificates.

Photos/Illustrations: FSG, Lürssen, Meyer Werft

Bunkering remains a key concern for a more widespread use of LNG as a ship fuel. GL has also been active in the concurrent BunGas project. The hose connections and procedures for bunkering conventional fuels can be diversified which require multiple adapters. LNG's different handling requirements require a solution enabling the daily operation of the ship type to proceed as they would coventionally while ensuring safety.

An overview of the growing bunkering infrastructure and the continuing development of safety standards and guidelines was offered by Henning Pewe, GL's Lead for Gas Technology (see also page 18). Despite there not being any import terminals to facilitate small-scale LNG distribution in Asia at present, he said, there were plans for an LNG bunker facility in Singapore, and work was continuing on the development of ship connectors for bunkering, crew training standards, and required procedures and regulatory safeguards for harbours.

GL's Dr Pierre C. Sames, Head of Research and Rule Development, presented the four project partners with approval-in-principle certificates, recognising the technical feasibility of the designs. Dr Sames noted that presenting the certificates showed once again that there were market-ready designs available for owners to take the next step and move to LNG. ■ **SA**

FOR FURTHER INFORMATION:

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

Phone: + 49 40 36149-113, E-Mail: pierre.sames@gl-group.com

FUEL LOGISTICS. Natural-gas-powered ships such as the GL-classed „Bit Viking“ will soon become more common, helped by stricter environmental and efficiency requirements. But ports such as Hamburg have yet to create an appropriate infrastructure for LNG bunkering.

Wanted: Reliable Gas Supply

Legal stipulations, logistics requirements and technical challenges: a new study clarifies how LNG bunkering can be made a reality in German ports

Photos: Hbbolten/Peresanz | Dreamstime.com Tarbit Shipping

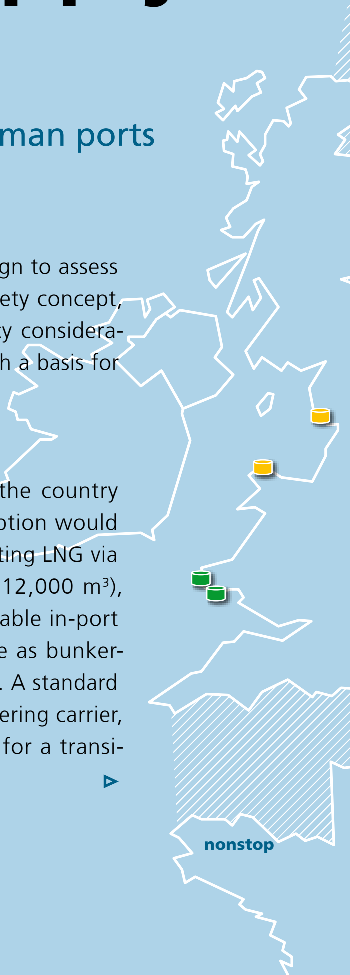
Boosting energy efficiency while lowering noxious emissions to air: with bunker oil prices on a steady rise and stricter exhaust gas emission limits in force, propulsion systems using liquefied natural gas (LNG) as fuel are more attractive than ever. Even as a transitional technology, natural gas is moving into focus as a key enabler of the global energy turnaround. Anticipating a growing global demand for natural gas, the German government considers it a strategic necessity to diversify its natural gas sources and the associated means of transport.

With this in mind, the German Ministry of Transport commissioned a safety and feasibility study to explore LNG bunkering of oceangoing ships in German sea and inland ports using special LNG bunkering vessels.

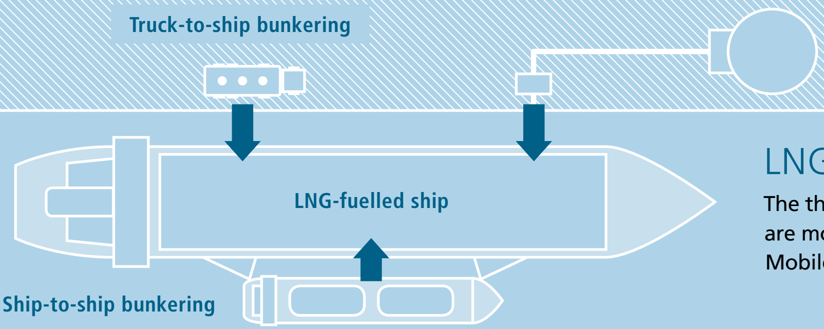
The study investigates the existing liquefied natural gas infrastructure in northern Europe and Germany, proposes an LNG bunkering logistics concept, and examines a specific ship-to-ship bunkering interface design to assess the risks. Finally the study presents a draft safety concept, which accounts for legislative and competency considerations, to provide the responsible authorities with a basis for further action.

Infrastructure Analysis

To enable LNG bunkering in German ports, the country needs to build a supply infrastructure. One option would be to adopt the Norwegian method of distributing LNG via small-scale LNG carriers (capable of carrying 12,000 m³), with short-term LNG storage provided by suitable in-port terminals. The small LNG carriers would serve as bunkering ships distributing the LNG within each port. A standard LNG carrier, or an appropriately designed bunkering carrier, could provide the necessary storage capacity for a transitional period. ▹



LNG Infrastructure in Northern Europe



LNG Bunkering Methods

The three liquefied-gas fuelling methods are most likely to succeed in the market. Mobile tank units are another option.

▶ The study includes an in-port LNG infrastructure concept using Hamburg as a reference port, and accounting for the relevant legal conditions. As a general conclusion the authorities will face considerable challenges finding appropriate in-port locations for a short-term storage terminal, the standby berth for the bunkering vessel and additional water areas for maintaining and commissioning gas-handling systems, or making the necessary water traffic safety arrangements during bunkering. Current restrictions do not permit LNG transfer outside gas terminals.

The analysis of existing regulations applicable in Germany found that pursuant to MSC.285(86) as incorporated into the German Ship Safety Act, a valid legal framework for operating and approaching an LNG-fuelled ship is already in existence. Operating LNG-powered ships is therefore legal. Similarly the German regulatory situation for transporting hazardous goods by oceangoing vessel (LNG carrier) is relatively clear, contrary to fuel bunkering. However, there are significant differences among German ports.

It would therefore seem advisable to define specific requirements for the "Transfer of Fuels with Flashing Points below 60 °C", and to treat LNG bunkering and LNG transport as separate processes. Furthermore, a set of general safety criteria should be defined to help the responsible authorities develop a consistent nation-wide set of rules.

Technical Concept

The study includes a technical concept for ship-to-ship bunkering of liquefied natural gas based on an LNG bunkering ship designed by TGE (see illustrations on the right). The concept reveals the basic engineering challenges inherent in bunkering liquefied gases.

One of the core assumptions was that the system should be designed to allow simultaneous bunkering and cargo loading/unloading. In addition, it was decided for economic and logistical reasons that it should be possible to refuel a ship with both gas and conventional liquid bunker oil simultaneously. A hard arm was designed, placing particular emphasis on avoiding possible leakage. The system calls for suitable QC/DC coupling systems that minimise the potential for operator errors. An emergency quick-disconnect system further enhances safety.

An evaluation of the technical feasibility of LNG bunkering showed that the required technology as well as comprehensive LNG handling experience are available now. From a

Concepts for Bunkering Vessels

TGE Marine Gas Engineering and FKAB Marine Design are developing concepts for ship-to-ship bunkering.

TGE. This design is intended for simultaneous transport of LNG and MGO.

Total tank volume	3,000 m³ (LNG), 400 m³ (MGO)
Number of tanks	2 (2×1,500 m³)
LNG discharge rate	1,000 m³/h
LNG intake rate	900 m³/h
Length over all	93.6 m
Beam	14.8 m
Height to main deck	8.2 m
Draught (LNG full, at departure)	5.05 m
Draught (empty, following bunkering)	3.5 m

Photo: The Linde Group

TERMINAL. A tanker vessel taking in LNG from a local storage facility in Sweden.

technical viewpoint, there is no reason to oppose the implementation of LNG bunkering.

Risks Inherent in LNG Bunkering

An analysis of hazards involved in refuelling an LNG-powered ship from a bunkering vessel revealed a number of potential errors that could increase the associated risk. These mainly include inadequate communication between the two ships, personnel falling over board, and LNG leakage while bunkering. A ship collision might cause the refuelling hose to break or a tank to suffer damage. In the event of hose breakage, the amount of leakage could be minimised effectively by a fast-acting safety chain that would keep the hazardous effects within controllable limits.

However, in the event of a ship collision potentially damaging the LNG storage tank, such a system would not be able to contain the leakage. Therefore the study investigates the probability of a collision in the given situation. The analysis showed that a collision with a ship at berth (whether for bunkering or otherwise) is highly unlikely. Imposing appropriate limitations of the manoeuvring space around ships being bunkered would further mitigate the collision risk. The study concluded that the likeliness of a collision with a bunkering vessel in transit from its berth to a customer is the same as for any other ship moving within a port. Careful monitoring and control of in-port traffic by the port zone authority can help minimise the collision risk. This includes specific measures such as safety distances, closest-point-of-approach rules, zone limitations or tug support.

The outcome of the study and its safety analyses served as a basis for the development of a safety concept for bunkering liquefied gas. The resulting draft concept is intended to provide the responsible authorities with guidance in taking further steps towards harmonised rules for all of Germany.

The safety concept makes a distinction between port-specific and general requirements. The requirements were generally defined on a functional basis wherever possible so as to ensure safety while excluding technical solution variants. The draft guideline was amended to contain a list of compulsory items to include in a bunkering procedure, and a corresponding bunkering check list.

The study closes with recommendations for adapting the legal basis as well as for building the necessary infrastructure. ■

FOR FURTHER INFORMATION:
Henning Pewe, Gas Technology Expert
Phone: +49 40 36149-653, E-Mail: henning.pewe@gl-group.com

Photos: TGE Marine Gas Engineering, FKAB Marine Design

FKAB. This vessel will be equipped with two engines capable of burning either LNG or biogas.

Length over all	67.6 m
Beam	11.6 m
Draught	3.5 m
LNG tank volume	800 m³
LNG intake rate	300 m³/h
Top speed	12.5 kn
Engine output	2 × 675 kW

Safer Racing

Modern racing yachts walk a thin line between ultra-lightweight design and structural strength. Spectacular racing accidents have shown the need to scrutinise structural integrity. Volvo Ocean Race has the structural design of its next-generation racing yachts certified by GL

Legend has it that it all began over a beer in a Portsmouth pub some 40 years ago. Today the Volvo Ocean Race is one of the world's highest-profile yacht races, exposing humans and their equipment to the most extreme conditions.

In 1973, 17 boats left the Solent for the first ever "Whitbread Round the World Race", as it was then called, heading south to Cape Town on the first leg of the circumnavigation. Crews were using standard ocean cruisers for the race around the globe; some of them may have expected a romantic sea adventure. In those days, offshore racing relied on classical analogous navigation methods, following traditional trade wind routes. As it turned out, racing was far from being a romantic adventure but a highly competitive, demanding and dangerous sport. Tragically, three lives were lost during this first race. A further two participants died in the nine subsequent races.

These events marked the onset of a relentless drive towards maximising speed and performance while ensuring personal and equipment safety. Many of the ideas ▶

Photo: IAN ROMAN/Volvo Ocean Race

SAIL CHANGE.
Abu Dhabi Ocean Racing bowman Wade Morgan getting pounded by waves at the start of Leg 9 of the Volvo Ocean Race 2011/12.

developed over the years eventually trickled down into leisure sailing. However, as the sport became more professional so the costs for a full campaign increased steadily, rising to as much as 30 million euros in some cases. At the same time, the number of entries dropped and the race organisers came to the conclusion in 2012 that brave decisions had to be made to keep the event in its position as offshore sailing's number-one challenge.

