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ISSUE 2 · 2010

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Dear Readers,

Dr Hermann J. Klein

The climate protection goals are ambitious, and the year 2020 is just around the corner. Within this decade, the shipping industry will be expected to implement no less than 13 major international regulations, all of which aim at limiting the environmental impact of maritime traffic. To achieve this objective, all parties involved in international shipping, whatever their role, must pull in the same direction. A number of technologies improving the efficiency of ships and reducing emissions to the environment are available today. But there can be no doubt that an even greater effort will be required to make shipping more sustainable and "green".

Many innovative concepts are currently being developed by shipping companies and shipbuilders, naval architects and suppliers, maritime organizations and classification societies. Considering the complexity of today's ships, however, merging these efforts into effective, viable overall concepts will not only take interdisciplinary thinking and acting, but also vigorous advocacy.

A major factor driving advances in ship technology and efficient ship operation is simple business arithmetic. Competitive pressure contributes to a wide-spread sense of urgency in promoting technological progress. Furthermore, the maritime industry is determined to further improve its environmental track record, and to do so visibly.

Greener, safer, smarter: For decades the industry has been benefiting from Germanischer Lloyd's expertise, wealth of practical experience, and global presence allowing the company to disseminate intelligent solutions in many disciplines, including protection of the marine environment. We take the challenges of this decade head-on, and we are committed to being a competent, trustworthy partner to the industry, ready to deliver the right answers to the questions of the future.

As a matter of fact, GL has taken the lead in fields such as fuel efficiency and emission control. To give an example, hull design optimization strategies developed by GL enable ships to operate more economically while emitting less CO_2. Alternative propulsion systems and fuels, backed by GL research, are gaining ground. And innovative analytics software by GL helps improve the operational efficiency of ships.

In the present issue of nonstop you will learn how the ECO-Patterns analysis tool from GL reveals shortcomings in energy management (p. 16), how GL experts track down and eliminate sources of excessive noise and vibration on ships (p. 12), and what pre-heating does for weld quality (p. 33). Read our article "Thunder God Ready to Roll" (p. 46) about specialized ships for offshore wind turbine installation and find out how ships, apart from being an indispensable global means of transportation, also play an important role in harnessing the power of renewable energy. Happy reading!

Yours sincerely,

Dr Hermann J. Klein
Member of the Executive Board
Germanischer Lloyd

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Photo: Yps-Collection

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Photo: Eberhard Petzold

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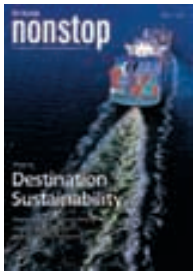
COVER STORY: MARITIME SOLUTIONS



Cover Photo: Corbis

MARITIME SERVICES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Safety Mission

At Germanischer Lloyd (GL), safety has always been part of the corporate mission to prevent loss or harm to people and assets. This view is shared by HOERBIGER, a world leading manufacturer of explosion relief valves for crank cases of marine engines.

Survey. GL has granted type approval to HOERBIGER explosion relief valves in compliance with the GL Rules and international regulations. In 2009, HOERBIGER has opened a new valve manufacturing facility in Changzhou in eastern China's Jiangsu Province. The availability of GL inspection services has been very helpful in realizing this ambitious expansion project. GL surveyor Lu Ming (see photo), based in Shanghai, has been put in charge of testing an explosion relief valve manufactured at the new Changzhou plant.

Photo: Mondhe


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SINGAPORE

Forum on Innovative Maritime Software

Advancements in Maritime Software for Safe and Efficient Ship Operations" was the subject of a GL forum held in Singapore, drawing an attendance of 30 industry representatives. "Modern technologies play a central role in increasing competitiveness, improving efficiency and minimizing risk in shipping operations," said Dr Torsten Buessow, Global Head of GL's Maritime Software business. His presentation addressed innovative solutions and trends for effective ship management and maintenance. In particular, Dr Buessow introduced GL HullManager, the latest development in the field of maintenance. GL HullManager supports visual inspection

ON-SITE VERIFICATION

MTU Opts for Alternative Product Certification

APC AUDIT. Norbert Straub, Expert/TQAA; Dagobert Heß, Head of Department/TQA; Sascha Müller, Station Manager GL Augsburg; Dr Dirk Fischer, Project Manager MC-TE GL Hamburg; Markus Perwein, Team Leader/TQAA; Torsten Brendel, Expert/TQAA and Stefan Jahnes, Expert/CSQM (from l. to r.).

German propulsion and power solutions specialist MTU is the first engine builder authorized by GL to test, document and issue test certificates for its own products. MTU has opted for the Alternative Product Certification (APC) which was introduced in 2008 as part of the modular certification system. The results of the APC audit at the MTU Friedrichshafen site near Lake Constance gave evidence of a trustful and trustworthy relationship between MTU and GL. The audit covered areas such as the manufacture of crankcases and turbo chargers, TQA processes, surveys of measuring equipment and documentation of filing processes. According to MTU, the new certification system provides a much higher level of flexibility regarding the planning of quality tests. This helps the company observe extremely tight production schedules while ensuring quality and safety across the entire global supply chain.

Attention to detail. The APC not only looks at systems and components but also at the manufacturing processes and testing procedures. The quality audit combines elements of a system, a product and a process audit with the main focus on the processes to ensure the highest degree of objectivity, reliability, transparency and comprehensiveness. The APC certificate is valid for three years. MTU has trained engineers of its TQA department to perform the quality tests and final inspection of assembled engines or engine parts. MTU is well-known for its engines and propulsion systems for ships, planes, heavy land vehicles, trains and defence vehicles and for the oil and gas industry.

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Photo: Kroisenbrunner

COMPETITION. Rising operating costs are encouraging shipping companies to search for new ways of improving efficiency.

and thickness measurements using a 3-D model of the respective vessel.

New approaches. Hydrodynamic considerations as a means to improving ship safety and efficiency were the topic of the lecture held by Dr Lars Gruenitz, GL's Business Development Manager South East Asia. Shipping companies are constantly generating large amounts of data on operational, technical and commercial processes. Kevin Brunn, Sales Manager, GL Maritime Software showed how this data pool can be used to drive strategic and operational decision making. GL FleetAnalyzer software is an effective tool to extract valuable information from existing data. www.gl-maritime-software.com

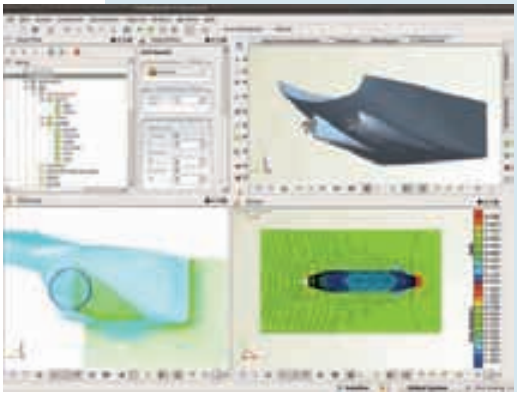
SHIP DESIGN

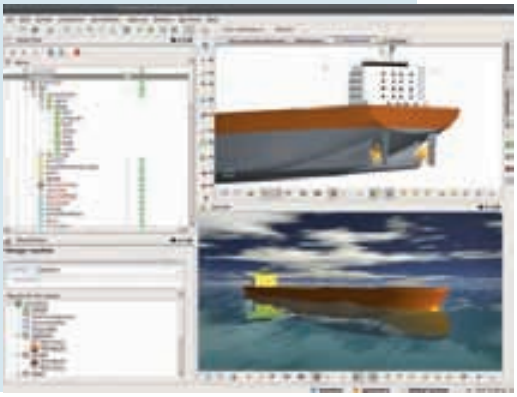
Twin-Skeg Designs Boost Efficiency

A research study conducted by Friendship Systems reveals the great potential for ship safety and efficiency enhancements inherent in a twin-skeg concept. A comparison of the hydrodynamic performance of single vs. twin-skeg tanker designs showed that the twin-skeg concept can be essentially superior. In their study, Friendship Systems included an extensive variation test of two parametric twin-skeg models that can be applied to a wide range of ship types.

Superior potential. The result: The vertical angle of the skegs is crucial for avoiding turbulences and the resulting increased overall resistance. Designs with high vertical skeg angles were found to have both a low overall resistance and a high wake quality. Subsequent large-scale automated optimization showed that twin-skeg ships can have a better hydrodynamic performance with respect to propulsive efficiency than their single-screw counterparts.

www.friendship-systems.com





OPTIMIZATION. Provided that certain restrictions are accounted for, a twin-skeg design can be more efficient that a single-skeg design.

X-RAY LASER

First Dig. Then Bore.

The sheer dimensions are stunning: The behemoth is 6.17 m in diameter, 71 m long and weighs 550 tonnes. It even has a name: TULA (TUnnel for LAser). TULA is the first of two shield tunnelling machines that will be boring the tunnel system for the European XFEL x-ray laser project.

The new subterranean x-ray laser research facility, which will be 3.4 km in length, is under construction in Hamburg and the neighbouring Schleswig-Holstein. Its tunnel system consists of a 2.1 km tube that will accommodate an electron accelerator, and a fan-like array of five tunnels where the experimental x-ray flashes will be generated. These five tunnels all end in the subterranean experimentation hall.

Photo:European XFEL

STARTING PIT. The 17-million euro tunnelling machine has been boring since late June.

Twelve checks. The tunnel system has a combined length of 5,777 metres. GL has been entrusted with the inspection of the compressed-air locks and compressed-air patient cabins. Eleven additional checks will follow before the end of 2012.

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AUTHORIZATION. Niels Appel, GL's Country Manager Netherlands; Manfred Schlott, GL's Head of Department Flag State Affairs/IACS; Michael Beltman (IVW) Managing Director Netherlands Shipping Inspectorate; Aren Jumelet (IVW) Project Manager Task-Transfer IVW Scheepvaart during a meeting in Rotterdam (from l. to r.).

THE NETHERLANDS

Inland Vessel Inspection

The Dutch traffic inspection agency "Inspectie Verkeer en Waterstaat" (IVW) has authorized GL to conduct certification inspections of inland vessels. GL will issue statements of compliance as proof that the ships comply with the applicable legislation. "This authorization is a huge step forward for us as a classification society engaged in the inland waterway business, especially since the Netherlands is one of the most important countries for inland navigation in Europe," explains GL expert Niels Appel. Currently about 700 inland waterway vessels are GL-classed, including modern double-hulled tankers. Several seagoing vessels of GL's fleet are subject to inland waterway certification as well.

MARIKO

Promoting Co-operation, Exploring Synergies

The Maritime Centre of Competence (MARIKO) in Leer, East Frisia, Germany supports efforts to combine and interlink maritime activities in the German-Dutch region. Apart from training and continued education programmes, it offers qualification and research services, promotes the area, organizes professional events and advises maritime business start-ups.

Sustainable projects. MARIKO's navigation simulator SUSANNE is a training instrument with a 270-degree panoramic view system perfect for future shipmasters learning to manoeuvre a ship. In addition, the facility has a navigation lab with four dummy bridges. In a project named "MariStart", the institute fitted the former minesweeper Naarden with advanced equipment for use by German and Dutch universities and other educational institutions for training purposes.

The next project, MariTIM, is mainly dedicated to promoting maritime technology and innovation. Main areas of focus are offshore wind energy and clean fuels for ship propulsion.

MARIKO. Shipowners Alfred Hartmann and Hermann Buss support a regional platform for cross-border maritime learning, research and consulting.

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COMBUSTION ENGINES

Aftertreatment Technologies for Diesel Engines

The exhaust gas aftertreatment technology of the future will have to be more efficient to meet stricter requirements. The question: "Quo Vadis – Aftertreatment?" was the leitmotiv of a symposium held on the occasion of the 10th anniversary of the German Council of Aftertreatment Technologies for Diesel Engines (FAD e.V.) in Dresden on 1 and 2 July 2010. 110 participants from Germany, Austria, Switzerland, France and Finland joined to search for answers and discuss technical advancements in exhaust gas treatment for diesel engines.

Emission standards. In his presentation, Dr Fabian Kock, GL, Department Combustion Engines Environmental, gave an overview of the latest revisions to emission standards in the maritime sector and an outlook on future developments. He also reviewed several technical solutions from the perspective of a classification society and summarized the technical, operational, organizational and administrative challenges.

JAPAN

Criteria for Environmental Risk Evaluation

The National Maritime Research Institute of Japan (NMRI) and Germanischer Lloyd have signed a project cooperation agreement. Since both institutions are involved in analyzing the environmental impact of shipping, they agreed to join forces in a project to develop environmental risk evaluation criteria. The project will focus on carbon dioxide and methane, and explore ways of balancing safety and environmental requirements in risk assessments.

In agreement. "With the increasing emphasis on environmental protection today, balancing safety and environmental requirements is the key to success in developing competitive shipping solutions," explains Dr Pierre C. Sames, Senior Vice President Strategic Research and Development, GL. Dr Koichi Yoshida, Director International Coordination Centre, NMRI, confirms: "Environmental risk evaluation criteria are essential for identifying cost-effective technical and operational solutions for sustainable shipping. Teaming up with GL enables us to progress faster and deliver advice to our flag state administrations for their deliberations at the IMO."

www.nmri.go.jp

HANDSHAKE. Dr Koichi Yoshida and Dr Pierre C. Sames celebrating the cooperation agreement.

READY FOR ACTION. Members of the German-Korean joint development project.

MATERIAL FATIGUE

All Steel Plates Thick and Thin

In current design practice, the lower limit for steel plate thickness is defined by the minimum requirements whereas the upper limit depends on the strength requirement. A typical plate thickness range for ship structures is 6 mm to about 80 mm. Following the trend towards weight reduction there have been calls for a lower thickness limit of 3-4 mm. Structural optimization efforts have resulted in the use of high-strength steels to limit the maximum plate thickness. In fact, there are now steels with an increased yield strength of up to 470 MPa, called GL-E47EXP (YP47). This new material class features properties far beyond the well-established HT40 steels.

Combined forces. Two joint development projects (JDP) have been addressing topics such as the fatigue resistance of thin-walled welded structures, or the weld fatigue behaviour of the new GL-E47EXP (YP47) material class.