New Entry Rules

That dramatic change was initiated in mid-2012, even before the end of the last race. Having spent considerable time evaluating future options, the Volvo Ocean Race management board decided to change its entry rules for the 2014/15 race from individually designed boats to a one-design class. This should significantly cut the costs of running a campaign since all teams will be using the same racing material and share the costs of design, construction and spares. As a consequence, teams will be able to lower their overall investment, including operating and maintenance costs. The Race organisers are hoping for a fleet of at least eight to ten boats in the 2014/15 race.

The new, standard version of the racing yacht is supposed to be slightly smaller than its predecessors, without compromising speed. This requirement from the design brief is quite a challenge for the chosen yacht designer, Farr Yacht Design, US. The specifications also call for improved reliability because the boats used in recent years turned out to be overly fragile; on some legs of the race, an original fleet of six would shrink to a mere three. Following several loops of conceptual iterations, the designers arrived at a concept that satisfies the demands for an exciting race, excellent performance, enhanced safety and, last but not least, striking appearance.

With a total length of 20.5 metres, the new design comes with a full-length hull chine, vertical hull topsides, and a reverse stem. The canting keel is not only designed to provide the proper righting moment by shifting weight

MANOEUVRE. Charles Caudrelier on board Groupama Sailing Team during Leg 1 of the Volvo Ocean Race 2011/12, from Alicante to Cape Town.

CAPE TOWN. Emirates Team New Zealand, skippered by Australian Chris Nicholson during the In-Port Race between Leg 1 and 2 of the VOR 2011/2012.

Photo: IAN ROMAN/Volvo Ocean Race

windward to provide more sailing stability, but also includes an inclined canting axis so that the keel foil provides hydrodynamic lift and the weight of the bulb is moved aft when canted. The two asymmetric daggerboards are capable of reducing the so-called "leeway" of the hull, further reducing resistance. These are just a few examples of the innovations introduced by the new design.

The boat will be equipped with the most advanced media technology to share visual information using high-resolution photography and high-definition video. During a race the on-board system will send frequent status updates and reports to the worldwide audience. Current GPS-based tracking and other information technology will enhance the crew's safety significantly.

Photo: Yann Riou/Groupama Sailing Team/Volvo Ocean Race

Cutting the Cost

The boat will be constructed by a consortium of boatyards in the UK, France, Italy and Switzerland, and assembled and sold by UK-based Green Marine Ltd. The first boat is scheduled to be delivered in June 2013. The price of a fully equipped boat will be around 4.5 million euros, cutting the cost of a race campaign to between 12 to 15 million euros, more than half of what some participants spent in the past.

The current record for a 24-hour run is 596.6 nautical miles (nm) at an average speed of 24.85 knots. The new fast-planing yachts will again reach top speeds of close to 40 knots. The Volvo Ocean Race management, bearing in mind the rough conditions the yachts will be exposed to in the Southern Ocean, explicitly stated it wants to design and build "ultra-reliable" boats for future contests.

Meanwhile, the developers' engineering and design concepts have been evaluated. As expected, the plan intends using lightweight, carbon-fibre-reinforced sandwich ▶

MATERIAL. *One square metre of hull shell, made of nomex honeycomb or foam-cored carbon sandwich skins, weighs only about 10 kg.*

COUNTDOWN. The fleet head off the starting line, competing in the Sanya Haitang Bay In-Port Race during the Volvo Ocean Race 2011/12.

Photo: PAUL TODD/Volvo Ocean Race

HISTORY:

Winners of the Volvo Ocean Race, formerly "Whitbread Round the World Race" (until 1998):

1973/74
"Sayula II"

1977/78
"Flyer"

1981/82
"Flyer II"

1985/86
"L'Esprit d'Equipe"

1989/90
"Steinlager II"

1993/94
"NZ Endeavour"

1997/98
"EF Language"

2001/02
"Illbruck Challenge"

2005/06
"ABN Ambro One"

2008/09
"Ericsson 4"

2011/12
"Groupama 4"

structures for the hull. Every single component will be optimised for structural performance under the anticipated loading scenarios and lifecycle assumptions. FEA analyses will be performed to enhance the global as well as detail structural design processes.

Strong Capabilities

In an unprecedented effort, every conceivable measure is being taken to assure structural reliability. A panel of external structural engineers, all experienced in the field of high-profile racing yachts, have been engaged to review the design submitted by Farr Design. The engineers at Green Marine (UK), Gurit UK and PURE Design & Engineering (NZ) will review and comment the outcome.

The strict structural safety specifications of the design brief require the boat to conform to current scantling standards. This is where Germanischer Lloyd comes in: GL's active involvement in the design of an America's Cup racing yacht a few years ago demonstrated the strong capabilities the company can offer in this field. In fact, GL was able to establish itself as a widely respected authority on structural reliability assessments for racing yachts. Furthermore, Germanischer Lloyd has recently extended its range of activities to include certification of racing yachts to the requirements of the International Sailing Federation (ISAF). In the wake of the America's Cup project, GL published a new set of rules called "Guidelines for the Structural Design of Racing Yachts > 24 m".

PERSICO. Work has started on laminating the first hull of the new 65-foot boat.

Photo: Mark Somerville/Persico

As early as last June, GL was approached by the VOR project manager requesting a plan review and inquiring about certification. To provide VOR with the best possible service, a double-check was proposed and agreed. The structures for the new yacht were to be checked for compliance with both the pertinent ISO standards generally applying to standard leisure craft, and an adapted version of GL´s "Guidelines for the Structural Design of Racing Yachts". The process of scrutinising the plans for the new VO65 Volvo Ocean racer is now underway at GL. ■ **HH**

FOR FURTHER INFORMATION:
Hasso Hoffmeister, Special Craft & Offshore Service Vessels
Phone: + 49 40 36149-411, E-Mail: hasso.hoffmeister@gl-group.com

The new Volvo Ocean 65

The new boat design will be used in the next two editions of the VOR. Developed by Farr Yacht Design it was unveiled last year in June by VOR CEO Knut Frostad

Green Marine Ltd. is an established performance boat builder in Lymington, UK, and has been building many of the world's best-known racing and cruising yachts for 28 years, including VOR contenders, America's Cup challengers and cutting-edge cruising superyachts. Green Marine, part of the Vitters Shipyard group, has earned a worldwide reputation as a leading specialist in advanced carbon-fibre moulding techniques.

Decision S.A. are specialists in the use of composite materials in construction. Since 1984, DECISION has been active in the boatbuilding industry and from 2000 to 2009, the company built the boats used by Team Alinghi, including America's Cup winners in 2003 and 2007. Switzerland-based DECISION has wide experience in other areas of construction, the space industry, aviation and telecommunications.

Multiplast are pioneers in composite boatbuilding with an outstanding 30-year track record in the world of offshore racing (Route du Rhum, Jules Verne Trophy, Atlantic record). The combination, within the same company, of an office of naval architecture and manufacturing workshops for composite parts is unique and provides a comprehensive professional approach.

For the current edition of the VOR, MULTIPLAST built the Volvo Open 70 Groupama 4.

Persico S.p.A. is one of the world's most experienced and versatile mould-engineering specialist companies with automotive, rotomoulding, engineering, marine and aerospace/aeronautics divisions located in an area of 60,000 square metres in Nembro (Bergamo), Italy.

Persico Marine has been involved in projects including Moro di Venezia | 1992 (bulb and keel), RC44 | 2004 (hull-deck-helm mould), Luna Rossa 2007 and Luna Rossa 2012, Abu Dhabi Ocean Racing 2011, and Artemis Racing wings (plugs and moulds) 2011-12.

Farr Yacht Design, Ltd. has a long-running record of achievement dating back more than 25 years and including 40 World Championships won in Farr designs and a multitude of design successes at internationally prestigious grand prix yachting events such as the VOR, America's Cup, Vendée Globe, Sydney Hobart, Barcelona World Race, Transat Jacques Vabre, Copa del Rey and many others.

Founded by Bruce Farr and Russell Bowler in 1981 as Bruce Farr & Associates, the present-day Farr Yacht Design has grown to a design team comprised of 18 members providing an enormous range of talent and skills.

Technical Specifications

Hull length	20.40 m (67 feet)
Length on deck	19.80 m (65 feet)
Length over all	21.95 m (72 feet)
Hull beam	5.60 m
Max. draft	4.70 m
Boat weight	10,750 kg
Rig height	30.30 m
Mainsail area	151 m^2
Working jib area	135 m^2
Max. upwind sail area (incl. "Code 0")	451 m^2
Max. Downwind Sail Area	550 m^2
Canting keel	+/ –40°
Water ballast	2 × 800 l aft, 1 × 1000 l fwd.

"We Respond Flexibly to Customer Requests"

Europe's shipbuilding landscape is in a state of upheaval. Fassmer, a yard with a proud tradition, has long since reacted and is already active in wind energy

Seldom has a company endured as a family-owned enterprise over five generations. At the Fassmer yard in Berne, the generational handover has always been a smooth process. With a good sense of proportion and innovative energy, Holger and Harald Fassmer are steering the company through the crisis in European shipbuilding. Harald Fassmer spoke to *nonstop* about successful projects and new opportunities.

NONSTOP: Very few entrepreneurial families manage to operate and even expand a company over five generations. What is the secret of the Fassmer family?

HARALD FASSMER: One very important prerequisite is of course that the previous generation does a good job and develops the company further. A generational transition can only succeed if the successors are given the requisite leeway. For that, they really have to understand the business and be motivated to take it further.

And, naturally, a certain amount of luck is always needed. My brother and I expanded the business carefully, step by step, and avoided taking risks that were too big for us. We complement each other well. Investments and the associated risks are analysed jointly by both of us.

ENTREPRENEUR. Since 1992, Harald Fassmer and his brother Holger have led this long-established yard located on the Weser River in northern Germany.

Photos: Fassmer

POLISHED.
Even under these difficult market conditions, Fassmer is staying its course as a builder of special-purpose vessels.

NONSTOP: That certainly also applies to your investments in Poland and China. There you have carved out a successful market position with your own subsidiaries. What was your strategy?

FASSMER: We decided to proceed in small steps, and not kick off with large joint venture projects. Our cooperation partners today were initially subsuppliers. We got to know each other slowly, and then let the level of trust build up to a fruitful partnership. This approach has served us well, and our diversification efforts have proved successful.

NONSTOP: How do you define success in the light of the difficult market environment and the stiff competition?

FASSMER: The competitive situation is indeed tough in all sectors, but especially so in shipbuilding. The necessary transformation to special-purpose shipbuilding poses a great challenge. Shipyards with little experience in this market segment often underestimate the complexity of custom-built ships. Coupled with the necessity of winning new orders, this leads to unrealistic quotations. A situation that makes life difficult for us as an experienced builder of special-purpose ships, with over 50 deliveries in recent years. Europe's shipyards are under massive pressure, not least because the European shipping companies are continuing to place their orders primarily in Asia and not with domestic yards. Living from shipbuilding alone is a great challenge for any enterprise in view of the overpowering Asian competition.

NONSTOP: What are you doing to remain competitive?

FASSMER: In special-purpose shipbuilding, it is decisive to support the client from the very beginning with technical problem-solving expertise, to respond flexibly to customer ▹

OSV. Offshore service vessels perform special tasks (supply, transport and towing) in the offshore sector. These ships can be classified according to GL Rules.

▷ requests, and to be able to give rapid answers to issues of the day. We certainly have these capabilities: our development and design department boasts over 80 engineers. This may seem excessive for a location with a total workforce of 400, but we also offer our engineering services to the yards that build naval vessels to our designs for their home markets.

In order to survive in the international market, the sales activities have to be expanded adequately, more projects have to be won, and the spectrum of products and services has to be broadened further. A particularly important point is the systematic advancement of technological aspects: for example, Fassmer has been working on LNG and hybrid drives for some time now. Environmental topics are also squarely in the focus of our attention.

NONSTOP: What role does Europe's new energy policy play in the future of the Fassmer shipyard?

FASSMER: With the energy shift and the establishment and connection of offshore wind farms, a whole new market is being created over the medium term. The demand for OSVs will increase, and I am optimistic that Fassmer will also enjoy a share in the construction of service vessels and transport ships. However, this requirement does not exist as yet. The greatest problems are the financing and the grid connection of offshore wind turbines. Here the guiding hand of the state is needed to provide the appropriate stimuli for expansion of the infrastructure. Given the enormous funding requirement, only the major energy utilities can play a part here. A greater commitment by the Federal Government would be welcome in order to strengthen the domestic shipbuilding industry.

SAFETY. Fassmer builds lifeboats that can fall freely into the water from a height of up to 26 metres.

Photos: Fassmer

NONSTOP: What significance does the offshore sector hold for your company?

FASSMER: The offshore business segment now makes up more than a quarter of our total turnover. In the area of wind power, we have established ourselves internationally as a supplier of spinner and nacelle covers. We also offer access systems for wind turbines, such as helicopter winching pads. As an innovation, we have developed a landing system for safely accessing wind turbines from service boats. This opens up new market opportunities.

NONSTOP: You supply equipment housings to all the leading international turbine manufacturers. Not exactly typical for a shipyard. How did this come about?

FASSMER: This business is based on our experience in the building of lifeboats. After demand plummeted in September 2001, we analysed the market and recognised the need for large GRP mouldings. Then we very quickly identified the wind turbine producers as potential clients. Business has developed well; further expansion of these activities will follow when demand increases.

We also make high roofs for delivery vans and, within the scope of single-sourcing concepts, have developed just-in-time production methods for a major automobile firm.

OFFSHORE. For about 15 years now, Fassmer has been delivering components – such as helicopter winching platforms – to the manufacturers of wind turbines.

NONSTOP: Where do you see the Fassmer shipyard in ten years?

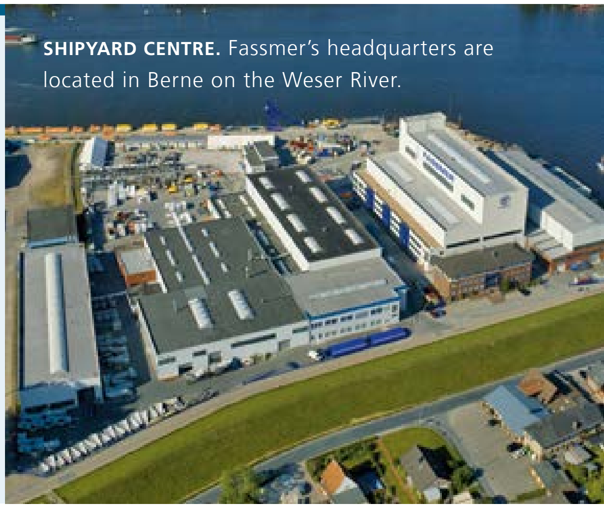
FASSMER: What the next ten years will bring is difficult to predict. But we believe that the wind energy sector will grow and that this will enable us to compensate for market fluctuations and workload problems in other areas. There is still a lot of innovation potential in shipbuilding through the use of new materials, such as composites and aluminium. The progress in welding alone has advanced shipbuilding technology considerably in recent years. At present, ourorder book is by no means as full as it was in the boom years. Still, we have enough work for the next two years, and I am looking forward to a number of newbuilding contracts we expect to receive in the course of the year. ■ **OM**

FOR FURTHER INFORMATION:
Dirk Lange, Business Development Manager
Phone: +49 40 36149-7907, E-Mail: dirk.lange@gl-group.com

Fassmer – A Story of Success

In 1850, Johannes Fassmer founded the shipyard in Berne on the Weser River. In the early years, business was concentrated on the building of small wooden ships and lifeboats. Today, Fassmer is an international enterprise that is successfully diversified with six divisions: Shipbuilding, Lifeboats, Deck Equipment, Wind Power and Composite Technology as well as After-Sales Service.

The brothers Holger and Harald Fassmer are already the fifth generation to lead the company; production facilities in Germany, Poland and China – amongst others – employ a total of more than 900 workers. The internal development and design department plays a central role: it allows a high level of customer focus and individual support.



SHIPYARD CENTRE. Fassmer's headquarters are located in Berne on the Weser River.

Photo: Dreamstime

GL Academy – Dates at a Glance

Selected seminars in 2013 – information and registration: www.gl-academy.com

MARCH

21.03.2013
Gas as Ship Fuel
Hamburg, Germany

21.03.2013
Maritime Security – Developments and Best Management Practices
Piraeus, Greece

26.03.2013
Offshore Basics and Dynamic Positioning
Singapore

27.03.2013
Disability-Awareness and Assistance Training for Passenger Ship Operation (acc. Regulation (EU) 1177/2010)
Copenhagen, Denmark

28.03.2013
MASP – Método de Análise e Solução de Problemas – ISO 9001:2008
São Paulo, Brazil

APRIL

01.04.2013
Ship Structural Design
Singapore

02.04.2013
Voyage Optimisation
Istanbul, Turkey

02. – 03.04.2013
Implementation Workshop ILO Maritime Labour Convention
Piraeus, Greece

08. – 11.04.2013
Port Facility Security Officer (PFSO) Training Course
Doha, Qatar

09.04.2013
Damages to Machinery and Repairs
Copenhagen, Denmark

12.04.2013
Bulk Carriers – Technical and Operational Aspects
Genoa, Italy

18.04.2013
How Lean Is Your Safety Management System (SMS)?
Hamburg, Germany

19.04.2013
Damages to the Hull Structure
Riga, Latvia

22. – 24.04.2013
Energy Manager ISO 50001
Dubai, United Arab Emirates

23.04.2013
STCW 2010 Implementation Workshop
Madrid, Spain

25.04.2013
Oil and Chemical Tankers – Technical and Operational Aspects
Hamburg, Germany

29.04.2013
Air Pollution from Ships in Practice
Hamburg, Germany

MAY

06. – 08.05.2013
Company/Ship Security Officer (CSO/SSO) Training Course
Tallinn, Estonia

07. – 08.05.2013
Application and Implementation of an SEEMP
Copenhagen, Denmark

09. – 10.05.2013
Designated Person Ashore (DPA) Training Course
Madrid, Spain & Singapore

13. – 14.05.2013
ISM – A Risk Management Approach
Genoa, Italy

15. – 16.05.2013
Accident Investigation in Shipping – Analysis and Root Cause
Istanbul, Turkey

15. – 16.05.2013
Vetting Inspections
Rome, Italy

20.05.2013
Energy-Efficient Fleet Management
Genoa, Italy

27.05.2013
Emergency Preparedness and Crisis Management
Limassol, Cyprus

28. – 31.05.2013
Approved HazMat Expert
Ciudad Lázaro Cárdenas, Mexico

Cooling Water Circuits

More Ways to Conserve Energy on Board

FutureShip Research scrutinises big energy consumers

BY DR JÖRG LAMPE AND DIPL.-ING. MALTE FREUND

Photo: Gary Blakeley | Dreamstime.com

Photo: Eberhard Petzold/foto-dock.com

SHIPPING. Cooling water systems are power guzzlers.

Rising energy costs, fierce competition and stricter emission control requirements are three good reasons to continue the search for further saving potential on board ships. A new study conducted by GL subsidiary FutureShip looks at the energy consumption of the complex cooling water circuits.

There is definitely more shipowners can do to lower their costs and protect their bottom line. The question is: Which are the parameters to fine-tune, and what are the most economical ways to optimise both ships in operation and newbuilding projects? These are key issues researchers at FutureShip have been investigating. A recent study conducted in cooperation with a large shipping company focused on the cooling water circuits in the engine room of a post-Panamax container vessel.

The cooling water systems are among the most energy-hungry auxiliary systems, consuming roughly one third of the electrical energy generated on board. Therefore the purpose of the study was to identify the energy and cost-saving potential of certain changes to the system architecture and a more flexible approach to system operation.

Modelling Delivers the Best Answers

Virtualisation enables extensive testing of multiple design alternatives and scenarios that could never be evaluated thoroughly or feasibly enough by conventional means. To allow an analysis of the complex stationary and dynamic behaviour of different variants of the cooling water system, FutureShip developed a computer-based simulation model of the engine room cooling systems, and verified its accuracy by comparing it with on-board measurements.

The cooling circuit was modelled at a rather fine level. Modelling the complete cooling water circuit was a rather complex task, since the components belong to different physical areas, all of which had to be covered by the software employed: the main engine (thermodynamics), the heat exchangers (thermodynamics, fluid dynamics), the flow in piping (fluid dynamics), and the pumps (electrics, mechanics). The object-oriented multi-domain CAE simulation software SimulationX provided the required level of detail for the components involved. It accounts for mass flow, heat and pressure balance. The design values used for the simulation model were confirmed by on-board measurements.

Evaluating Model Variants

The next step was to search for system modification options harbouring significant saving potential. To make modifications, values and characteristic curves could be assigned to all component properties, e.g. of the main engine, auxiliary engines, pumps, heat exchangers, etc. Since the model captured the design values and the measurements very well, the proposed simulated variants could be assumed to be reliable as well.

The two most promising solutions were selected for further analysis. These two variants of the simulation model were subjected to a variety of design load cases and typical operational scenarios.

The cooling water system consists of three subsystems:

- **THE HIGH-TEMPERATURE (HT) COOLING SYSTEM**, a freshwater circuit, cools down the main engine (ME) engine jacket and its coolant is heated up from 77 °C to 90 °C.

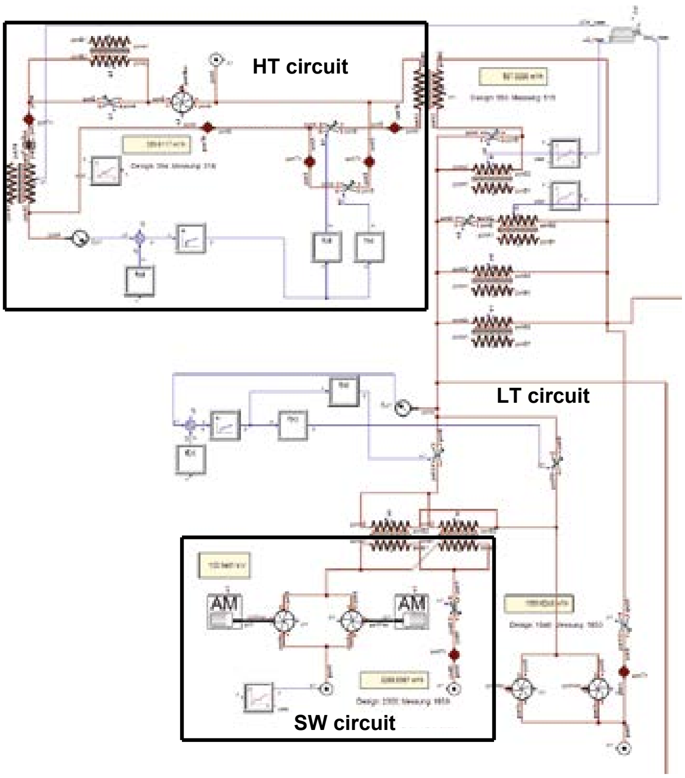


FIGURE 1. HT, LT and cooling SW circuit with SimulationX.