The first project, a national JDP, includes three German navy shipyards and GL. Its focus is on butt welds for block joints, which are being examined in large and small-scale tests. The second international JDP has been formed by Korean steel mill POSCO, three major Korean shipyards and GL. It performs fatigue tests on small-scale butt-welded specimens as well as fillet welds on longitudinal stiffener ends made of YP47. This JDP will eventually include investigations of fracture mechanics. The tests are coordinated by GL and performed at Hamburg's TUHH and Aachen's RWTH universities.

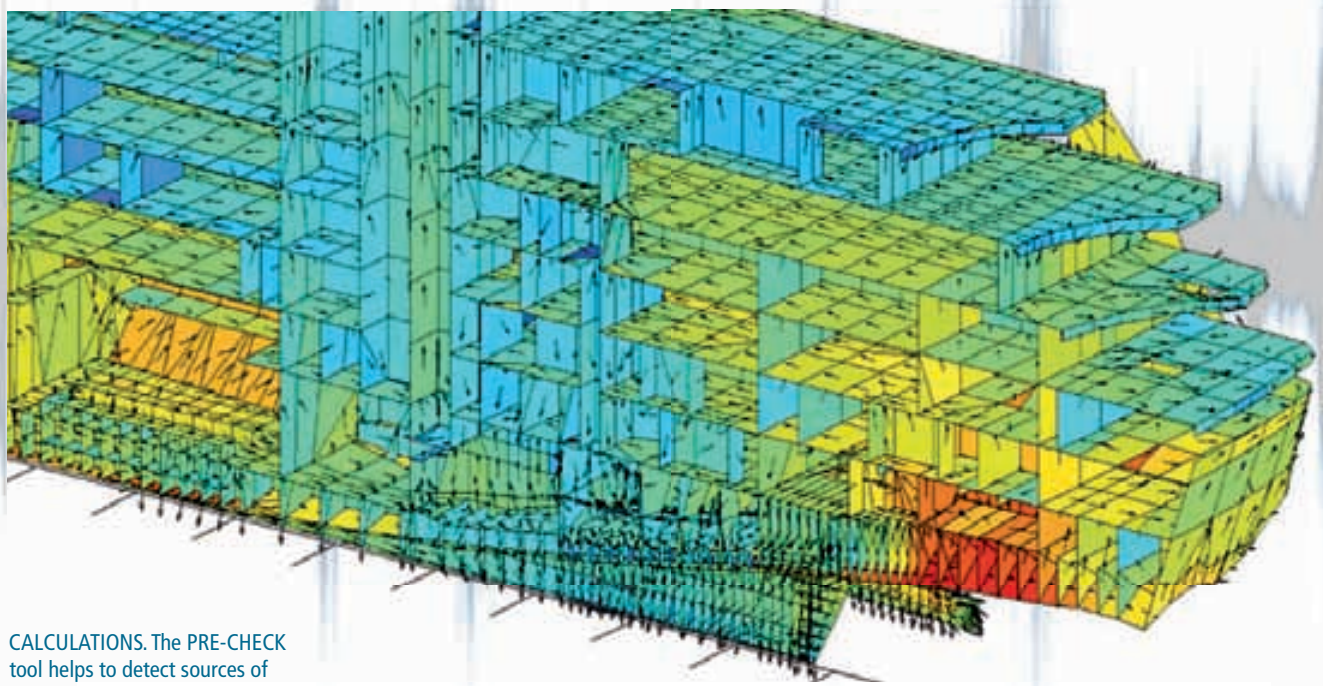
Both projects will be completed before the end of 2010.

First You Check It, Then You Build It

RISK. Undesirable vibration can damage exposed ship components and cause safety hazards.

There are certain potential functional issues affecting a ship that cannot be mitigated during the design phase using conventional methods. The "Noise & Vibration PRE-CHECK", a newly-developed noise and vibration analysis tool, can deliver answers

Photos: YPS Collection, Dreamstime



CALCULATIONS. The PRE-CHECK tool helps to detect sources of excessive noise and vibration.

Something just wasn't right: the incessant rumbling of the deck plates on the 7,500-TEU containership was simply unbearable. Every time the main drive entered a specific frequency range, the deckhouse steel plates started resonating, driving the entire crew crazy. The strange thing was, it was a brand-new ship delivered in good manufacturing quality.

"That could have been avoided by conducting a Noise & Vibration PRE-CHECK," calculations engineer Ulrich Behrens might point out here. But lecturing is not what he has in mind. The topic is way too serious. Behrens, a Senior Engineer with GL subsidiary FutureShip, is well aware that noise and vibration aboard a ship can compromise not only the morale of the crew but also their occupational safety. It is not for nothing that the 2006 ILO Maritime Labour Convention (MLC) set tight limits for such undesirable side effects, in accordance with IMO res. 468 XII and ISO 6954. Noise and vibration have a strong impact on the well-being of the affected individuals, and in particular, their ability to concentrate on their work. In fact, noise and vibration can cause highly dangerous conditions in ship operations.

What is more, in Behrens' experience these malignant symptoms frequently occur simultaneously, causing severe damage to ship components. "They might conceivably cause tanks to crack, and that would definitely be a safety issue," Behrens stresses. Other components exposed to damage may include the mast carrying signalling and nautical equipment.

Standardized Method

Weak areas can be detected early on during the design phase of a new ship by carrying out a Noise & Vibration PRE-CHECK to pinpoint potential noise and vibration issues pre-emptively. FutureShip applies a largely standardized process that allows the labour-intensive PRE-CHECK to be completed within just a few days. "It is this standardized procedure that sets us apart from the competition," Behrens emphasizes. "It enables us to deliver very quickly. Provided that the parties involved collaborate well, we can complete our PRE-CHECK within three days. Ship construction will not be delayed."

Provided everybody collaborates – that means, the client must supply all the data needed for the PRE-CHECK calculations. Without the parameter values and design details specific to the vessel, FutureShip can neither calculate the exciting frequencies nor determine the resonance

OCCUPATIONAL SAFETY ON BOARD

The ILO's Maritime Labour Convention, 2006 provides comprehensive rights and protection at work for the world's more than 1.2 million seafarers. The new labour standard consolidates and updates more than 65 international labour standards related to seafarers adopted over the last 80 years. The Convention sets out seafarers' rights to decent conditions of work on a wide range of subjects, and aims to be globally applicable, easily understandable, readily updatable and uniformly enforced.

Global instrument. It has been designed to become a global instrument known as the "fourth pillar" of the international regulatory regime for quality shipping, complementing the key conventions of the International Maritime Organization (IMO). The resulting requirements for the construction of new ships have been defined in resolutions and standards. IMO res. 468 XII and ISO 6954 set tight limits for vibration and noise emissions.

frequencies. But here again, PRE-CHECK makes matters easy for the client, as Behrens emphasizes: "All the client needs to do is fill in a data form and submit the steel drawings for the deckhouse to be analyzed." The number of data items required is not excessive. The method, developed by a team of shipbuilding engineers and acoustics experts, always accounts for the interaction between all relevant parameters: the number of propeller vanes, the engine type, the deck reinforcements, the panel arrangements, the deckhouse position and the performance parameters of the ship.

Risk Class Assessment

As a result of the analysis, the ship is assigned to one of five different risk classes. These classes indicate how likely the ship will fail the requirements. Assessment levels range from "very low" to "very high". This is how far the PRE-CHECK goes. "Now the client has a firm basis for deciding how to respond and what measures to take to ensure compliance with current standards and the upcoming, binding MLC regulations," says Behrens. If the client decides in favour of making actual design changes to avoid the negative effects of noise emissions and vibration, FutureShip can offer customized engineering solutions based on the PRE-CHECK results. Experienced acoustics engineers will work with shipbuilding engineers to develop solutions that will eliminate detrimental resonance. "In most cases, the solution involves controlled shifting of the resonant frequencies," Behrens comments.

This entire process confirms that the PRE-CHECK service should be applied during one of the early project stages before the actual construction begins. Behrens knows first-hand that making changes to finished components is many times more expensive than modifying the design early on. While excessive deck plate vibration detected during a sea trial can still be reduced by installing additional stiffeners, girders and brackets, this involves additional shipyard work and cost. And it can easily compromise the delivery schedule. "The PRE-CHECK service should be made standard procedure for all ship newbuilding projects," says Behrens. ■ JI

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SHIP OPERATION. Noise and vibration compromise safety on board.

Photo: Dreamstime

Model Calculations Drive Profitability

Operating ships in a manner that is both profitable and friendly to the environment is not self-contradictory, as FutureShip's "ECO-Patterns" tool shows. ECO-Patterns exposes weaknesses in energy management and helps reduce both CO_2 emissions and fuel consumption

Volker Höppner, Managing Director FutureShip, takes a pragmatic approach: "We'd rather develop solutions of our own." He is talking about reducing CO_2 emissions from commercial shipping. It is a safe bet that ships will have to pay for their CO_2 emissions sooner or later. In Höppner's opinion, voluntary commitments to CO_2 reduction are preferable to legal requirements.

A subject of heated debate. Critics question the relevance of ship emissions for climate change. Höppner isn't so sure either: "Ships are the most environment-friendly way of hauling goods from here to there. The specific CO_2 emissions of trucks are many times higher, not to mention planes." Even rail transport is no competition for ships when it comes to the climate hazard of CO_2 emissions. Those are strong arguments. But the dramatic symptoms of climate change observed in recent decades leave no room for exceptions: each and every CO_2 source must be scrutinized. The IMO is working hard to push measures for CO_2 reduction, but the focus of these efforts is not really on the current contribution of shipping to worldwide CO_2 emissions, which is a mere four per cent. What is much more worrisome is where shipping is headed. Apart from occasional dips in the business cycle, the volume of sea traffic is on a steady rise. By 2050, CO_2 output from ships could reach up to five times the present volume. That would definitely make commercial shipping a "big emitter".

Comparison Reveals Weak Spots

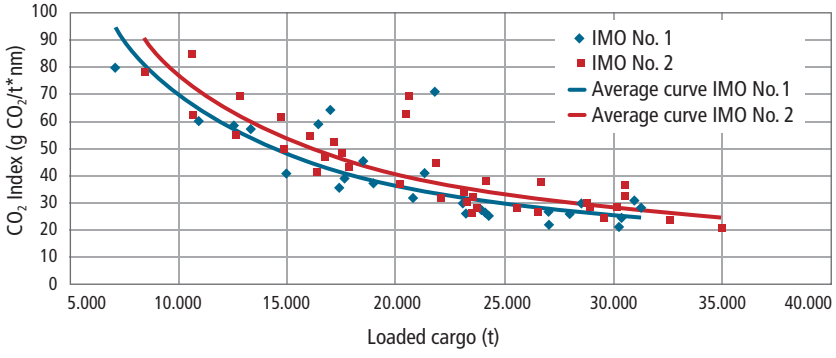
As long as ship engines burn heavy fuel oil or diesel, they will inevitably produce CO_2. As a rule of thumb, burn- →

ECO-PATTERNS – ANALYZING ENERGY EFFICIENCY

Two ships identical by design supplied their operational data to feed the ECO-Patterns analysis tool. An evaluation of the data resulted in different Energy Efficiency Operational Indicator values (EEOI).

As the diagram shows, performing a root cause investigation to improve energy efficiency would be well worth the effort.

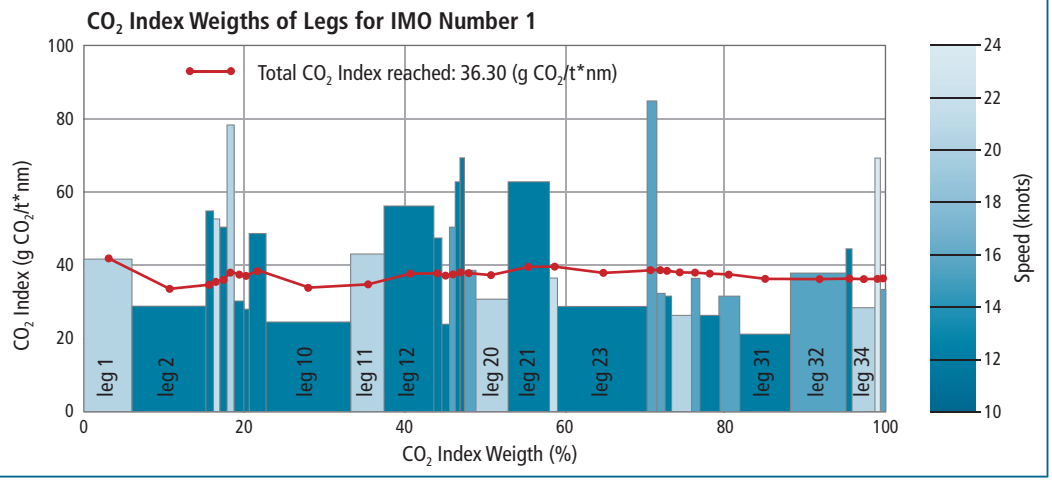
FutureShip offers ECO-Practices analyses to find the answers.



COSTS. "ECO-Patterns" analyzes the fuel consumption and helps to reduce it.

ECO-PRACTICES: ROOT CAUSE ANALYSIS AND RECOMMENDATIONS FOR ACTION

An analysis of the average speed, utilization of capacity and fuel consumption of both ships shows that the number of possible causes of the discrepancy can be narrowed down. The most logical solution is to examine the ship's operating parameters, its capacity utilization and maintenance practices.



→ ing one tonne of fossil fuel releases nearly three tonnes of carbon dioxide, and there is no technical gadget to avoid that. The only thing that can make a difference is boosting efficiency.

This is where ECO-Patterns comes in, an analysis tool developed by Höppner and others. The first step towards optimizing the fuel consumption of a vessel is analyzing its current operation. The tool is used to gather all relevant travel information over a period of time long enough to be representative. The resulting "long-term study" covers all data needed to assess the current energy consumption. "Of course, the data alone doesn't really tell us anything," says Höppner. "We need to follow up with a comparison, wherever possible with one or several sister ships, or at least with the data from a similar ship type. This quickly tells us whether there are any statistical outliers with regard to energy consumption."

The best possible scenario for Höppner has been an analysis project involving an entire fleet of ships identical by design and operating in very similar environments. Comparison was straight forward – and the outlier was quickly identified on the summary diagram: its Energy Efficiency Operational Indicator (EEOI), which ECO-Patterns is based on, was ten per cent lower than the average of the other ships. Among the rest of the fleet, the CO_2 emissions and, consequently, the fuel consumption values were very similar – the expected result for identical ships operating under nearly identical conditions.

Drawing on the Skipper's Expertise

So what is next after the ECO-Patterns analysis? "FutureShip can then offer a root-cause analysis," says Höppner. "Our next step is what we call ECO-Practices." This is essentially a Failure Mode and Effects Analysis (FMEA) whereby each energy-relevant system undergoes an error and risk assessment. "To give an example," Höppner explains, "a situation we encounter frequently, the cooling water system often wastes a lot of energy. So we take a close look at its operation and try to come up with the best way to improve efficiency." Another area to scrutinize is the on-board power-generating equipment.

Working closely together with the ship's officers is essential for Höppner. He draws on their insight into the subtle ways the ship's systems interact. "The amazing thing is – knowledge how to achieve efficient ship operation does exist on board. But in many cases nobody ever asks. We try to bring it out into the open."

Accurate Directions

FutureShip with its varied portfolio of consultancy services can assist in many different ways. The final results of the analysis can be applied on several intervention levels: the lowest or operational level addresses the way the ship is run. The second level involves minor retrofitting measures, and the third level includes major technical modifications. The customer decides how far he wants to go.

In the case of the fleet of identical ships described above, the statistical outlier provided some valuable insights: the ECO-Patterns analysis quickly demonstrated that it was worth searching for hidden potential for optimizing operations. The question what to do in a given case – whether to give new directions to the skipper and his officers or to invest in some technical modifications, such as a better cooling water pump – can be answered by running an ECO-Practices analysis. ■ JI

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EEOI

The Energy Efficiency Operational Indicator (EEOI) was developed by the IMO as a means to measure and optimize ship efficiency. The indicator is computed from a CO_2 factor specific to the fuel used, the amount of fuel consumed, the distance travelled and the volume of goods transported. The industry is still debating whether or not the use of the EEOI should become a binding requirement. But it is safe to assume that it will be introduced on a voluntary basis before long.

The Customer's Language

In shipbuilding, more than in any other industry, time is cash. This means that being close to the customer is of the essence. In Shanghai, GL is firmly established as a reliable partner of shipyards and shippers

Photo: Fotolia

PUDONG. The business and high-technology district of the metropolis Shanghai.

The beginning wasn't easy," recalls Ulrich Behrens, now Senior Engineer with GL subsidiary FutureShip. He went to China in 2006 to set up GL's Engineering Service East Asia (ESEA) office in Shanghai. The German engineer received valuable support from the local colleagues running GL's ASEA office in Shanghai. Initially the foreign environment and language were tough challenges for Behrens.

Having had some prior experience in China helped him adjust, he says. "I had already spent one year working there in 2003, and I knew what to expect. But I must say, Shanghai is definitely a very special place." First of all, the hot and humid summer climate is a tough challenge for a central European. And with roughly 19 million inhabitants, the metroplex area is among the world's largest mega-cities.

Since 2007, the Shanghai ports form the largest container hub globally – larger even than Singapore, Hong Kong or Rotterdam. As for Behrens, the leading industrial city of the People's Republic of China is a "must be" kind of place, a commercial centre where no large international enterprise can afford not to be represented. Shanghai, along with Hong Kong and Singapore, is a gateway to the entire Asian market. Many customers are headquartered here: Chinese shipyards as well as shipping companies having their vessels built in China.

At Eye-level

The groundbreaking work of Behrens and his successor, Sebastian Knees, was not in vain. GL's ESEA has long since become an important part of the shipping community in the "dragon's head" metropolis. Just over a year ago, Dr Leshan Zhang took over the command of GL's Shanghai office. Business is international, but it has its local peculiarities. "English only has it limits," says Zhang. "Once you get into details, especially technical ones, being able to communicate in Chinese makes a big difference." This is why local presence makes a big difference, and this is why the staff must be able to communicate in the local language.

ESEA offers its customers a wide range of ship engineering services, such as vibration calculations, strength calculations or supervision of measurements for troubleshooting and training. Another sought-after GL offering is HullManager, an application for optimizing ship structural management.

Getting Involved Early Is the Key

The best time to involve ESEA is during the early stages of a ship newbuilding project. This avoids the root causes of problems GL's engineers will otherwise have do address later in a tedious trouble-shooting process. An example: During the sea trial of a containership, strong vibration was noticed on the bridge deck. "We took some measurements and compared the results with a finite-elements model," Zhang reports. "The analysis showed that a wall was missing in one of the cable ducts. This caused the relatively soft deck surfaces to start resonating at a specific propeller frequency."

This manufacturing error could not be repaired directly because the affected duct was no longer accessible. ESEA solved the problem by installing several additional support posts. "The same solution was then applied to the sister ships prior to their sea trials. This saved the owner a significant amount of money," says Zhang. Co-operation with the Chinese shipyards has been so successful that they entrust ESEA with many crucial calculations for new ship designs. Good news for ESEA. The People's Republic of China is a growing shipbuilding market and has already caught up with the shipbuilding nation of South Korea. ■ JI

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FUTURESHIP

FutureShip, GL's maritime consultancy division, helps shipping companies and shipyards optimize ship design and operation using custom-developed software.

The GL subsidiary was created by merging Friendship Consulting with GL's Advanced Engineering Competence Centre. FutureShip gives advice on fleet development, ship management, ship design and operation, environmental matters and certification.

Clean Air at Sea

When it comes to environmental compatibility, the German commercial fleet is a role model. With the world's first-ever on-board test installation of a waste gas dry desulphurization plant, shipping company Rörd Braren takes a major step ahead

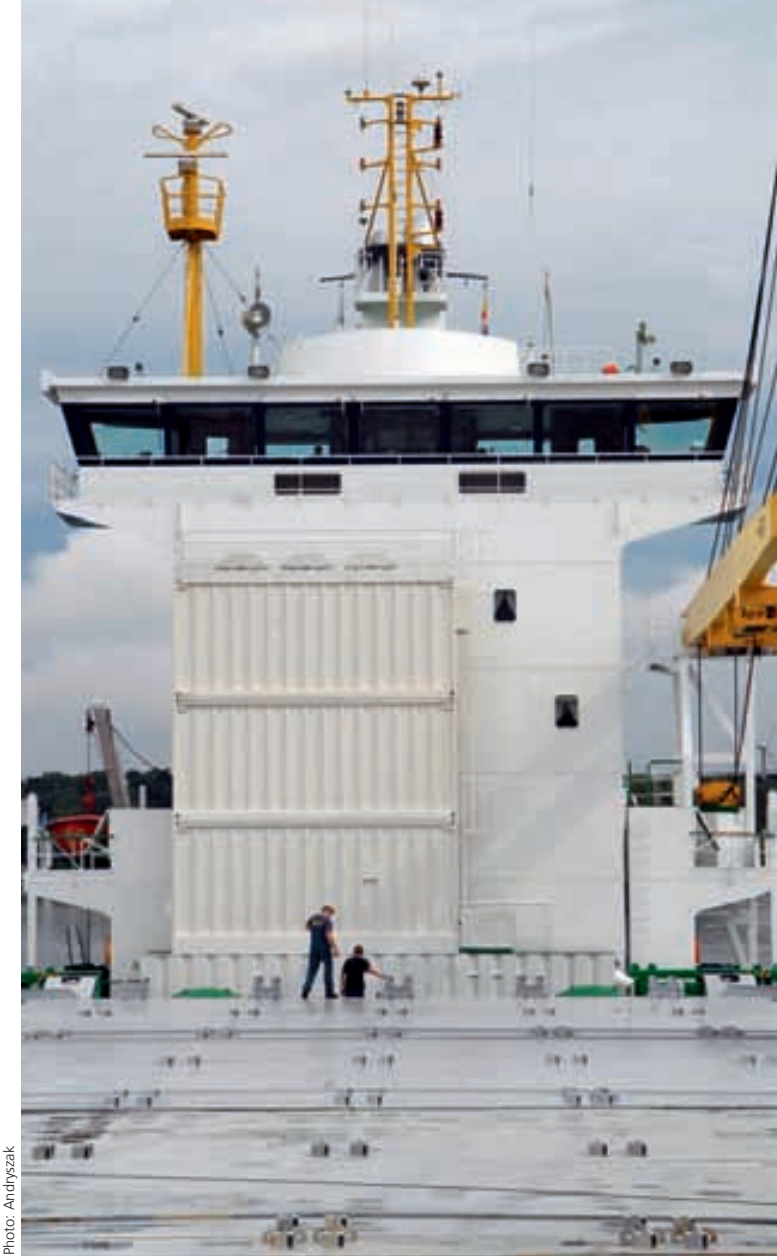


Photo: Andryszak

Timbus" is the name of rather a special ship: She is a trial ship for on-board sulphur oxide reduction technology. Conspicuous even from afar, an unusual structure in front of her bridge catches the viewer's eye, resembling an additional container stack attached to the superstructure and painted white.

What might seem an architectural misfit at first is the first-ever attempt at cleansing the exhaust gases of a commercial vessel by means of a so-called DryEGCS plant. "We maintain close, trust-based relationships with our customers and partners, and we take an active role in testing and establishing new technologies for ship operation and environmental protection," says owner Rörd Braren. The shipmaster and shipowner, a member of the board of directors of the German shipowners association VDR, again takes the lead. Among his company's credits to date are a "Blue Angel" environmental label awarded by the EU administration in Brussels, and a "Clean Marine Award" for exemplary commitment to environment protection.

His new initiative was prompted by the new limits for the sulphur content of ship fuels and the nitrogen oxide (NO_X) content of exhaust gas as issued by the International Maritime Organization (IMO) in 2008. Furthermore, even stricter limits have been set for the SO_X Emission Control Areas (SECAs) in the Baltic Sea and North Sea.

Proven Inland Technology

An especially critical aspect of the regulation is the reduction of the allowable sulphur content in fuels to only 0.1 per cent by 2015 in all SECAs. Ship operators running ships inside SECAs can only comply with this stipulation by switching their engines to Marine Diesel Oil (MDO), also called gasoil, while in a SECA. However, during the 2007 and 2008 peak demand period, the price of gasoil was nearly twice that of standard low-sulphur fuel.

Such high costs would cause freight rates to skyrocket. As a consequence, shippers might be tempted to move their goods by truck rather than ship, which would be incompat-

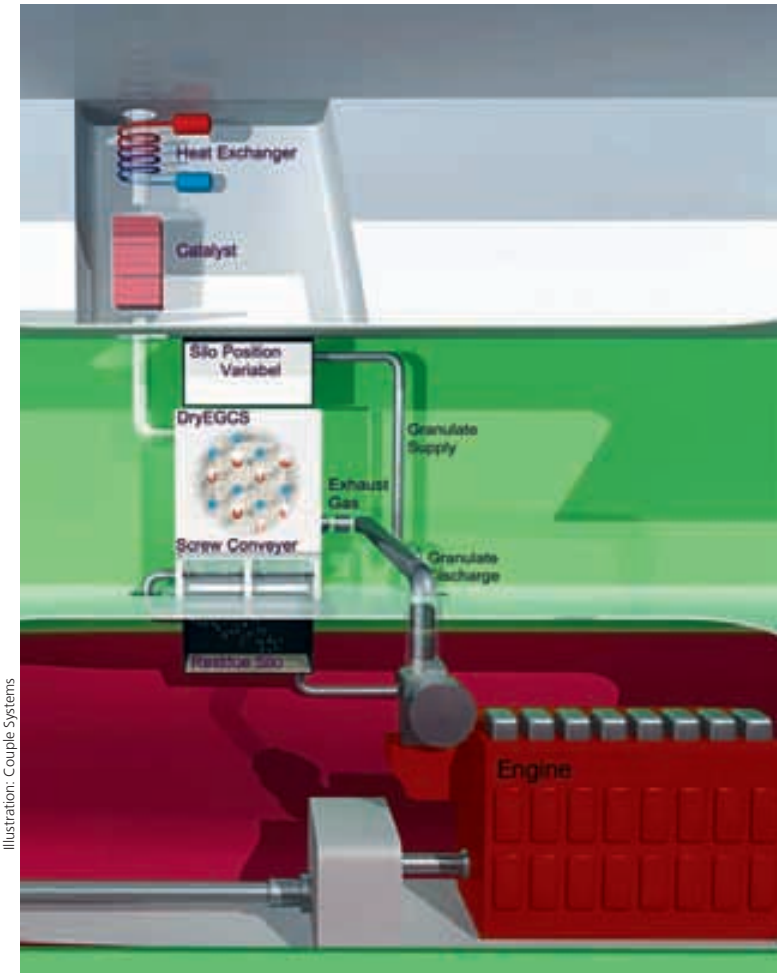


Illustration: Couple Systems

BEST PRACTICE. The DryEGCS desulphurization plant was certified by Germanischer Lloyd according to GL rules and IMO guidelines.

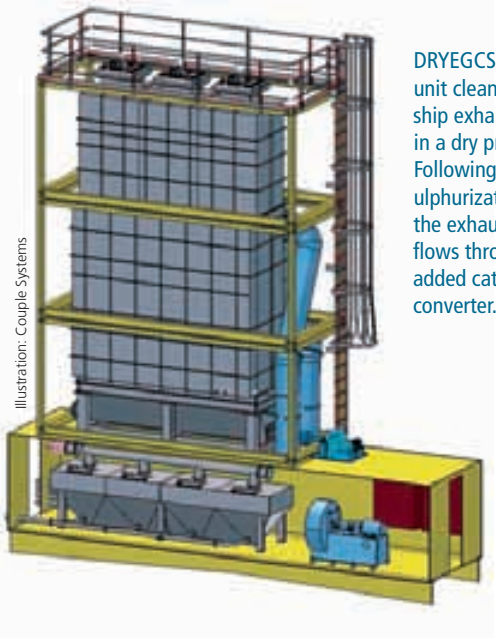


Illustration: Couple Systems

DRYEGCS. The unit cleanses ship exhaust gas in a dry process. Following desulphurization, the exhaust gas flows through an added catalytic converter.