- **THE LOW-TEMPERATURE (LT) SYSTEM** likewise uses fresh water. It cools down various components in parallel, such as the lube oil, the main engine scavenge air, the auxiliary diesel engines, alternators, refrigerant condensers, excess steam condenser, etc. In a further stage the low-temperature system also cools down the high-temperature cooling system. The water in this circuit flows at 1,840 m³/h and is cooled from 50 °C to 36 °C. The low-temperature circuit is bypass-controlled to maintain a constant temperature of 36 °C downstream of the central cooling unit. Thus, depending on the heat load from the engines and the seawater temperature, parts of the cooling water bypass the cooler.

- Finally, **THE SEAWATER (SW) COOLING SYSTEM** uses seawater to cool down the water of the low-temperature circuit. Two main seawater pumps run in parallel to provide a volume flow of 2,300 m³/h to the central cooling unit.

Figure 1 shows a screenshot of the SimulationX model representing the three cooling subsystems. The high-temperature circuit for the main engine is displayed in the upper left. The main engine model, located in the upper right corner, is not modelled in every mechanical detail; rather, it is represented by the three heat sources that charge the cooling water system, comprising the lube oil, scavenge air and jacket cooling systems. The heat exchangers (jagged components) shown in the upper right area of the schematic belong to the low-temperature circuit, which is only represented in part on this screenshot. The structure of the SimulationX model matches the corresponding process flow very closely.

Variants and Simulation Results

Several variations of the actual cooling circuit were studied, and the most promising two were analysed in greater detail. Simulation studies of both variants were carried out to investigate different operational scenarios. A number of operational scenarios were defined based on various main ▹

Table 1: Operational profile of a representative voyage

Operational mode	Time (%)	ME workload (% MCR)	No. of aux. engines used
Port	30	0	1
Manoeuvre	5	20	3
Restricted water /slow steaming	35	45	2 – 3*
Sea passage	30	65	1 – 3*

* Varying number of auxiliary engines

▹ and auxiliary engine workloads. The design case represents the vessel under full load at tropical conditions, i.e. for a seawater temperature of 32 °C. A representative journey provides the operational scenario for simulating the variations (Table 1).

The following two variants of the cooling water circuit were analysed with respect to energy saving, related cost saving and payback period:

- VARIANT 1 assumes frequency-controlled (FC) pumps for the seawater cooling circuit.
- VARIANT 2 assumes a separate cooling circuit for the scavenge air cooler with frequency-controlled pumps.

Variant 1: Frequency-Controlled Pumps for the Seawater Circuit

The main cooling pumps for the seawater circuit are the biggest consumers of electric energy in the cooling water circuit, providing a constant volume flow of 2,300 m³/h. They are designed to handle the full load of cooling the main engine and auxiliary engines at a seawater temperature of 32 °C, which corresponds to tropical conditions. To maintain a constant temperature of 36 °C in the low-temperature circuit, the 1,840 m³/h volume flow is assumed to partly bypass the coolers.

Variant 1 suggests to shut down the bypass and guide the entire low-temperature volume flow through the two low-temperature coolers (Figure 2). Installing frequency converters for the seawater pumps will allow the volume flow through the seawater circuit to be controlled flexibly, and the heat transfer in the coolers to be adjusted accordingly. As indicated in Figure 2, the frequency converters are triggered at 36 °C, which is the design inlet temperature of the low-temperature circuit. On voyages with a seawater temperature below 32 °C, the volume flow through the seawater cooling circuit can be reduced to further reduce the consumption of electrical energy by virtue of the cubic relationship between the volume flow V and electrical power P_{el}. For instance, a volume reduction of 20 per cent will result in energy and cost saving of close to 50 per cent:

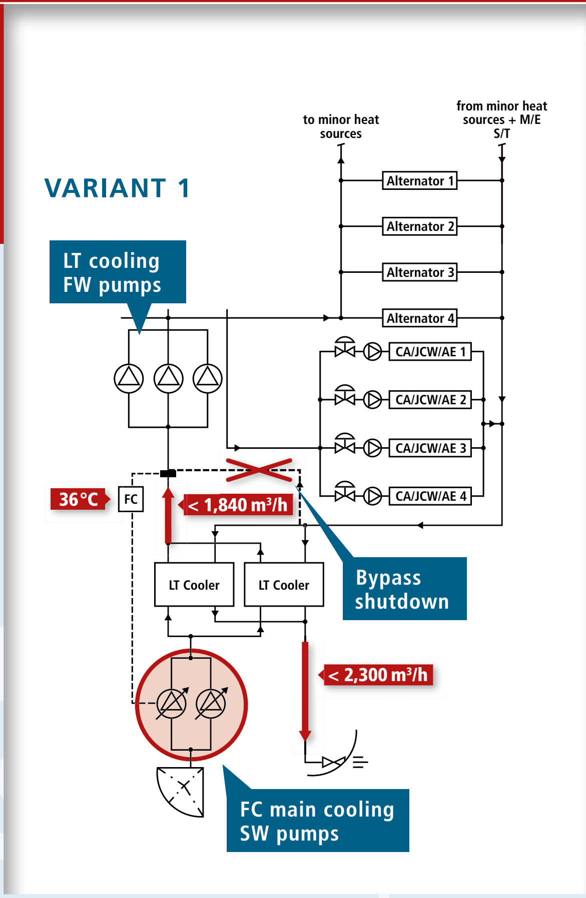


FIGURE 2. Seawater pumps with frequency converters.

With the relation $P_{el} \sim V^3$ the electrical power required is reduced by:

$$(0.8 \cdot V)^3 \approx 0.51 \cdot V^3 \sim 0.51 \cdot P_{el} \approx 50\%.$$

Since the operational costs of the pumps are directly related to the required electrical energy, this is an immediate way to save costs. It should be noted that decreasing the grid frequency by means of frequency converters will slightly diminish the efficiency of the electric motor, an effect the simulation model accounts for; however, compared to the achievable saving in electrical power this is rather small.

This variant requires only minor re-piping. The three-way temperature-regulating valve in the low-temperature cooling water system would be removed and replaced by two manually-operated butterfly-type flaps (one in the main line and one in the bypass) to allow manual temperature regulation in the event of frequency converter failure.

Variant 1 was evaluated for both newly built and existing vessels. Note that even vessels in service will not require new pumps; all that is required is retrofitting the existing pumps with frequency converters and control units. In the simulation, a lower bound of about 25 per cent of the nominal volume flow for the seawater pump was applied to avoid fouling up the piping.

Variant 2: Separate Cooling Circuit for Scavenge Air Cooler

The scavenge air cooler (SAC) generates the greatest heat influx (12 MW) into the cooling circuit at design operation, requiring a low-temperature cooling water volume flow of 440 m³/h, which is nearly a quarter of the total flow. Variant 2 proposes a separate cooling circuit with two additional 25 kW pumps fitted with frequency converters (FC). The cooling water for the scavenge air cooler is cooled down to 36 °C in a separate heat exchanger using sea water (Figure 3).

The heat influx from the scavenge air cooler strongly depends on the main engine load. The proposed separate cooling circuit will allow the cooling water flow to be adjusted based on demand, enabling substantial energy saving during part-load operation. Since implementing these measures for existing vessels would require re-piping and additional space for heat exchangers, this variant is only considered for new ships.

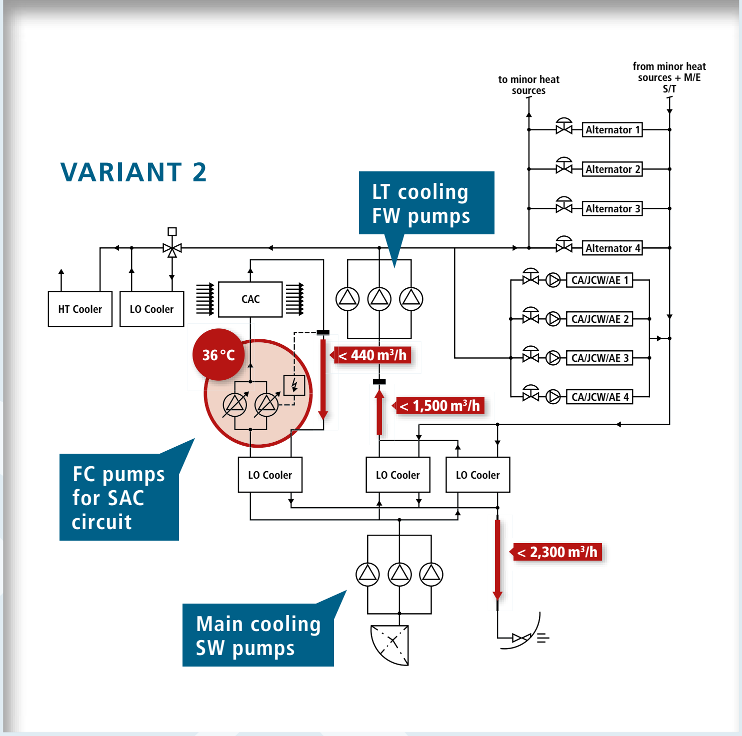


FIGURE 3. Separate cooling circuit for scavenge air cooler.

Substantial Savings

The simulated energy saving as compared with the costs of each variant, and the corresponding payback periods were calculated. The on-board electrical power was assumed to be generated by the auxiliary engine generator sets. With a typical specific fuel oil consumption of 215 g/kWh and a price of heavy fuel oil (HFO) of 700 US dollars per tonne, the price of 1 kWh computes as follows:

$$215\frac{g}{kWh}\cdot 700\frac{\$}{ton}=0.151\frac{\$}{kWh}=15.05\frac{ct}{kWh}$$

Table 2 lists the simulation results for both variants based on the operational profile specified in Table 1. Significant saving and a short payback period of just a few months are the clear benefits that can be achieved by using frequency-controlled seawater pumps (Variant 1) on both newly built and existing vessels. Implementing a separate low-temperature circuit for the scavenge air cooler (Variant 2) also harbours substantial saving potential, if at a higher investment sum and with a two-year payback period. While both variants are attractive, the first one is especially attractive as a small but highly efficient measure. ■

Table 2: Saving Generated by the Variants Proposed

Variants	Energy saving per year (kW)	Cost saving per year ($)	Cost of newbuild/ existing vessel ($)	Payback period for newly built vessels (year)	Payback period for existing vessels (year)
Variant 1 – typical journey	158	210,000	23,000/58,000	0.1	0.3
Variant 2 – typical journey	28	37,000	77,000/ –	2.1	–

Licensed to Lift

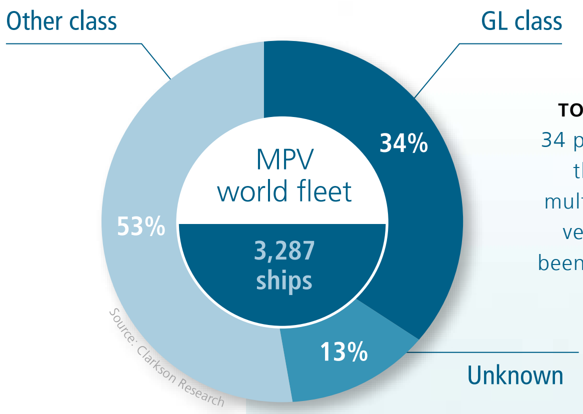
Germanischer Lloyd is the world market leader in the classification of containerships. But GL's experts are also in demand for multi-purpose cargo carriers. More than 1,100 multi-purpose vessels (MPVs) are under way worldwide with Class GL

Versatility is their greatest strength: depending on the particular type, multi-purpose freighters can handle the most diverse and unusual transport tasks. For instance, heavy-lift cargo ships are designed to transport extremely weighty cargo of up to 20 tonnes per square metre. Roll-on/roll-off carriers take aboard cars, trucks or even trains; some multi-purpose vessels (MPVs) compete with all-container ships. The fleet is rounded off by specialists for custom cargoes, such as the transportation of wood (timber carriers).