Photo: Couple Systems

Photo: Couple Systems

GRANULATE. The hydrated lime granules extract the eco-harmful sulphur.

INSTALLATION. The desulphurization unit is pre-assembled onshore. The cleansed gas exits the unit through the pipe attached to the top of the silo.

ible with environmental policy. The IMO regulation offers an alternative approach: ships may continue to burn heavy fuel oils provided they clean up the exhaust gases. What matters most is what exits the smoke stack, in other words, the sulphur content of the exhaust gases. The industry is searching for technical solutions. Manufacturers favour two waste gas cleaning methods proven in inland applications: the wet method forces the exhaust gas through a water mist that causes the sulphur oxides to be converted to sulphuric acid; the dry method uses hydrated lime (calcium hydroxide), which is converted to gypsum.

Rörd Braren chose the latter approach for his "Timbus". The DryEGCS project, headed by Couple Systems, is a collaborative effort involving the Hamburg-Harburg and Rostock Technical Universities, MAN Diesel SE, GL, Motorenwerke Bremerhaven, Märker Kalk and Kleinwächter Co., Hallenberg, as partners. Their common goal: Desulphurized exhaust gas independent of the sulphur content of the fuel used.

Dry Desulphurization

Upon completion of the 5000-hour trial on board Timbus, the DryEGCS test project has meanwhile reached a successful conclusion. "We are already fully in compliance with the IMO regulations to enter into effect in 2015 in conjunction with MARPOL Annex VI," says Olaf Knüppel, Managing Director with Couple Systems.

Of course, due to their considerable size these units occupy a certain amount of cargo space. But this can be accounted for during the planning stages for new ships. In addition, more than half the ships in operation could be retrofitted, says Knüppel, who has discussed the concept with several ship-owners. There appears to be a general willingness to accept the loss of a few container spaces in return for ships being ready for the future.

DryEGCS units are pre-assembled on shore, placed inside containers stuffed with mineral wool, then installed on board. Once the exhaust gas has passed through the desulphurization system, it flows through an additional catalytic converter. The unit on board Timbus uses the dry desulphurization method. The exhaust fumes are channelled through the system's two tanks filled with granulated hydrated lime. The 3.6-megawatt main engine of Timbus boasts a volume of 36,000 cubic metres of exhaust gas per hour. The gypsum produced by the unit drops to the bottom where a slowly-turning auger discharges it into containers. "Timbus's four-cycle main engine consumes approximately 10 to 16 kilogrammes of lime per hour," says Ralf Jürgens, head of Couple Systems' Research and Development department. This modest quantity is a result of the favourable reaction conditions the high exhaust gas temperature of the four-cycle engine – 350 °C – creates for the lime. "The residual sulphur content of the emitted exhaust gas is near the detection limit," says Jürgens. DryEGCS, which was certified by Germanischer Lloyd last December, is the world's first system of its kind modified for ships.

A Few Technical Challenges

Wet or dry: with both processes the question remains what to do with the sulphur once it has been extracted on board. The contaminated water discharged by the wet-process scrubbers must be collected in tanks and pumped ashore at dockside for disposal. However, large quantities of scrubber water accumulate rapidly on board and must be treated before being returned to the sea. As for the dry process, the gypsum it produces must likewise be disposed on shore. The quantities produced on long trips are excessive.

So for the time being, a few technical challenges remain on the agenda. Yet, the fact remains: German shipowners are one step ahead of the competition when it comes to pioneering environment-friendly solutions. ■ MJ

NEW EMISSION LIMITS

Sulphur oxides (SO_X) – The regulation in effect since 1 January 2010 for all EU ports stipulates: any time a ship moors at the pier for two or more hours, it must use a fuel with a sulphur content not exceeding 0.1 per cent until the ship casts off.

For the SO_X Emission Control Areas – the Baltic Sea and the North Sea – the current 1.0-per-cent limit will remain in force until the stricter 0.1-per-cent limit takes effect in 2015. Otherwise the upper limit in international waters remains at 4.5 per cent; it will be cut to 3.5 as of 2012, and to 0.5 per cent effective 2020.

Crystal Clear Alternative

New, stringent emission regulations are forcing the shipping industry to rethink its fuelling options. Liquefied natural Gas (LNG) offers an attractive alternative to conventional fuels – and GL helps shipowners prepare for the introduction. With an appropriate infrastructure available, Northern Europe could become a testing field for gas as a ship fuel

NATURE. Tight limits on noxious emissions, such as those in the North Sea SECA zone, have been introduced to protect the environment. This requires lower-emission ship propulsion systems. LNG is a realistic option.

Slow steaming, operational fine tuning and a review of sailing schedules have been adopted by the maritime industry as efficient tools to save fuel and reduce air emissions. Reducing transit speed has been one of the best strategies to help owners to survive current market conditions. In respect of lower limits for harmful emissions from ocean-going vessels, tough engine and fuel standards have been put on the agenda of IMO and various flag states. With the introduction of environmental protection areas in Europe (SECA) and soon in U.S. and Canadian territorial waters (ECA), shipowners are asked to consider alternative fuels to traditional heavy fuel oil (HFO).

Given the price tag on marine gas, alternative fuels with less environmental impact are becoming a formidable option to consider. The economic and environmental benefits of LNG as an alternative fuel for shipping are already evident. Compared to oil, natural gas has two key advantages: high efficiency and a lower environmental impact.

Meeting the Emission Challenges

Engine problems and damage caused by low-quality heavy fuel oils will be a thing of the past for shipowners switching to gas as a ship fuel. The concept of a fuel switch will be implemented at first in the Baltic Sea. The short sea sector with its intensive ship traffic is an ideal region to build up the necessary LNG infrastructure.

The move away from heavy fuel oil makes sense, when the price of marine gas is considerably higher than the one for LNG. LNG is already a commercially viable fuel for shipping. It offers the prospect of 25 per cent reductions in CO_2, a complete elimination of sulphur emissions and close to 90 per cent reduction in nitrogen oxides (NO_x). The long-term future of heavy fuel oil as bunker is questionable,

TRANSPORT. Smaller LNG tankers could fill the logistics gap between liquefaction plants and in-port refuelling operations. Ships such as "Norgas Innovation" are in operation already.

both in terms of dependency on oil and not least with regard to emissions. In contrast, natural gas ensures a far more environmentally friendly combustion and, in addition, there appear to be greater reserves available than oil. Thus, natural gas in liquid form (LNG) as marine fuels has the potential to be the solution for the shipping industry to cope with its emission challenges in the years to come. In time for innovative shipowners who are eager to obtain "first mover" benefits, GL has prepared new guidelines for gas as a ship fuel and supporting technical guidance on the application of the relevant IMO regulations.

Risks associated with conventional ship fuels include bunker quality issues, poor ignition and combustion, and uneven heat and pressure distribution on pistons, piston rings and cylinder liners. In early June 2009 the IMO Committee on Maritime Safety (MSC) lifted the ban on natural gas as a ship fuel by adopting Resolution MSC 285(86), called "Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships". Developed by the IMO subcommittee on Bulk Liquid and Gases (BLG) with GL assistance over the past few years, the Interim Guidelines are the first step towards the envisioned general code for gas as a ship fuel, the so-called IGF Code, which is currently under development by IMO and is expected to enter into force conjointly with the revision of SOLAS 2014.

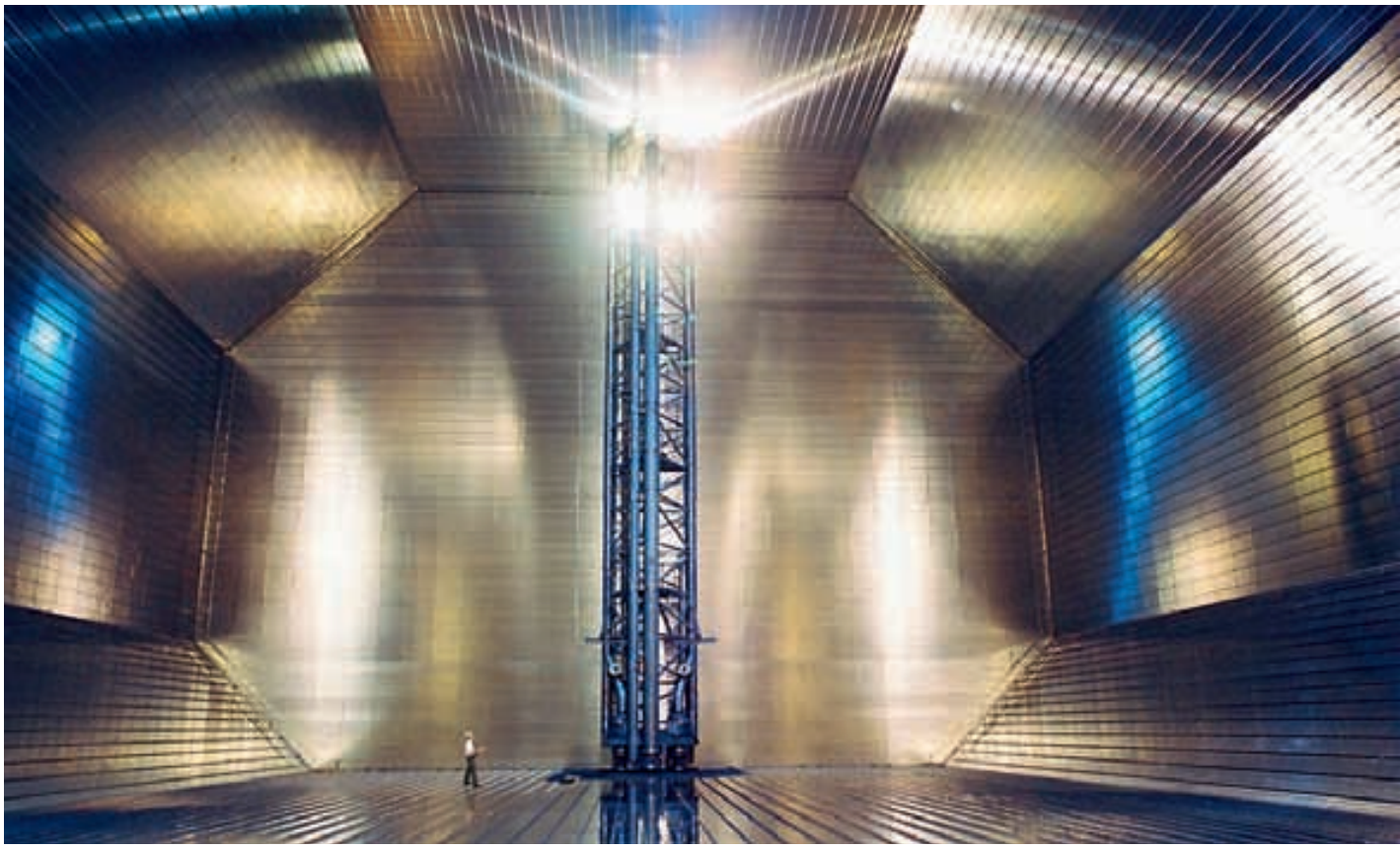
The GL guidelines will help shipowners and yards prepare for the introduction of gas as a ship fuel. The new guidelines provide criteria for the design arrangements and installation of propulsion and auxiliary machinery powered by natural gas to ensure a level of integrity, safety, reliability and dependability equivalent to that of comparable, state-of-the-art machinery burning conventional fuel oil. The internal combustion engine installations subject to the IMO Interim Guidelines may be single-fuel (i.e. natural gas) or dual-fuel (gas and fuel oil) machines, and the natural gas may be stored in gaseous or liquid state. The Interim Guidelines are to be applied in conjunction with the relevant provisions of the International Convention for the Safety of Life at Sea (SOLAS), 1974, and the Protocol of 1988 relating thereto, as amended.

Environment- and Budget-Friendly

Liquefied natural gas (LNG) is gas (predominantly methane, CH_4) that has been converted temporarily to liquid form for ease of storage or transport. It is odourless, colourless, non-toxic and non-corrosive. The reduction in volume compared to its gasous state makes it much more cost-efficient to transport over long distances. The energy density of LNG is 60 per cent of that of diesel fuel. Therefore, a doubling of tank capacity is necessary. Increasing numbers of new LNG carriers are equipped with high-efficiency dual fuel engines. This trend, which originated in commercial shipping around the millennium, has encouraged the introduction of LNG as a ship fuel.

An appropriate infrastructure supplying LNG fuel in ports has yet to be established. GL believes LNG as a ship fuel may be just the solution the shipping industry has been looking for to cope with the current emissions →

Photo: iStockphoto



→ challenges. Introducing LNG as fuel for shipping requires the availability of LNG in ports and the aim of protecting the environment from emissions, especially CO_2 and NO_x. A growing population, the industrial development and limitations of fossil fuel resources will drive the tendency towards low carbon content of fuel and higher efficiencies, which are possible through technologies that are already on their way.

Infrastructure in Place

With an appropriate LNG infrastructure available, Northern Europe could become a testing field for gas as a ship fuel. The Emission Control Areas imposed in the Baltic Sea and parts of the North Sea would make this region an ideal environment for an immediate test trial. LNG offers significant cost advantages over a conventional vessel using low-sulphur fuel (MGO quality) from 2015 onwards. The European Union has already introduced 0.1 per cent sulphur as a maximum level for a ship's fuel when in ports and on inland waterways. As of 1 July 2010 the maximum level of sulphur in fuel is set at 1 per cent within SO_x Emission Control Areas, and the requirements will be further tightened to 0.1 per cent by 2015. Within a joint research project on "gas-fuelled feeder container vessels" GL and the other partners, namely MAN, TGE Marine Gas Engineering and Neptun-Stahlkonstruktions-GmbH, evaluated the feasibility of a gas engine onboard of a container vessel propelled by LNG. The study assumed the integration of an MAN dual fuel engine onboard, the design of the LNG tanks and the layout of the gas conditioning system according to MSC.285(86).