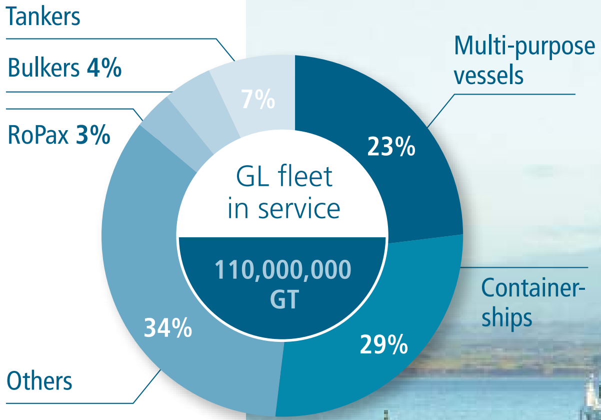
Multi-purpose vessels are the opposite of containerships: the cargo is not standardised, is often oversized in terms of length, width or weight, and is frequently conveyed only once from one remote location to another, far off the major container shipping routes. The ship's dimensions and equipment are chosen to meet these special requirements. MPVs are between 70 and 180 metres in length, have cargo holds ranging from 25 and 85 metres in length, are strengthened for heavy cargo, and carry their own cranes.

Mission Offshore

Despite the difficult macroeconomic climate, the outlook for the MPV segment is rather promising. "The call for dry bulk goods is stable," says Jan Rüde, Ship Type Expert for Multi-Purpose Vessels at Germanischer Lloyd. "The increasing containerisation of cargoes that previously were not transported in containers is certainly affecting the demand for multi-purpose cargo space." Much of the former MPV cargo is now being carried in containers. An example of this is rolls of steel or paper. "It means that the need for MPVs with large container capacities is likely to increase in future," says Rüde. What is more, there is a growing demand for multi-purpose vessels that are able to carry special cargoes: "Large and



TOTAL FLEET. 34 per cent of the world's multi-purpose vessels have been classified by GL.



GL CLASS. Multi-purpose vessels make up almost a quarter of GL's active fleet.

bulky cargoes, special-purpose or heavy-lift gear and unusual locations," says Jan Rüde, referring to the transports for offshore wind energy or for deepwater oil and gas production.

The global MPV fleet currently comprises almost 3,300 ships with a total cargo capacity of about 23 million GT. At present, the orderbooks of the shipyards worldwide contain few multi-purpose vessels. The new orders are only intended to replace decommissioned ships; the fleet itself is not growing.

The largest cost items in ship operation are, apart from the bunkering expenses, the crew as well as maintenance and repair work. For these issues too, GL gives its shipping company customers valuable support: "For a long time now, GL has been offering the class character AUT for automated engine operation and the software solution GL Machinery-Manager for optimised repair activities," Jan Rüde explains.

Technical supplements such as ice class are also strongly in demand for MPVs. "About 80 per cent of the multi-purpose vessels with GL class are strengthened for navigation in ice," says Rüde and estimates that about half of the entire MPV fleet is operating with ice strengthening. Of course, the rules of environmental policy for shipping also apply to multi-purpose freighters: by 2020 a set of more stringent environmental requirements will become mandatory, affecting both pollutant emissions and ballast water.

Optimised Design

The current requirements for transport constrain the design of this versatile ship type. Previously, the closed hull structure imposed limits on the length of the cargo. Because the trend is increasingly towards particularly large, cumbersome or weighty cargo, this situation is changing. "Many ▶

SPECIALIST. The demand for multi-purpose vessels for transporting large and bulky cargo is growing.

"Lifting 2,000 tonnes with a ship that itself has a deadweight capacity of 18,000 tonnes – that is quite a feat."

JAN RÜDE
Ship Type Expert Multi-Purpose Vessels at GL

▹ heavy-load ships now have their superstructures located forward," says Rüde. This offers a distinct advantage. The ship can be operated partially "open top", i.e. without hatchcovers, which does away with the height limitation of the hold. "This is especially suited to the transport of components for the offshore industry that are not especially heavy but can be 50 metres high," Rüde points out. "For the carriage of wind farm or offshore industry components, you need ships that can be loaded from astern and that have open holds."

Shipboard Cranes

When multi-purpose vessels call at ports that are not that well equipped, the cranes on board the ship become more important. "They are used not only in the ports, but also in offshore-like situations," says Jan Rüde. With the complex loading and unloading procedures, the environmental conditions are closely monitored so that the wind, wave lengths, and wave heights remain within acceptable limits," the GL expert explains. Today's largest cranes can hoist 1,000 tonnes. "That is quite a feat – lifting 2,000 tonnes with a ship that itself has a deadweight capacity of 18,000 tonnes." This special ability of the multi-purpose vessels is used particularly for unloading operations in offshore gas fields.

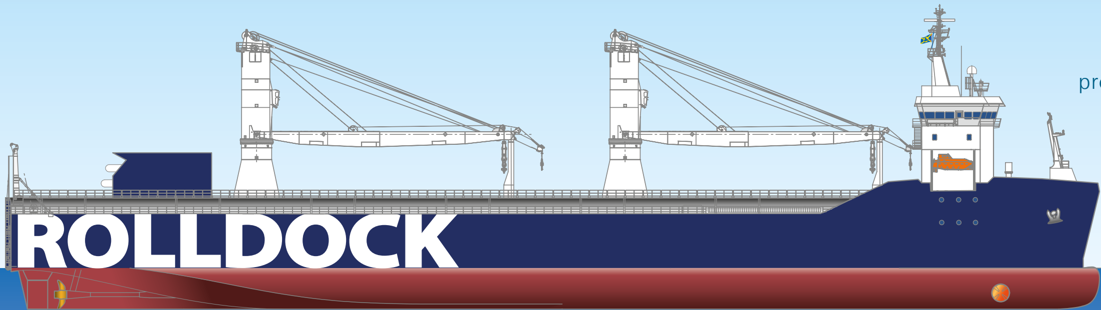
What does this mean for the technical configuration? "The cranes must be designed for greater flexibility, since differing numbers of load cycles and differing load spectra occur under wave-induced loading," says Rüde. For this reason, Germanischer Lloyd has revised its Rules for Cranes and updated them to reflect the international codes of the oil and gas industry (e.g. Euronorm, American Petroleum Institute). For GL's shipowning customers, this offers a larger scope of application for cranes that is oriented towards the load cases required by the shipping company.

Gentle Giants

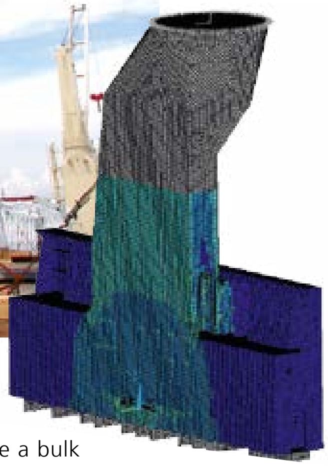
The RollDock design is a ship with a length of 151.5 metres for the flexible carriage of challenging project cargo.

Only recently, Flensburger Schiffbau-Gesellschaft commenced the construction of two units, with delivery planned for 2014. Two heavy-lift cranes can move up to 700 tonnes in tandem. In addition, the vessel's design offers adjustable stern ramps and hatchcovers that can be adapted to differing quay heights in ports.

This permits the loading or unloading of individual cargo up to 3,000 tonnes in weight in the classical RoRo manner. Finally, the ships can be submerged by more than twelve metres to allow cargo to be moved according to the float-in/float-out principle. Each vessel has a deadweight of 8,000 tonnes. The accommodation area of the ship has space for up to 32 persons, so that – besides the crew – escort staff can accompany the often highly complex and sensitive project cargo.



INNOVATION. Multifunctional project cargo carriers with GL class.



BIG BOY. The cranes of the MPVs often have to lift very cumbersome and heavy loads. They must therefore be integrated into the side structure of the ship with great care.

Since a multi-purpose vessel – unlike a bulk carrier – does not have any intermediate bulkheads, it is essential that cranes be integrated into the side structure of the ship. But does this not result in a highly complex distribution of forces? "Certainly," admits Jan Rüde. "You have to compensate for the moment. To do this, ballast water is pumped into the side tanks on the other side. This has to function very precisely, as with a balance scale. If 1,000 tonnes have to be lifted in five minutes, you also need pumps that can move the water fast enough. And if this is not sufficient, anti-heeling pontoons are used." These additional buoyancy bodies are lowered into the water with the crane, and then connected to the ship with a large boom. "As with a catamaran, the pontoon increases the waterplane area, with the increase also located far from the centreline of the ship," as Jan Rüde explains the principle.

If something goes wrong during this complicated hoisting process, the stability of the ship can rapidly be at risk. "Although it rarely happens, a sudden loss of the load can cause the openings of the ship to dip below the waterline. The consequences can be serious," Rüde warns.

To cover this safety aspect as well, GL has included loss of load as a design criterion in its new Rules for Stability, which have been in force since January 2013. As Jan Rüde puts it: "We calculate the maximum deflection and how much the ship swings back. Then we provide pointers on how the results are to be considered in the design." The necessary calculations can also be carried out for ships that are already in service.

Ten Thousand Wave Scenarios

To compute the large number of different load cases for the hull structure of multi-purpose vessels, GL has also extended the strength calculations. "Our modelling calculations take a holistic approach. They include the engine room and the forebody with their very complex geometries," says Rüde. The ship model determined in this way is then tested with the various load cases specified by the shipowner and then sent on virtual voyages through 10,000 different wave scenarios. "In this way, we can identify the 50 most difficult cases and adapt the stresses, deformations and strength of the ship to account for these extreme loads." This computation and the procedure have been laid down in a guideline by the GL experts, and is now available to shipowners and naval architects.

Multi-purpose carriers are of great interest from both the logistical and the technical viewpoint: "The long cargo hold with very narrow sides and very large cranes that have to transfer their loads. The hold is rather like a shoebox, preferably without rounded edges, the long boom of the pontoon, extremely high point loads on the inner bottom, hatchcovers that can be converted into bulkheads, moveable tweendecks that can be dropped into hinged holders, or the possibility of carrying containers – these ships are truly special," is how Jan Rüde sums up their broad scope. And the expert from GL is ready for the next technical challenge. Which shipping company will it come from? ■ **SNB**

FOR FURTHER INFORMATION:

Jan Rüde, Ship Type Expert Multi-Purpose Vessels

Phone: +49 40 36149-4172, E-Mail: jan.ruede@gl-group.com

Optimising Optimisation

GL's consultancy arm FutureShip is a world leader in the complex fields of hull and trim optimisation. Its software ECO-Assistant recently received a prestigious award

The atmosphere was festive as the coveted prize was presented to the winner in Singapore last November. Steen Lund had every reason to be thrilled: "We are honoured that our trim optimisation software tool ECO-Assistant has won the Environment Award at the Lloyd's List Asia Awards 2012," said the Executive Vice President and Regional Manager of GL Maritime Services Asia/Pacific. "This award once again demonstrates that the maritime industry recognises and appreciates GL's longstanding commitment to improving energy efficiency in shipping and preventing pollution of the marine environment."

PRIZE. GL's Steen Lund (ctr.) received the Environment Award at the Lloyd's List Asia Awards 2012 in Singapore.

ECO-Assistant was developed by FutureShip, the GL engineering and consultancy company specialising in hydrodynamic design. FutureShip boasts more than a decade of experience in optimising hull shapes and ship operation to minimise fuel consumption. Yet it was only during the past few years that the work of FutureShip found true recognition as the industry woke up to the need for greater energy efficiency in the face of rising fuel prices, depressed freight markets and tightening environmental regulations.