Cost Advantages

Factors boosting the advantages of gas-fuelled feeders are the CO_2-emission costs; the NO_x limitations for conventional vessels to take effect in 2016; fuelling auxiliary engines with gas while in port; and harnessing scale effects in gas tank production. The fuel cost advantage far outweighs the additional costs of outfitting new ships with LNG equipment. Estimates from yards and suppliers suggest that LNG

GASPAX. In a joint project with Meyer-Werft shipyards, GL develops solutions for gas propulsion systems on passenger ships.

Photo: AIDA Cruises

EFFICIENCY. LNG tankers equipped with membrane tanks are more streamlined and consume less fuel than ships with spherical tanks.

TREND. Increasing numbers of new ships are equipped with highly efficient dual-fuel engines, such as the MAN 7L51/60DF.

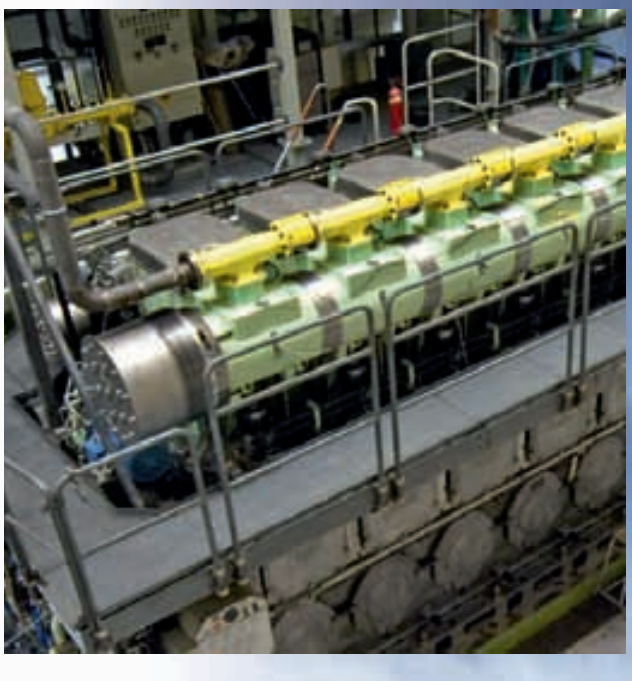


Photo: Navantia

power would add around 15 per cent to the cost of a newbuilding. The elimination of equipment like heavy fuel oil service tanks, pre-cleaning and pre-heating equipment, clean oil tanks, fuel oil drain tanks and oil-water separators effectively reduces costs. This will be compensated by more sophisticated fuel tanks due to the required insulation.

Bunkering Procedures Required

GL assumes that LNG bunkering will be comparable to HFO bunkering. Details of the LNG bunkering process are currently being examined, and GL recently performed a design review and submitted a joint proposal for a funded project called BunGas. A number of scenarios for LNG refuelling are being analyzed such as bunkering from shore at a fixed hub or bunkering by refuelling vessel during harbour operation. Within a risk assessment, various scenarios are investigated such as a LNG spill, leaking joints, valves, flanges etc., line failure due to unexpected movements or material failure, or collisions during the bunkering process or during manoeuvring. Therefore, Emergency Shut Down (ESD) procedures have to be developed which rely on a data link between bunker ship and supplied vessel.

In addition, a large number of questions have to be resolved with respect to the tank type of the supplied vessel and the implications for the bunkering process. After all, LNG bunkering must be competitive with fuel oil bunkering concerning time, location, and procedures. In the end, common accepted safe bunkering systems and procedures must be developed and in place to win public acceptance for the alternative fuel.

Current developments in northern Europe indicates that LNG as fuel will be available for bunkering within the next years due to new liquefaction plants like the NORDIC LNG plant, located in Stavanger/Norway. These developments will establish the basis for an LNG supply chain for dedicated markets. Small-scale LNG carriers (~10,000 m^3, build for regional supply) could pose the link between liquefaction plants and bunkering in harbours. A number of small LNG carriers like Norgas Innovation, Coral Methane and Pioneer Knudsen are already in service and further new buildings are under construction.

Regulatory Framework

According to the IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) only LNG carrier are allowed to utilize LNG boil-off gas in the machinery space as fuel. Since the year 2000 a few LNG-fuelled vessels, which are not covered by the IGC Code, have come into service with the permission of the national administration. These vessels are only allowed to sail in these national waters or need permission from each port state where this ship wants to berth and operate.

The lack of international safety requirements for gas as fuel for non-LNG tankers initiated the development of an International Code for Gas as Ship Fuel (IGF Code) in 2004. The goal of the guideline was to provide an international standard for ships with natural gas-fuelled engine installations. The Interim Guideline (MSC.285(86)) was adopted in June 2009 and gives criteria for the arrangement and installation of LNG-fuelled machinery to achieve an equivalent level of integrity in terms of safety, reliability and dependability compared to conventional oil-fuelled machinery. The Interim Guideline is the international safety standard until the general Code is developed and set into force as a part of a review of the SOLAS convention in 2014.

Go for It

LNG is already a technical viable alternative to HFO. The economical analysis shows cost advantages for gas-fuelled feeders operating in an ECA from 2015 onwards. Further cost advantages will be materialized if CO_2 emission costs and NO_x limitations are imposed.

LNG will play a substantial part in the coming decades in enabling substantial near-term carbon emission reductions. Natural gas is widely regarded as a bridge to a low-carbon future. For the maritime industry, gas could be a viable alternative to heavy fuel oil which, out according to IMO, will be phases out within the next ten years. Gas has the potential to reduce dependence on other fossil fuels with heavier carbon impacts. Since the IMO is actively supporting the international shipping industry by providing regulations which are flexible and forward looking to reduce the environmental impact of shipping, the time is right for a new chapter in ship fuels. ■ OM

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Engine Watchdog

The automation of ship operation technology is advancing constantly. With the permanent condition monitoring of complex machinery installations, the maintenance requirements can be reduced and failures prevented

Without the electrics and electronics, the large diesel engines on ships would no longer be able to function. Nowadays, almost all plants are dependent on auxiliary electrical units (e.g. pumps, compressors). Increasingly, electronic components are being implemented in engine technology: speed governors, monitoring and protection systems – and more and more frequently also the electronic injection systems that have become indispensable in meeting the emission limits and reducing fuel consumption.

Because they are more sensitive to faults, the main drives require many more measuring points to make sure the ship is running smoothly. Whereas approx. 200 to 500 measuring points were usual in the 1990s, this number has since swelled to more than 2,000. However, nothing has changed with regard to the basic principle of alarm generation in the event of damage.

Flexible Maintenance

To safeguard the reliability and availability of the main propulsion plants of merchant vessels, the goal is not only to detect damage and malfunctions but also to prevent them in good time. An important role here is played by condition monitoring (CM). The aim of condition monitoring is to move away from rigid servicing intervals towards condition-based maintenance that can be planned flexibly and help identify damage at an early stage of its development.

In this way, it becomes possible to minimize the risk of unexpected failures and the ensuing downtime and expense. On the other hand, damage through unnecessary inspections can also be avoided, because the dismantling and reassembly of sensitive components – such as the bearing shells of a crankshaft – are not entirely free of risks.

While ships in the seventies were operated by a crew of forty, less than twenty persons are on board today's automated vessels. In the case of ships with fully automatic engine operations and a so-called "one-man bridge", the manning level is sometimes only fourteen. The one-man bridge is designed to require only one person navigating the vessel on the open sea. With the ever more complex ship systems and the simultaneous reduction in personnel, damage to machinery installations can no longer be diagnosed and rectified with shipboard resources alone.

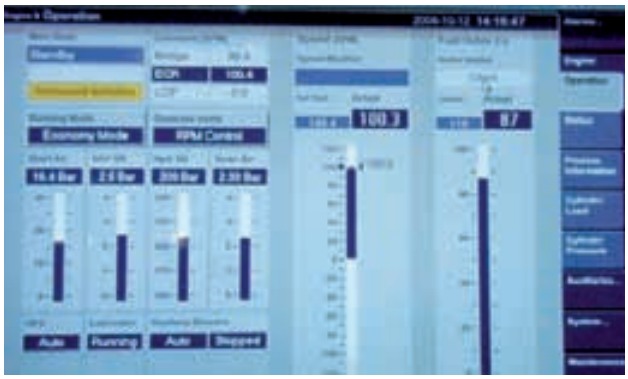
The crew needs support from shore personnel. Modern automation systems offer the possibility of remote diagnosis. In a similar fashion to the on-board diagnostics used in the automotive sector, the operating states, error messages and long-term data can be read out of the modern control units of marine diesel engines. However, a ship will be at sea for most of the time. The data are therefore transmitted to shore by radio. The requirements concerning data protection are high: the systems must be able to deal with unsecured and interference-prone communication paths. Protection of the data, security of transfer and a failsafe response to interruptions in transmission must be guaranteed.

In the course of several pilot projects conducted since 2005, Germanischer Lloyd has been developing innovative solutions in cooperation with engine manufacturers, shipping companies and the makers of CM systems. Here Germanischer Lloyd profits from the interdisciplinary expert knowledge of its own staff in the fields of shipbuilding, ship operation, mechanical and electrical engineering, electronics, automation as well as in radio, data and information technology.

When applying CM to a two-stroke crosshead engine, the bearings of the crank assembly are monitored for wear. Bearing wear is registered by a simple yet precise position measurement of the pistons at the bottom dead centre of each revolution. The trends of the measured data are conditioned to account for corruptive influences, and then analyzed.

Comprehensive Assessment

The necessary CM components, such as sensors, measuring transmitters and evaluation electronics, must be able to function reliably and precisely over a long period in a situation characterized by high temperatures and strong vibration. The general scientific approach must



ADVANCED ENGINE MANAGEMENT. Visualisation of the operating status of the fuel injection system.

BRIDGE. A state-of-the-art layout automates many processes, reducing the workload of the crew.

Photo: Eberhardt Petzold

be transformed into a robust system that is fit for normal operation. To make sure that the various electronic components can survive permanently in the harsh marine environment, it is important to test them for their suitability in respect of the prevailing mechanical and climatic conditions as well as the requirements of electromagnetic compatibility.

In this field, GL is a good point of contact for complete systems, too. The selected components are type-approved according to the GL guidelines, with a view to ensuring their operational readiness under the tough ambient conditions. Evaluation of the software with regard to the Guidelines for the Use of Computers and Computer Systems also ensures the reliable and optimum interplay of all the components. After all, systems such as those used for condition monitoring are intended to minimize the maintenance requirements and not themselves give cause for repair.

Rising Efficiency

Condition monitoring – as the permanent watch over an engine state – will become a commonly used technology in only a few years. With the increasing miniaturization of systems in recent times, their operational scope has widened appreciably. Lubricant quality is another important issue. While current systems only check for water content and, possibly, viscosity on a permanent basis, future technology might enable a more detailed automated analysis.

Condition monitoring has already become an invaluable tool in some sectors. In this regard, the operators of wind turbines are pioneering the use of these systems. The implementation of CM systems can also serve to enhance operational efficiency. Producers who aim to achieve 100 per cent uptime for their machines have to know exactly what is going on inside them and how strongly the crucial points are loaded. As a result, the plastics and paper industries as well as compressor makers are highly interested in implementing CM.

The investment costs will not prove an obstacle to the use of CM systems in shipping whenever decisions have to be taken on the procurement of a CM-protected engine or a retrofit kit to measure vibration, torques, weight loads and temperatures. The prices for sensors and other hardware, and for the necessary software, have declined strongly in recent years. And so the trend towards CM is likely to gain further momentum. ■ MR

CHECK. Today's complex technology demands constant supervision.

Photo: Eberhardt Petzold

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The Chemistry Is Right

European shipyards are having a hard time. But Santierul Naval Constanta, equipped with leading-edge technology and a skilled workforce, is ready for the next economic upswing in the tanker market

ROMANIA

BLACK SEA

CONSTANTA

STRATEGIC POSITION.
The yard is located in the port of Constanta on the western shores of the Black Sea.

Photo: NASA

Last year there were several tectonic shifts among the ten leading shipbuilding countries: nations that used to be also-rans moved up to the front, among them the Philippines, India and Vietnam. On the other hand, some European shipbuilders lost ground. Romania dropped to 11th place after ranking 9th in 2008.

In other words, shipyards in Romania can't be doing too well. Yet, Santierul Naval Constanta (SNC), the country's second largest shipyard, managed to hold its ground in the oil tanker and bulk carrier business. Santierul Naval Constanta's current orderbook lists three 41,000-dwt oil and chemical tankers. Construction will begin in September 2010. This makes the yard one of the foremost shipbuilders in south-eastern Europe. Within Romania, the only yard that tops Santierul Naval Constanta is Daewoo Mangalia Heavy Industries (DMHI), located in the port city of Mangalia.

High Carrying Capacity

Not long ago, Santierul Naval Constanta delivered Histria Gemma, another 41,000-dwt oil and chemical tanker. She was the penultimate ship of a major series boasting 18 units that was begun in 2005. The design of these state-of-the-art vessels has since been optimized in a steady process. 180 metres in length and 32.2 metres wide, these double-hull tankers have a draught of 10.5 metres. What sets the design apart is the carrying capacity, which is comparatively high for a ship this size. Each tank is equipped with its own deep-well pump and discharging line. The main engine, a B&W 6S50 MC-C, cranks out 9,480 kilowatts at 127 revolutions per minute, propelling the ship at a service speed of 15 knots. The tanker has an 11,000-nautical-mile cruising range. The series has been classified by Germanischer Lloyd as Chemical Tankers Type 3/Oil Tanker.

Photo: Adi Man

CONVERSION. With the challenging conversion of the single-hull tanker Histria Diamond into a double-hull bulk carrier, Santierul Naval Constanta entered new territory.

Photo: Santierul Naval Constanta S.A.

CAPACITY. SNC has two large dry docks and two floating docks.

Strategically Positioned

The history of the shipyard has been long and eventful. First mentioned in a ministerial report in 1892, Santierul Naval Constanta built up a reputation as a repair yard, which it maintained over several decades. The company was firmly established in the port of Constanta, which is strategically well-placed on the western coast of the Black Sea. The yard grew steadily. In 1936 its future potential became evident when the motor yacht Crai Nou was completed, the first new ship ever constructed at the yard, and a milestone in its history. the next step followed in 1950: The company began relying on its newbuilding business as a major second area of activity, investing heavily in its facilities. Two new dry docks and numerous fabrication halls were built. SNC became an important factor in the Romanian economy.