"As engineers we were originally just interested in hull shape optimisation for its own sake," explains Dr.-Ing. Karsten Hochkirch, Vice President FutureShip and one of the developers of the services. "It took us a couple of years to understand that there were significant cost savings involved, and that was an eye-opener. But even then it was difficult to convince everyone of the merits," Hochkirch continues, "especially shipowners who charter out their vessels to other operators who are the ones paying for the fuel."

Two Main Services

Karsten Hochkirch and a group of fellow naval architecture graduates from the Technical University of Berlin set up a company in 2001, initially specialising in yacht design while at the same time trying to gain a foothold in the commercial shipping industry. The breakthrough came from 2008 onwards when fuel prices began to rise – and the team was promptly snapped up by GL and rebranded as FutureShip in January 2009.

Today the fluid engineering department focuses on two main services: Hull shape optimisation, which helps owners and yards design the most energy-efficient new vessels; and trim optimisation, advising operators how to sail existing vessels in the most cost-effective way. Both services are available to all clients irrespective of their classification society.

FutureShip has also begun offering an extended range of engineering consultancy services, such as conceptual designs for fuel-efficient, next-generation vessels. One example is a 9,000 TEU containership sized for the widened Panama Canal, which required short ship lengths and a beamy design. FutureShip's work on this project included studies into stability as well as energy efficiency.

New Hull Shapes

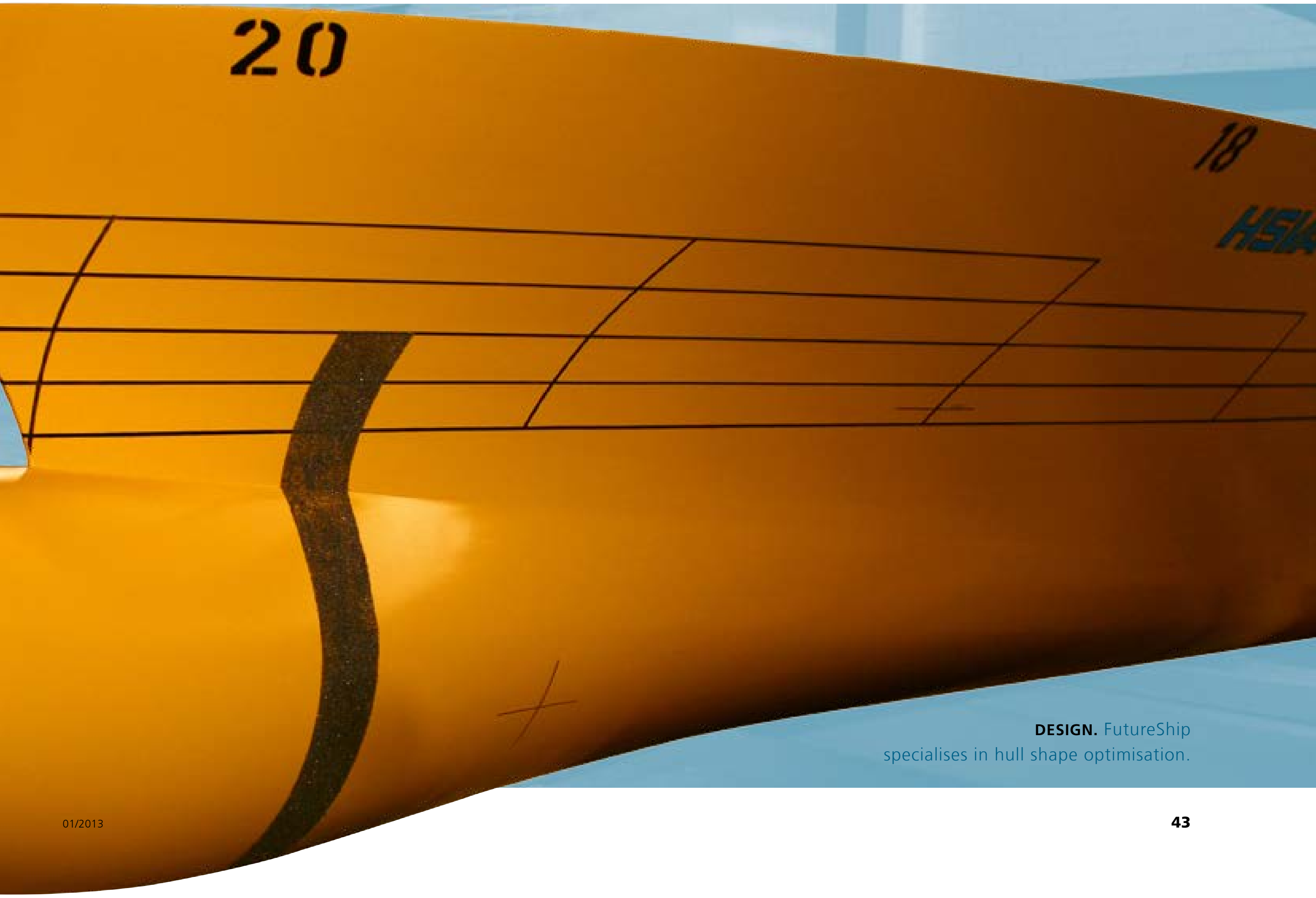
The company also offers consultancy on issues that are primarily relevant for passenger ships, such as noise, vibration and the avoidance of motion sickness. Hull shape optimisation, however, remains the area where FutureShip believes it has truly stolen a march on yards as well as other class societies.

"Many yards may claim to have optimised their initial designs by changing various parameters such as the length and profile of the bow, and testing the various results," says Hochkirch. "However, what we do is strive for the optimum design right from the start." To do this, FutureShip starts from the essential principles of fluid dynamics, then applies a systematic and rigorous approach to CFD testing.

"Optimised hull designs require in-depth consideration of the ship's operational profile," he adds, "especially its likely range of speeds." Many yards tailor hulls to the design speed fully laden as specified in the shipbuilding contract, rather than the speeds the vessel is likely to actually employ, especially in these days of slow steaming.

"By being very specific about speeds, owners can realise the greatest saving," Hochkirch explains. "We can ▸

CFD. *Computational fluid dynamics is a field of fluid mechanics that uses numerical methods and algorithms to analyse and solve problems involving fluid flows.*

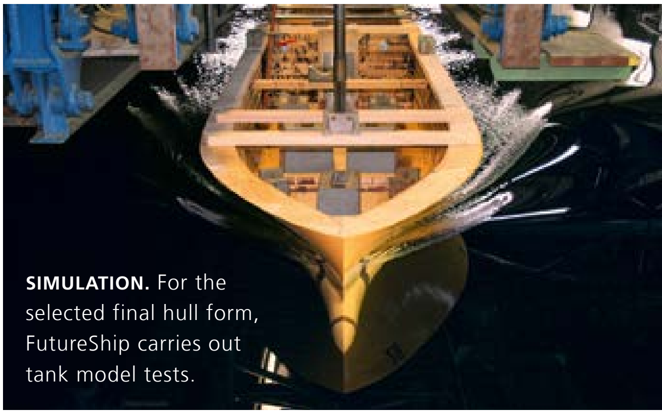


DESIGN. FutureShip specialises in hull shape optimisation.

help owners draw up an operational profile based on noon reports of existing vessels, and design their vessels in accordance with their perception of how the market will develop and the specific niche they want to occupy."

Among FutureShip's reference clients for hull design optimisation are Meyer Werft, Germany, where Royal Caribbean are having their new class of ships built, and Athens-based company Enesel, which is building a series of 10,000 TEU vessels for charter to Evergreen, "potentially the most efficient ships in the world", according to the operator.

Meanwhile, there is a huge market beckoning for energy efficiency enhancements to existing vessels. One fairly straightforward way to boost a ship's efficiency is to optimise its trim in the water. This can be accomplished by implementing FutureShip's award-winning ECO-Assistant, first introduced in 2010. This software application helps onshore cargo planners distribute the cargo on board to minimise fuel consumption. The shipmaster and his crew will use the information provided by the software to trim and ballast the vessel effectively, making sure they sail with the best possible trim. In addition, ECO-Assistant supports automatic ballast water optimisation in conjunction with the on-board loading computer.



SIMULATION. For the selected final hull form, FutureShip carries out tank model tests.

"Many yards may claim to have optimised their initial designs… We strive for the optimum design right from the start."

DR.-ING. KARSTEN HOCHKIRCH
VICE PRESIDENT, FUTURESHIP

There is no single optimal trim; rather, the best trim for a given scenario is a function of the hull shape, propulsion system, speed displacement and water depth, as the experts at FutureShip like to point out. The solution developed by the GL subsidiary includes calculating a series of CFD-based trim optimisation schemes for various operating conditions, then making the results available to the crew and ship operator through an easy-to-use software tool. To date, more than 350 systems have been installed on board and on shore worldwide.

Another consultancy service offered by FutureShip is the efficiency audit: For an upfront fee the client receives a study detailing the most cost-effective optimisation measures for an existing ship. The solutions developed may include hull shape modification by fitting appendages, propeller modification, and recommendations for the operating profile of the ship or even for the service concept itself. Furthermore, FutureShip is currently introducing a new fuel estimation service.

Cost Benefits

What are the potential cost benefits of these optimisation methods for the client? Hochkirch says that among all the services the company has rendered to date, the shortest payback time was six days, the average a few months and the longest less than a year. He gives the example of a 70,000 dwt bulk carrier that began using ECO-Assistant for trim settings. The ship immediately realised fuel economies of 6.7 per cent (under ballast condition), 3.4 per cent (laden), respectively, equivalent to saving 64,000 dollars a year at current HFO prices. New hull designs can achieve even more dramatic results.

For a 9,000 TEU vessel, FutureShip reckons a five per cent increase in fuel efficiency could add up to 50 million US dollars saved over the ship's lifetime, while a 15 per cent efficiency improvement, which is perfectly realistic if appropriate operational adjustments are implemented as well, could save as much as 150 millioin US dollars. "When owners talk about the costs of our optimisation services," concludes Hochkirch, "I ask them whether they can afford not to make that investment." ■ **BJ**

FOR FURTHER INFORMATION:
Dr.-Ing. Karsten Hochkirch, Vice President FutureShip
Phone: +49 331 9799179-0, E-Mail: karsten.hochkirch@gl-group.com

Photo: Alexstar | Dreamstime.com

Solving the Navier-Stokes Equation

The Navier-Stokes equation, which applies Newton's second law (of momentum balance) to fluid mechanics, has yet to be solved. Until then, the only way to predict which hull shape is "best" in terms of lowest possible water resistance is by empirical testing of various permutations, explains FutureShip VP Karsten Hochkirch.

Naval architects therefore employ a mixture of traditional methods, including professional "common sense", model tank testing and computational fluid dynamics (CFD) analyses of various possible designs, to arrive at the most promising solution.

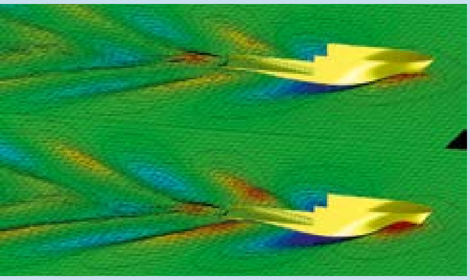
What shipyards call optimised design is often a mere adaptation of existing plans for similar ships, with a few dimensional adjustments. Following some selective CFD testing, the most promising designs are then tank-tested. The number of variations looked at rarely exceeds ten.

FutureShip, however, applies a somewhat different approach, characterised by Hochkirch as being "at the forefront of applying optimisation algorithms to hull shape optimisation".

Using a parametric hull model developed internally, FutureShip is able to generate a huge number of hull shape variants by altering just a small set of key parameters. All these variants are then subjected to meticulous analytical calculations on a powerful mainframe computer located in the basement of GL's Head Office in Hamburg, using 7,000 CPU of computing power.