In the meantime Santierul Naval Constanta has specialized in various ship types, especially tankers. Sizes range from 1,100-dwt chemical tankers to Aframax and Suezmax vessels. In addition, SNC builds Capesize bulk carriers, as well as LPG tankers, ammonia tankers, offshore supply ships and steel pontoons.

Challenging Conversion

A particular challenge the yard embraces is conversions of ships in operation. Rebuilding the single-hull tanker Histria Diamond into a double-hulled, 87,680-dwt bulk carrier was definitely a unique task. The project was completed in February 2010. It involved removing 5,000 tonnes of steel, then joining 7,000 tonnes of steel by welding. The entire cargo space had to be retrofitted, and the ballast water tank system had to be almost entirely replaced. The engineering →

Photos: Santierul Naval Constanta S.A.

POTENTIAL. From sailing ships to container vessels: The yard is equipped to build and repair ships of many sizes.

TANKER. The 180-metre tanker Lisca Nera M, named after a volcanic island, is currently sailing under the Italian flag.

→ work was done by SNC subsidiary SNC ShipDesign SRL. This complex conversion project, probably the only one of its kind in all of Europe, was a technical challenge for both the yard and GL. Many years of close co-operation truly paid off for the two companies, both of which have benefited from the technical experience gained during the project.

Today Santierul Naval Constanta operates two large dry docks (for ships up to 250,000 dwt and 150,000 dwt, respectively) and two floating docks (40,000 dwt and 15,000 dwt). The company's facilities cover a total area of 800,000 square metres. The floating docks are mostly used for repair jobs. To date, the yard has built tankers up to 150,000 tonnes and bulk carriers up to 165,000 tonnes, but it has the capacity to construct ships up to 200,000 tonnes.

"A Man of Action"

The change of tide in Eastern Europe has had lasting effects on the development of the yard's business. Since 1990, most orders have come from abroad, mainly from Western and Central European companies who appreciate the work of the skilled Romanian engineers and workers.

The most decisive event in the biography of the yard occurred in October 2002 when SNC was privatized. The main partner is the Histria Group with its president Gheorghe Bosinceanu. A former shipmaster with Romanian bulk carrier and oil tanker operator Petromin Shipping Company, the entrepreneur's first management position was as head of the tanker division of the company. Following the fall of Communism in Romania, Gheorghe Bosinceanu, who enjoys the reputation of a "man of action", built the Histria Group. In 2008, the shipyard recorded sales of EUR 153.5 million with a workforce of 2,300.

Market Uncertainty

The current intransparency of the tanker market and its many sub-segments makes forecasts difficult. While the oil tanker business is seeing a slight upturn owing to the regulations for phased decommissioning of single-hull ships, other market segments have been nearly without demand. Due to the long delivery periods of three or more years for new ships, there are still ships under construction or being delivered that were ordered prior to the financial and economic crises. Order volumes are far from reaching pre-crisis levels.

In view of rising freight rates in the container business and a recovery in the bulk carrier new-building segment stimulated by the economic boom in China, Gerhard Carlsson, market researcher with German Naval Architecture and Ocean Engineering Association VSM, cautions against overly optimistic expectations for tankers: "At the moment, rates are going up and down all the time so any forecast would be futile. There are no reliable market trends."

As for SNC, the yard is well-prepared for an economic recovery. In 2008, SNC presented a draft design for a 50,000-dwt oil and chemical tanker developed by SDC Ship Design & Consult, Hamburg. This is GL's first tanker design based on the new IACS Common Structural Rules. The design, featuring increased fatigue strength, met with serious interest from potential buyers, but unfortunately, early orders were cancelled in the wake of the financial and economic crisis.

SNC with its highly skilled engineers and workers could begin implementing this design at any time. For the time being, SNC continues repairing ships and building offshore and marine vessels. ■ HS

SNC at the SMM 2010: Hall B4, Booth EG 261
www.snc.ro; www.histria.ro

PARTNERS. Gheorghe Bosinceanu, President of the Histria Group, and GL Executive Board Member Dr Hermann J. Klein.

CLASSIFICATION

Close Co-operation with GL

Co-operation between SNC and Germanischer Lloyd began in 1990 with GL overseeing the construction of a series of six 1,078-TEU containerships for Thien und Heyenga AG. The largest project to date has been a series of 18 chemical tankers for various customers, involving constant design improvements. Most of the ships were built for sister company Histria Shipmanagement S.R.L. Co-operation with GL has been very successful, especially since SNC adopted GL's ISO 9001:2008 quality management system.

In addition, the shipyard has implemented the ISO 14001:2004 standard for environmental compatibility, and an Occupational Health & Safety Management System compliant with the OHSAS 18001:2007 standard. Here again, SNC was a pioneer among Romanian shipbuilders.

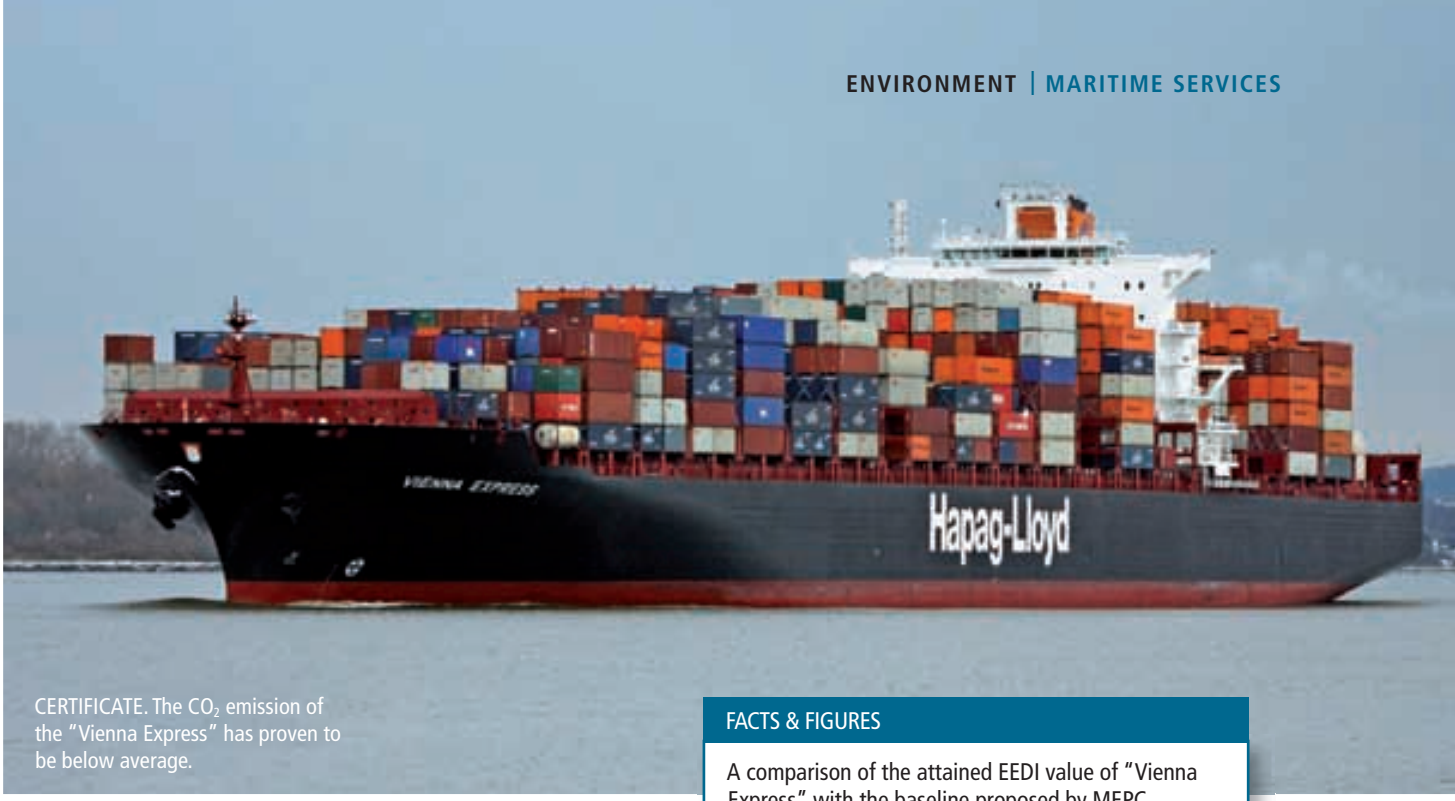
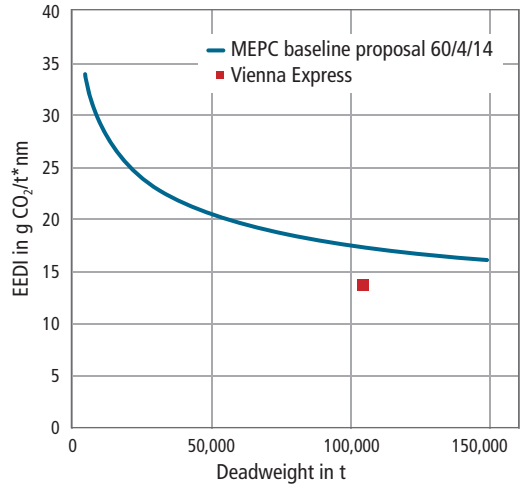


Photo: Hasenpusch

CERTIFICATE. The CO_2 emission of the "Vienna Express" has proven to be below average.

FACTS & FIGURES

A comparison of the attained EEDI value of "Vienna Express" with the baseline proposed by MEPC.



One Step Ahead

First EEDI certificate for a container vessel issued by GL

Germanischer Lloyd has conducted the first-ever Energy Efficiency Design Index (EEDI) certification for a large container vessel. The EEDI certificate is issued in accordance with the voluntary EEDI guidelines, MEPC.1/Circ.681 and 682 of the International Maritime Organization (IMO). The ship that received the certificate is owned and operated by Hapag-Lloyd.

With its first EEDI certification, Hapag-Lloyd underscores its leadership in sustainable container shipping. The attained EEDI value of the Hapag-Lloyd vessel is significantly better than the present average for vessels of this size, based on Lloyd's Register Fairplay database, a fact that attests to the high energy efficiency of its design. Hapag-Lloyd's move demonstrates that leading members of the maritime industry are pro-actively pursuing measures to improve the energy efficiency and reduce the CO_2 emissions of their merchant vessels.

Includes Fleets in Service

In 2003, the IMO launched its initiative to develop guidelines for the reduction of greenhouse gases from ships. The recent focus has been on the EEDI, which is expected to become a compulsory standard for ship construction. The EEDI certification process computes the assumed CO_2 emissions of the respective vessel relative to its transport work (g CO_2/(t*nm)). Eventually this value is to be benchmarked against an IMO-set requirement.

As the individually attained EEDI for a ship represents the basic energy efficiency of its design, it can be used as a benchmark both within an operator's fleet and for comparison against a competitor's fleet. Benchmarking against the ship's own operational performance is possible as well. This means that determining the EEDI also makes sense for ships already in service, provided all the data required for a complete EEDI Technical File is available. This file, which summarizes all relevant technical data, and documents the calculation procedure towards the final EEDI value, is used to verify the EEDI.

Some issues in this context require more attention from the IMO. Certain items have been forwarded to the German flag state administration for possible consideration at future IMO meetings.

Through its own research as well as recent contributions to the IMO's development of the EEDI on behalf of the German Ministry of Transport, Building and Urban Development, GL has developed unique competence in the interpretation and verification of the EEDI. With the introduction of the EEDI certificate, GL has extended its portfolio of services to include the energy efficiency of ships, ranging from certificates to consultancy services provided by GL's FutureShip subsidiary. ■ SNB

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More Time for Shipping

FLAG STATE. The extended dry-docking option benefits the shipowners.

Photo: Dreamstime

In Greece, GL has been the very first classification society to obtain flag state acceptance for extended dry-docking

The Greek Ministry has accepted Germanischer Lloyd's (GL) extended dry docking (EDD) programme. GL offers owners and operators the chance to extend the dry-docking period from five to seven-and-a-half-years. GL is the first Classification Society to obtain the Greek flag State's acceptance for extended dry-docking. Extended dry-docking is applicable from now on, to container vessels , general cargo vessels and multipurpose vessels flying the Greek flag and classed with GL. The programme is available for the above named type of ships up to ten years old , and must be completed by the age of fifteen years.

Photo: PASOK

LOUKA KATSELI. Greek Minister of the Economy, Competitiveness and Shipping.

Timing Flexibility

Owners who previously had to look for an available dry-docking facility for routine inspection every five years can now have their ship surveyed at dock side. "We are convinced that owners who implement the current technological options and maintain a stringent planned maintenance programme can benefit from the increased scheduling flexibility without compromising quality or safety," says Matthias Galle, GL Vice President for Classification and Technical Matters.

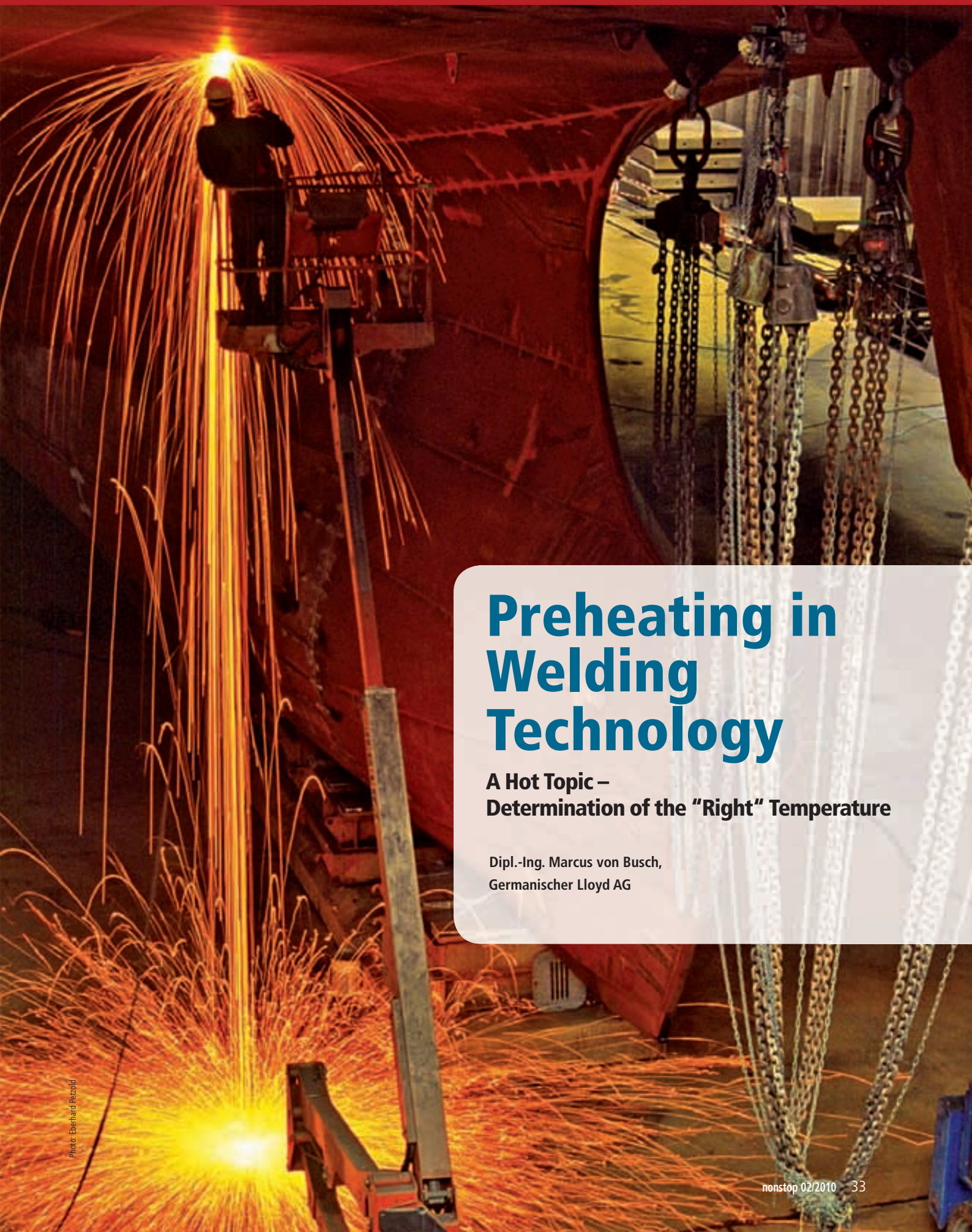
To assure the highest levels of quality and safety, only container vessels, general cargo ships and multi-purpose dry cargo vessels meeting GL's entry requirements are allowed into the programme. These requirements include flag-state programme acceptance and the IW (in-water) class notation. All ships must have a GL-approved planned maintenance system in place for both the hull (e.g. GL HullManager) and the machinery. In addition, each ship must be equipped with an approved-design shaft bearing and sealing system subject to a regular monitoring procedure.

On newly-built ships, the hull dry film thickness must be no less than 300 µm excluding the anti-fouling coating. Furthermore, newbuilds must be fitted with anodes with a seven-and-a-half-year service life and/or an impressed current system must be installed and maintained. On ships in service, the ballast water tanks must be kept in "good" condition as defined by IACS Rec. 87, and the vessel must be free of any condition of class concerning the underwater parts. In all cases, GL reserves the right to suspend the programme at any time if it is determined that an out-of-water inspection is necessary. In addition, the new scheme only applies to a given owner, flag state and class. In the event of a change in ownership or flagging, the EDD approval may be withdrawn and dry-docking required immediately.

Planned Maintenance Is a Must

The GL EDD programme places great importance on planned hull maintenance. Ships with a maintenance system already in place must have it approved by GL to be accepted into the EDD programme. For ships without a planned hull maintenance system, GL Maritime Software offers GL HullManager. This tool provides asset integrity management functionality for the ship's hull. It also supports an inspection strategy, input of thickness measurement results from the GL Pegasus application, marking and assessment of findings in 3-D, attachment of photos to the 3-D model, synchronization of onboard and onshore databases, and repair planning. It offers a variety of different views using colour codes to display any potential problem areas. With GL HullManager, EDD programme participants are always informed about where and when inspections and repairs must be performed. They receive early warning about degraded hull conditions, avoiding costly surprises in dry dock. The fleet status overview feature helps avoid reoccurrence of a known problem on sister vessels. ■ SNB

For further information: Matthias Galle, Vice President Classification and Technical Matters, Phone: +49 40 36149-134, E-Mail: matthias.galle@gl-group.com



Preheating in Welding Technology

A Hot Topic – Determination of the "Right" Temperature

Dipl.-Ing. Marcus von Busch,
Germanischer Lloyd AG

Photo: Eberhard Petzold

Preheating – Where on the Ship?

Time and time again, welded structures are found to exhibit cracks, although the development mechanisms – and hence also the possible countermeasures – have been studied widely and are now well understood. A very effective way of preventing cold cracks is to preheat the weld area to higher temperatures in order to delay the cooling of the welded joint; this promotes an increased release of hydrogen after the welding within a shorter time period than when no preheating is applied. If the cooling time t8/5 (i.e. the time taken to cool down from 800 °C to 500 °C) is long enough, excessive hardening in the heat-affected zone can be avoided. Moreover, preheating can minimize the residual stress condition. Depending on the welding conditions, "the mechanical and technological properties, in particular the hardness and toughness of the heat-affected zone […] can be influenced to a greater or lesser degree" [1] through preheating. If preheating is dispensed with entirely or is inadequate in scope, a good way of ensuring that the joint will be free of cracks is neglected. Although preheating is an effective means of reliably preventing cold cracks, it is frequently omitted or not carried out properly for reasons of cost. Ultimately, the decision on the necessity and level of preheating falls within the responsibility of the manufacturer.

Today's standards provide the manufacturer with a number of methods of determining the "right" preheating temperature with a view to achieving a balance between technical necessity and commercial interests. The established determination procedures include methods A and B according to EN 1011-2 and the Pcm method according to AWS D1.1. The following description explains, from a practical standpoint, how these methods can be applied to determining the preheating temperature. The temperatures thus obtained are then compared for the same input parameters. Furthermore, the possibilities of reducing the required preheating temperature are also indicated. Using shipbuilding as an example, it is shown how many welding tasks make it necessary to consider the topic of preheating. However, the statements made in this paper in respect of preheating do not apply exclusively to shipbuilding; they may also be transferred to other sectors.

FIGURE 1. Hull of a container-ship – section and construction drawing (right).

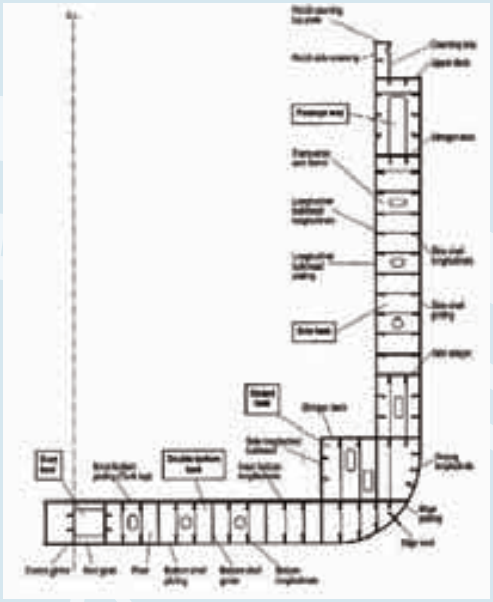
Preheating – Where on the Ship?

Ships are structures which are subject to highly dynamic loading. As a result, it is crucial to take full account of crack initiation and crack propagation. In general, weld joints must be free of cracks. For example, this is prescribed for ship structures in the Rules for Classification and Construction issued by Germanischer Lloyd. This publication also stipulates when and how much preheating must take place to prevent the origination of cold cracks after welding:

"The need to preheat ferritic steels and the preheating temperature depend on a number of factors. These include:

- **the chemical composition of the base material (carbon equivalent) and the weld metal,**
- **the thickness of the workpiece and the type of weld joint (two- or three-dimensional heat flow),**
- **the welding process and the welding parameters (energy input per unit length of weld),**
- **the shrinkage and transformation stresses, and**
- **the diffusible hydrogen content of the weld metal." [2]**

On the ship, there are components for which one or more of these parameters play a role.



Frequently, special attention must be given to thick-walled components or materials with high tendency towards hardness.

Hull

The hull of a seagoing vessel comprises, besides the keel, bottom, outer shell and side structures, also the bow and stern sections as well as decks and bulkheads. In areas of high dynamic loading, e.g. the sheer strake or hatch side coaming of a containership, higher-tensile shipbuilding steels with the GL quality grades E36 and E40 are used. These are fully killed and fine-grain-treated steels with plate thicknesses ranging between 50 and 100 mm, some of which are welded in single runs using high-performance methods such as electro-gas welding.

Stern Tube and Rudder Horn

The drive shaft for the propeller runs through the stern tube (see Fig. 2.1), while the rudder horn (Fig. 2.2) serves to accommodate the rudder blade. In general, these components consist of weldable cast steel with material thicknesses of up to 400 mm and are welded to the hull.

Main Engine

The foundation plates, casing and frame of diesel engines consist of cast steel or, in the case of the welded designs occurring more frequently nowadays, of normal-tensile steels with plate thicknesses of up to 300 mm.

Propeller

Ship propellers are made of cast copper alloys, e.g. CU1–CU4, or of non-corroding, and usually martensitic, cast steel alloys, e.g. 12Cr1Ni, 13Cr4Ni, 16Cr5Ni or 19Cr11Ni.

Steam Boiler

High-temperature steels are used for constructing steam boilers, e.g. 16Mo3, 13CrMo4-5 or 11CrMo9-10 in accordance with CR 12187.

Cranes and Load Suspension Devices

For crane components, higher-tensile shipbuilding steels and high-tensile fine-grained →

FIGURE 2.1. Stern tube.

FIGURE 2.2. Rudder horn.

Photo: 2010 Bundeswehr / Björn Wilke

FIGURE 3. Submarine U32 of the German Navy.

Determining the "Right" Temperature

FIGURE 4. Qualitative influences on the preheating temperature.

Preheating temperature is reduced	Influencing factor	Preheating temperature is increased
Low alloying element content	Chemical composition of the base material	Higher alloying element content
Low	Hydrogen content of the weld metal	High
Thin	Thickness of the workpiece or component	Thick
High	Heat input during welding	Low
Low	Residual stress condition	High
High	Ambient or workpiece temperature (heat dissipation)	Low

→ structural steels are used, offering yield strengths of up to 960 MPa.

Pressure Vessels

The pressure hull of a submarine (Fig. 3) consists of quenched and tempered structural steels meeting the German Naval Standard, such as the grades HY80 or HY100.

Determining the "Right" Temperature

As already mentioned in the introduction, the manufacturer of a welded structure is faced with the challenge of producing a component that is crack-free – or at least crack-resistant – at acceptable cost. The necessary preheating temperature depends on the complexity of the component, the welding process used, the magnitude of the component's residual stresses and the ambient temperature. Fig. 4 shows the qualitative influence of various factors on the preheating temperature level.

If a quantitative estimation of the preheating temperature is needed, a range of concepts are available for diverse applications. The guidelines of Germanischer Lloyd as an example for shipbuilding as well as the DIN 18800-7 standard for steel construction in Germany provide the manufacturer with an according choice of methods of determining the preheating temperature. Both rulebooks, however, give preference to a particular method.

GL Rules for Classification and Construction:
"The operating temperature to be maintained (minimum preheating temperature and maximum interpass temperature) for (hull) structural steels may be determined in accordance with EN 1011-2."

DIN 18800-7: "The required preheat temperatures are available in SEW 088."

As a matter of principle, this means the manufacturer is permitted to use competing methods to optimize the preheating temperature in his best interests. Verification that a certain preheating temperature will yield the intended outcome (lower hardness and therefore a reduced crack susceptibility) can be provided by means of e.g. a welding procedure test. The following are possible methods of determining the minimum preheating temperature:

- **DIN EN 1011-2:2001 – Annex C, Method A (derived from the British Standard) graphical determination**
- **DIN EN 1011-2:2001 – Annex C, Method B (based on SEW 88) computational determination**
- **AWS D1.1 – Annex XI (American method) computational/tabular determination**
- **JIS B 8285:2003 (Japanese method on the basis of the carbon equivalent CEN).**

Fig. 5 compares the concepts according to EN 1011-2 and AWS D1.1. The Japanese method will not be considered in this paper.

The basis of all methods is the determination of a carbon equivalent. Since other alloying elements besides carbon also promote cold cracking, carbon equivalents are often used to estimate the crack sensitivity. Calculation of the carbon equivalent is defined by numerous formulae, in which the various alloying ele-

EN 1011–2 Method A	EN 1011–2 Method B	AWS D1 1 Annex XI
1. Carbon equivalent of the base material (CE)	1. Carbon equivalent of the base material (CE)	1. Carbon equivalent of the base material (Pcm)
2. Hydrogen content of the welding consumable	2. Hydrogen content of the welding consumable	2. Hydrogen content of the welding consumable
3. Combined thickness	3. Plate thickness	3. Plate thickness
4. Heat input	4. Heat input	4. Residual stress condition
5. Graphical determination of the preheating temperature	5. Computational determination of the preheating temperature	5. Tabular determination of the preheating temperature

FIGURE 5. Qualitative influences on the preheating temperature – comparison of methods.

ments are weighted differently. In general, the carbon equivalent can therefore be viewed as a measure for the susceptibility of a material to cold cracking as a function of its chemical composition.