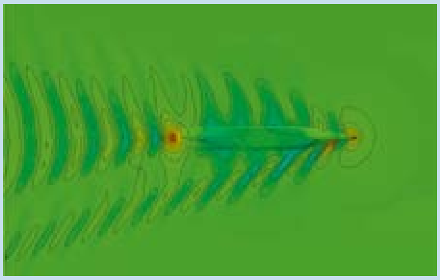
"We are basically using the same techniques naval architects have been applying for the last 100 years, but we have completely automated the process," says Hochkirch. "Evaluating a single design used to take an entire week. Today we can assess 10,000 designs on a single weekend." Which makes the wait for the solution of the thorny Navier-Stokes equation much less painful!

$$-\nabla p + \mu\left(\nabla^2 \vec{u} + \tfrac{1}{3}\nabla(\nabla \cdot \vec{u})\right) + \rho \vec{F} = \rho\left(\frac{\partial \vec{u}}{\partial t} + \vec{u} \cdot \nabla \vec{u}\right)$$



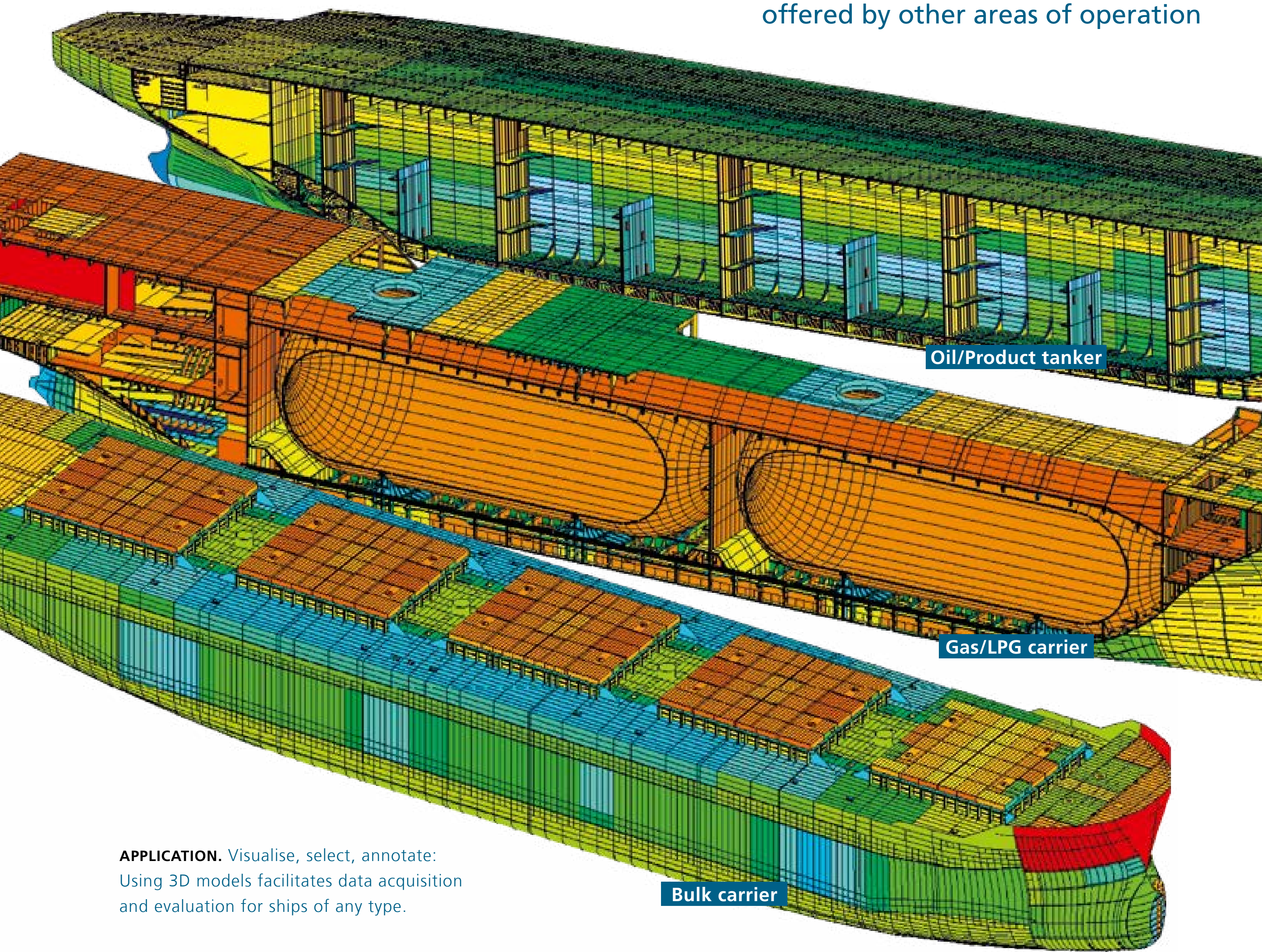
VARIANTS. The first step in the optimisation process is to generate a huge number of virtual hull design variants.

RESULTS. CFD software visualises the flow around the hull to determine the required propulsion power.



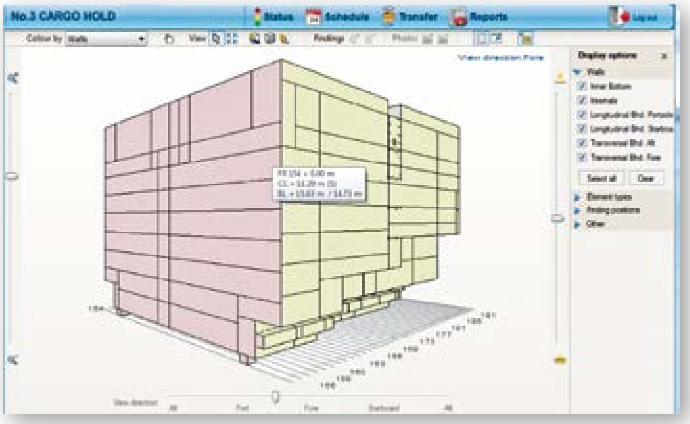
New Dimensions

Design, production, operation – the efficient application of digital 3D models supports key processes in a ship's lifecycle and ensures high availability. Germanischer Lloyd is examining the potential offered by other areas of operation



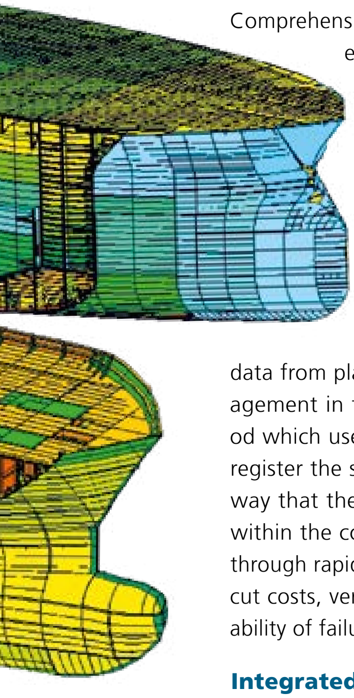
APPLICATION. Visualise, select, annotate: Using 3D models facilitates data acquisition and evaluation for ships of any type.

The procedure is firmly established: For many years now, digital 3D models have been used with success in the ship design phases. Despite this, the range of possibilities has not been exhausted yet. To optimise the use of 3D models further, it is primarily a number of technical issues that have to be solved first. How can the exchange of 3D data between the construction phase and subsequent ship operation function most effectively? How can the actual dimensions for the retrofitting of ballast water treatment systems be measured with the aid of 3D technology? How can the location of a structural crack be captured so that precise information can be reported and processed appropriately? And do 3D models really help to improve the communication between the various actors in the process?



INTERACTIVE DOCUMENTATION. 3D computer models optimise the entire process of inspecting and assessing on-board structures. Different tools for interaction with the model are displayed.

Effective Lifecycle Management



Comprehensive utilisation of information gathered over the entire lifecycle of a ship can greatly enhance the operating economy of the vessel. The ship managers benefit from an increasing level of competitiveness. A prerequisite for this, however, is consistent product data management (PDM) on the basis of data filing and administration that is in line with the system and component structure.

In ship newbuilding projects, this structure is defined and populated with initial data from planning, design and engineering. Lifecycle management in the technical sense is an organizational method which uses PDM approaches over the entire lifecycle to register the ship's condition and operational data in such a way that they can be accessed at any time and evaluated within the context of their creation. Here the objective is – through rapid and precise processing of the information – to cut costs, verify lower pollutant emissions, reduce the probability of failure, and also increase the reliability of operation.

Integrated Information Evaluation

A prime example of integrated information evaluation is given by the GL EmissionManager. This tool records the operational data, such as fuel consumption, speed and weather conditions, allowing well-founded conclusions to be drawn on the emission of pollutants. In the process, all environmentally relevant data for the ships deployed in a fleet are systematically collected and analysed. Detailed evaluation and analysis of the data provides the basis for a further reduction in pollutant emissions throughout the entire fleet. In addition, the system also delivers time-coded operational information, such as the ship's position, bunker levels, cargo situation and weather conditions.

With regard to its system architecture, the GL EmissionManager consists of two parts: the onboard client for data capture and a server component for administration of the data. The "Green Server" is supplied fully automatically by the data recorders on board; whenever necessary, it can then generate the required information or reports.

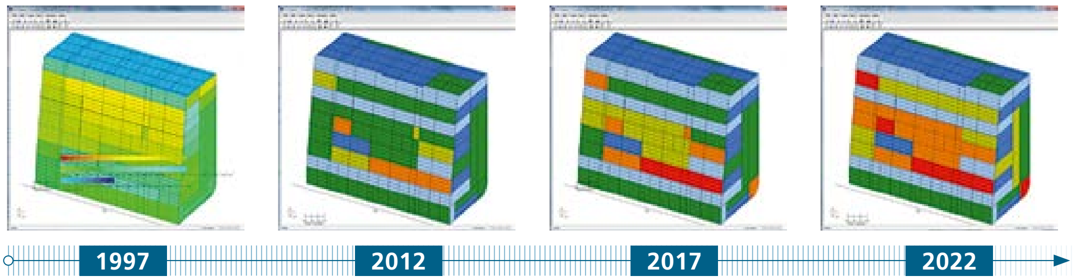
Model to Replace Plan in Approval

From the simple geometric models, which are used in the design phase for determining the stability or seakeeping behaviour of a ship, up to specialised models for the strength analysis or load calculation: there are already a variety of digital models that are used in naval architecture. Whilst digital drawings are usually produced during the initial design phase, 3D models are applied in the detailed design phase.

Ship designers are becoming increasingly interested in also using these models in GL's approval process for the design. "The idea is to use a 3D model of the hull structure instead of the conventional drawings in the approval process," says Dr Christian Cabos, responsible for Information Management and Tools at GL Classification.

However, it is not quite as simple as that. "A model is always a very specific representation of reality and must therefore be adapted to suit the particular problem at hand. For example, a CAD model is not a computational model ▶

TREND ANALYSIS. Analysing the data from routine thickness measurements allows a prediction of the future corrosion state of a ship's hull.



▶ and cannot simply be transferred," says Cabos. What is more, the classification societies are not the only parties who need to have the drawings. "The IMO requires that important design information be kept on board in the form of plans. The extent to which this availability can still be met by 3D models is still unresolved, especially in view of the fact that the crews and the surveyors have to receive training in the use of 3D models."

GL PEGASUS. *This 3D-based GL software streamlines the performance, documentation and evaluation of wall thickness measurements.*

Computer-Aided Maintenance

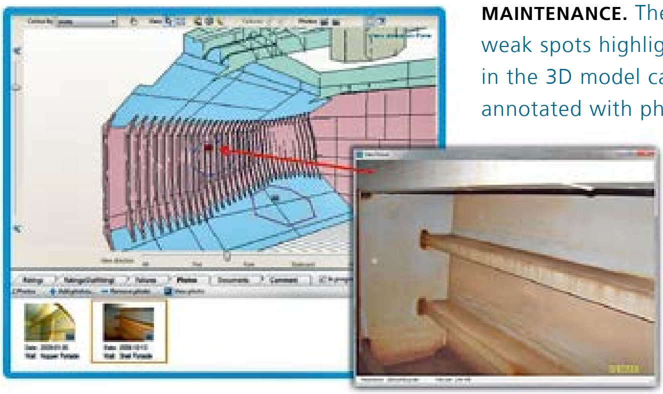
A problem in the planning of maintenance procedures is that the condition status data for the ship as a technological system must be adequately assessed, so that critical points can also be identified and addressed onshore. Damage data must be captured so that, whenever the need arises, these events can be accessed, evaluated and tracked in time. "3D models of a vessel's geometry can help to prepare, implement and document maintenance tasks in various ways," says Uwe Langbecker, Head of CAE Development at GL. "Complex steel structures on which one wishes to mark the damage cannot be described without a 3D model, since there is frequently no unambiguous nomenclature. Accurate positioning with 3D data is essential."

In a 3D model, it is possible to navigate, perform measurements, calculate values, and also display, select, filter, localise and annotate objects. These standard functions are all provided by CAD systems. "They are not available here, because they are made for the use of specialists, such as ship designers. What is needed here is a tool that covers most of these functionalities and can be used during ship operation," says Langbecker. "The effort needed to produce such a 3D model is considerable, however. The best approach is to take the models directly from the design phase, instead of generating them later from the drawings."

Precise Trend Analysis

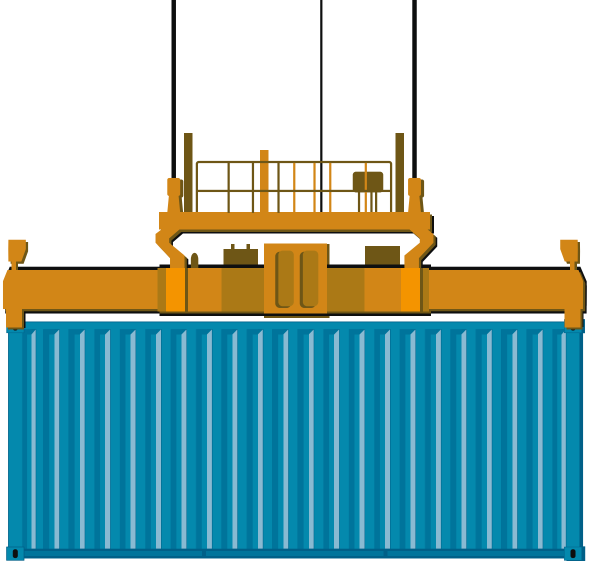
In the course of a ship's lifetime, further information is added to the product model, so that the combination of historical and current data can be used in making forecasts. For instance, thickness measurements are carried out within the scope of a class survey. During this process, large volumes of data are generated; these can only be administered by digital means.

With the aid of a 3D model, it is possible to obtain a quick overview of the ship's condition. Hull sections, parts of the cargo hold, or certain positions are examined. The same source is then used to compile and transmit a written report. "Thickness measurements taken during ship operation make it possible to predict the future corrosion state. The various condition measurements allow us to derive a targeted corrosion prediction model," explains GL expert Langbecker. ■ **NR**



MAINTENANCE. The weak spots highlighted in the 3D model can be annotated with photos.

FOR FURTHER INFORMATION:
Dr Wiegand Grafe, CAE Development
Phone: +49 40 36149-9208, E-Mail: wiegand.grafe@gl-group.com



Route-Specific Box Loading

There isn't a hurricane looming on every trade route, so why treat all containerships equally? GL is preparing more flexible deck stowage rules

The classification society Germanischer Lloyd will soon offer containership operators more flexibility regarding on-deck container stowage and lashing without compromising the required safety levels. Following in-depth studies of real-life sailing conditions in various ocean regions, GL is taking a new approach to loading rules to help container lines accelerate cargo operations in ports and gain competitive edge through enhanced on-board stowage flexibility.

Based on long-term statistical data on wave conditions, GL has developed a new class notation for route-dependent deck container stowage and lashing. The new scheme accounts for the fact that sea conditions vary from region to region.

The point of reference for both ship and lashing system design has traditionally been the stormy, hurricane-prone North Atlantic. But in reality, vessels are also deployed in many other oceanic regions during their lifetime much calmer. Relying on long-term statistics, GL has defined safety margins for determining wave and wind loads acting on deck containers and their lashing systems on specific routes.

New Class Notation

The upcoming GL class notation for route-dependent container stowage will take all this into account. On suitable routes, ship operators will be able to place heavier boxes on the upper tiers of deck stacks, more units on outside stacks, and even an additional tier of empty containers where the line of sight is not affected. Apart from faster and more flexible stowage, this could result in as much as ten per cent more cargo carried on deck, depending on vessel size and route.

GL's analysis of wave loads on a mega boxship vessel travelling a typical route between Asia and Europe revealed the extra cargo capacity a departure from the traditional rule would allow: without compromising safety, ships could not only take on an extra tier of containers; they could also, as an alternative option, handle the weight distribution more flexibly and even carry more payload on deck. As a result, operators would be able to increase the number of loaded containers on board and reduce the number of empty containers.

Individualised Service

As part of the route-dependent container stowage scheme, GL offers container lines a tailor-made stowage and loading plan for individual vessels and routes. This requires the use of lashing software, which will assist cargo planners as well as the crew in ensuring safe stowage and lashing while giving greater flexibility to operators to take advantage of opportunities whenever they arise.

GL is currently consulting with all relevant parties and will have its "Route Specific Container Stowage (RSCS)" class notation offer in place in the second quarter of 2013. It will be available to all GL-classed container vessels. ■

FOR FURTHER INFORMATION:

Jan-Olaf Probst, Executive Vice President, Global Ship Type Director

Phone: +49 40 36149-537, E-Mail: jan-olaf.probst@gl-group.com

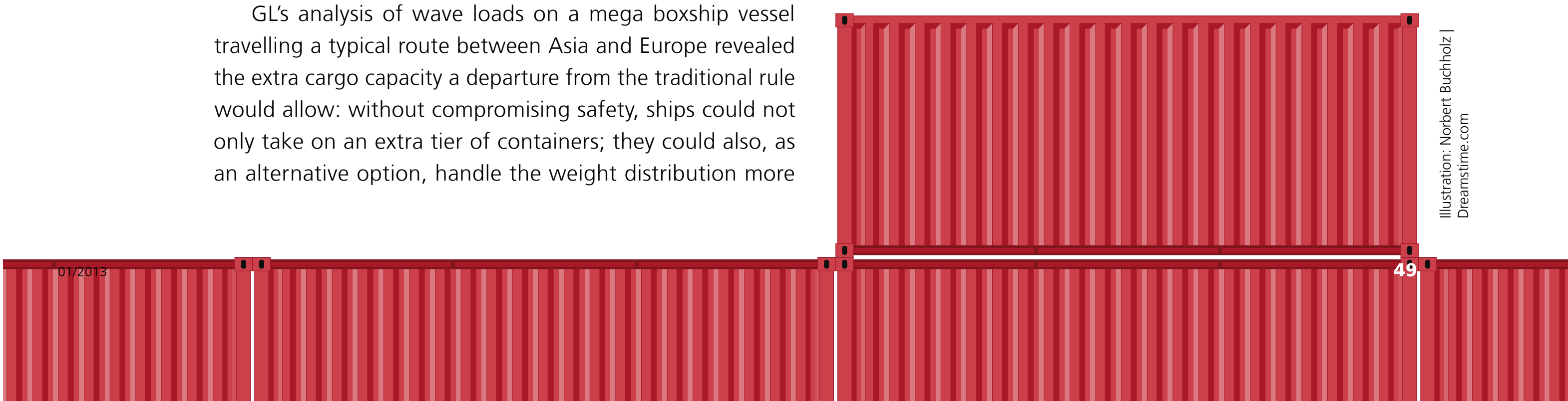


Illustration: Norbert Buchholz | Dreamstime.com

Photo: Dreamstime

Rules for Classification and Construction

Our latest brochures, rules and guidelines are available on request. Order forms are available on the Internet: www.gl-group.com > Rules & Guidelines

I - Ship Technology

Part 3 - Special Craft

Chapter 7
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Design of Racing Yachts ≥ 24 m 2012-12-01

III - Naval Ship Technology

Part 1 – Surface Ships

Chapter 1
Hull Structures and Ship Equipment 2012-12-01

VI - Additional Rules and Guidelines

Part 12 – Environment Protection

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Guidelines for Ship Recycling
Related Certification Processes 2012-12-01

EU RO – EU Recognised Organisations

Common Technical and Procedural
Conditions for Mutual Recognition
of Type Approval Certificates 2013-01-01

Dates at a Glance

For further dates and additional information, see www.gl-group.com/events

April

01. – 04.04.2013
Work Boats Exchange
Amelia Island, USA

04. – 06.04.2013
SMM India
Mumbai, India

08. – 11.04.2013
5th Annual Offshore Drilling Rigs
Singapore

08. – 11.04.2013
5th Annual Offshore Support Vessels
Singapore

08. – 12.04.2013
Hannover Messe
Hanover, Germany

09. – 10.04.2013
Ballast Water Treatment Technology Conference
Singapore

09. – 11.04.2013
Sea Asia
Singapore

09. – 12.04.2013
LAAD
Defence & Security 2013
Rio de Janeiro, Brazil

15.04. – 17.04.2013
COMPIT 2013
Cortona, Italy

22. – 23.04.2013
Tradewinds Shipping China Energy
Shanghai, China

24. – 25.04.2013
Offshore Patrol & Security
Portsmouth, United Kingdom

24. – 25.04.2013
Motorship Propulsion & Emissions Conference
Copenhagen, Denmark

May

08.05.2013
3rd Annual Houston Offshore Finance Forum
Houston, USA

08. – 10.05.2013
Emerging Asia Small and Mid-Scale LNG Forum
Singapore

08. – 11.05.2013
MTB Shipyards Asia
Shanghai, China

10.05.2013
Seatrade Awards 2013
London, United Kingdom

14. – 15.05.2013
Tugnology '13
London, United Kingdom

14. – 16.05.2013
Imdex Asia
Singapore

14. – 17.05.2013
Control
Stuttgart, Germany

15. – 17.05.2013
China International Marine, Port & Shipbuilding Fair
Nanjing, China

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Subscription service: For address changes and orders please send an e-mail to publications@gl-group.com

GL Group

Head Office

Brooktorkai 18
20457 Hamburg
Germany

Phone: +49 40 36149-0
Fax: +49 40 36149-200
E-Mail: headoffice@gl-group.com

www.gl-group.com

Germanischer Lloyd

Region Americas

1155 Dairy Ashford
Suite 315
Houston, TX 77079
United States of America

Phone: +1 713 863 1925
Fax: +1 713 863 0704
E-Mail: gl-americas@gl-group.com

Region Europe/Middle East/Africa

Brooktorkai 18
20457 Hamburg
Germany

Phone: +49 40 36149-8786
Fax: +49 40 3614976-8786
E-Mail: gl-ema@gl-group.com

Region Asia/Pacific

Room 3201–3220, Shanghai Central Plaza
381, Huaihai Middle Road
Shanghai 200020
People's Republic of China

Phone: +86 21 6141 6700
Fax: +86 21 6391 5822
E-Mail: gl-asia.pacific@gl-group.com

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