EN 1011-2 Method A

"Method A […] is based on extensive experience and data which is mainly, but not exclusively, for carbon manganese type steels. The preheating conditions […] have been found from experience to provide a satisfactory basis for deriving safe welding procedures for many welded fabrications. […] They should therefore be considered for guidance only." [1]

According to DIN 18800-7, for example, Method A may "not be used, since German experts are of the opinion that it offers inadequate assurance, particularly when welding the S355 steels and the fine-grained structural steels with Re > 355 MPa." [3]

The basis of Method A is provided by determining the carbon equivalent CE:

$$CE = C + \frac{Mn}{6} + \frac{Cr+Mo+V}{5} + \frac{Cu+Ni}{15}$$ [4]

This formula is applicable to steels with a CE value lying in the range 0.30 to 0.70 and for the maximum weight fractions of alloying contents stated in Fig. 6.

"The CE is based primarily on hardness measurements and was derived under the assumption that alloying elements contributing towards the hardening promote cold cracking to the same degree. Since the carbon equivalent CE, in contrast to newer carbon equivalents, seriously underestimates the effect of the carbon, it is less useful for addressing cold cracking problems than later models. It is unsuitable specifically in the range of shorter cooling times." [5]

After determination of the carbon equivalent, the "scale" for the hydrogen content of the weld metal must be obtained from Table C.2 of EN 1011-2 (see Fig. 7).

Information on the hydrogen content of a particular welding consumable may be found in the corresponding datasheet of the manufacturer or printed on the packaging. The next step is to ascertain the "combined thickness". This is →

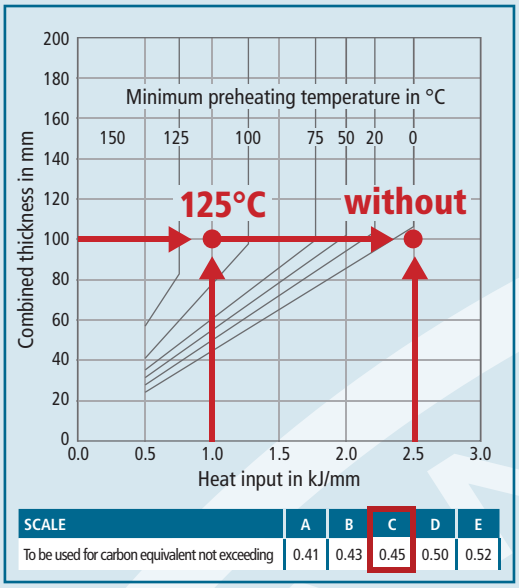
Diffusable hydrogen content ml/100g of deposited metal	Hydrogen scale
> 15	A
10 ≤ 15	B
5 ≤ 10	C
3 ≤ 5	D
≤ 3	E

FIGURE 7. Selection of the hydrogen scale [1].

C	Si	Mn	Cr	Cu	Ni	Mo	V
0.05 – 0.25	max. 0.8	max. 1.7	max. 0.9	max. 1.0	max. 2.5	max. 0.75	max. 0.2

FIGURE 6. Scope of applicability for CE.

FIGURE 8. Diagram from EN 1011-2.



SCALE	A	B	C	D	E
To be used for carbon equivalent not exceeding	0.41	0.43	0.45	0.50	0.52

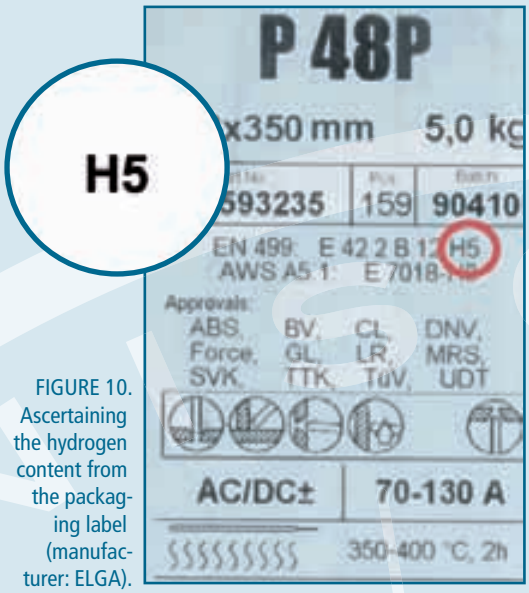


FIGURE 10. Ascertaining the hydrogen content from the packaging label (manufacturer: ELGA).

→ done by adding together all the plate thicknesses of the affected joint:

$$t_{combined} = t1 + t2 + t3$$

For directly opposed twin fillet welds that are deposited simultaneously, the combined thickness determined in this way must be halved. After that, the heat input is calculated as follows from the arc voltage, the welding current amperage and the rate of travel:

$$Q = k \cdot \frac{U[V] \cdot I\,[A] \cdot \text{welding time [sec]}}{\text{length of weld [mm]} \cdot 1000} = \frac{kJ}{mm}$$

where k is a correctioin factor for the welding process. For submerged arc welding, k is set to 1. For MAG and flux-cored arc welding, k = 0.8. In the case of multi-wire welding, the heat input must be calculated as the sum of the results obtained for each single wire, using the individual current and voltage parameters. [1] Depending on the relevant hydrogen scale (e.g. C – see Fig. 7) and the carbon equivalent (e.g. 0.43 – see Fig. 8), the appropriate diagram is chosen from EN 1011-2.

The necessary preheating temperature is obtained from the chosen diagram by reading off the preheating line immediately above or to the left of the intersection of the lines for heat input and combined thickness.

EN 1011-2 Method B

This method is applicable to the arc welding of steels belonging to groups 1 to 4 according to CR ISO 15608. The basis of this method is provided by comprehensive examinations of the cold cracking behaviour of steels during welding, both through special cold cracking tests and welded joint tests. As for Method A, the carbon equivalent must first be determined. However, a different formula is used here:

$$CET = C + \frac{Mn + Mo}{10} + \frac{Cr+Cu}{20} + \frac{Ni}{40}$$

which applies to the alloying contents stated in Fig. 9.

By analogy to Method A, the hydrogen content of the welding consumable in ml/100 g of weld metal is also required; this can be taken directly from the datasheet or by reading off the standard designation on the packaging (see Fig. 10).

FIGURE 9. Maximum alloy contents for CET.

C	Si	Mn	Cr	Cu	Mo	Nb	Ni	Ti	V	B
0.05 – 0.32	max. 0.8	0.5 – 1.9	max. 1.5	max. 0.7	max. 0.75	max. 0.06	max. 2.5	max. 0.12	max. 0.18	max. 0.005

Comparison of the Methods

The heat input is determined exactly as for Method A. The calculation of the preheating temperature can then be carried out according to the following formula:

$$T[^\circ C] = 697 \cdot CET + 160 \cdot \tanh\left(\frac{d}{35}\right) + 62 \cdot HD^{0,35} + (53 \cdot CET - 32) \cdot Q - 328$$

This relationship applies to steels with a yield point of up to 1,000 MPa and
CET = 0.2% to 0.5%,
plate thickness d = 10 mm to 90 mm,
hydrogen content HD = 1 ml/100 g to 20 ml/100 g,
heat input Q = 0.5 kJ/mm to 4.0 kJ/m.

Procedure According to AWS D1.1 – Pcm Method

Here too, a carbon equivalent is calculated as the input quantity. However, the formula for Pcm involves more elements than for CE or CET. For example, it also considers the element boron, which is a fine-grain agent that ensures nuclei at high temperatures but at the same time has a powerful hardening effect. Boron is given 5 times the weighting of carbon in the calculation. The Pcm method is especially suitable for short cooling times and for root welding applications.

$$Pcm = C + \frac{Si}{30} + \frac{Mn}{20} + \frac{Cu}{20} + \frac{Ni}{60} + \frac{Cr}{20} + \frac{Mo}{15} + \frac{V}{10} + 5 \cdot B$$

The susceptibility index describing the sensitivity towards hydrogen-induced cracks arising from the hydrogen content of the welding consumable can then be determined (see Fig. 11).

Finally, and here this approach differs from the methods described above, the preheating temperature is determined as a function of the residual stress level. A distinction is made between three levels of the stress condition:

- **low – simple fillet and butt welds with sufficient possibility of shrinkage**
- **medium – welds with limited possibility of shrinkage that are already connected to larger components**
- **high – welds without any possibility of shrinkage (e.g. very thick plates or repair welds).**

If the plate thickness (for the thickest plate of the joint) and the hydrogen scale are known, the preheating temperature can be taken from the table in Fig. 12.

The heat introduced by the welding process is not considered by the Pcm method.

Comparison of the Methods

An example (Fig. 13) will be used to show what results are obtained by the three methods for the same input quantities. A higher-tensile shipbuilding steel of the grade GL-E36 (similar to S355 NL according to DIN EN 10025-3) with a thickness of 50 mm is chosen as the material.

Various specimens are to be butt-welded with different heat inputs (1 or 2.5 kJ/mm) and different welding consumables (hydrogen content: 5 or 10 ml/100 g weld metal). The ladle analysis yields the corresponding carbon equivalents (Fig. 14). By considering the plate thicknesses (Fig. 15), the preheating temperatures are determined according to the different methods (Fig. 16).

The benefit of reducing the available hydrogen is clearly recognizable for both of the methods according to EN 1011-2. The preheating temperature is reduced considerably. The same effect could also be expected of the Pcm meth- ➔

Susceptibility Index

H1 = 5 ml/100 g weld metal
H2 = 10 ml/100 g weld metal
H3 = 30 ml/100 g weld metal
(all consumables not included in H1 or H2)

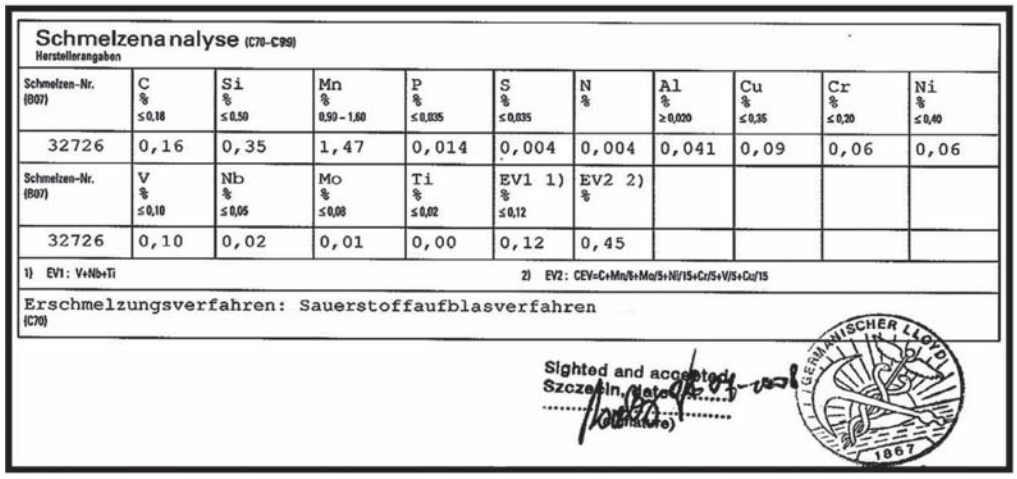
Pcm < 0.18	Pcm < 0.23	Pcm < 0.28	Pcm < 0.33	Pcm < 0.38
A	B	C	D	E
B	C	D	E	F
C	D	E	F	G

FIGURE 11. Table for determining the index for susceptibility to hydrogen-induced cracks according to AWS D1.1.

FIGURE 12. Table for determining the minimum preheating temperature according to AWS D1.1.

Restraint lLevel	Thickness (mm)	A	B	C	D	E	F	G
Low Describes common fillet and groove welded joints in which a reasonable freedom of movement of members exists.	< 10	< 20	< 20	< 20	< 20	60	150	150
	10 – 20	< 20	< 20	20	60	100	140	150
	20 – 38	< 20	< 20	20	80	110	140	150
	38 – 75	20	20	40	95	120	140	150
	> 75	20	20	40	95	120	140	150
Medium Describes fillet and groove welded joints in which because of members already attached to structural work, a reduced freedom of work exists.	< 10	< 20	< 20	< 20	< 20	70	140	160
	10 – 20	< 20	< 20	20	80	115	145	160
	20 – 38	20	20	75	110	140	150	160
	38 – 75	20	80	110	130	150	150	160
	> 75	95	120	140	150	160	160	160
High Describes welds in which there is almost no freedom of movement for members joined (such as repair welds, especially in thick material).	< 10	< 20	< 20	20	40	110	150	160
	10 – 20	< 20	20	35	105	140	160	160
	20 – 38	20	85	115	140	150	160	160
	38 – 75	115	130	150	150	160	160	160
	> 75	115	130	150	150	160	160	160

FIGURE 13. Ladle analysis of shipbuilding steel grade GL-E36.



Schmelzenanalyse (C70-C99)
Herstellerangaben

Schmelzen-Nr. (B07)	C % ≤0,18	Si % ≤0,50	Mn % 0,90 – 1,60	P % ≤0,035	S % ≤0,035	N %	Al % ≥0,020	Cu % ≤0,35	Cr % ≤0,20	Ni % ≤0,40
32726	0,16	0,35	1,47	0,014	0,004	0,004	0,041	0,09	0,06	0,06
Schmelzen-Nr. (B07)	V % ≤0,10	Nb % ≤0,05	Mo % ≤0,08	Ti % ≤0,02	EV1 1) % ≤0,12	EV2 2) %				
32726	0,10	0,02	0,01	0,00	0,12	0,45				

1) EV1: V+Nb+Ti 2) EV2: CEV=C+Mn/6+Mo/5+Ni/15+Cr/5+V/5+Cu/15

Erschmelzungsverfahren: Sauerstoffaufblasverfahren (C70)

Sighted and accepted
Szczecin, ...
(Signature)

GERMANISCHER LLOYD 1867

→ od, but in this particular case it is overshadowed by the influence of the restraint condition (high for thick plates), so that there is no reduction and the preheating temperature remains unchanged. A similar effect is to be seen with the heat input. High heat inputs tend to produce lower preheating temperatures. With the Pcm method, the heat input through the welding process has, by definition, no influence on the result. The greatest impact, however, is caused by a reduction in the carbon equivalent or carbon content, because the preheating tempera-

EN 1011-2 Method A	EN 1011-2 Method B	AWS D1.1
CE	CET	Pcm
0.449	0.317	0.267

FIGURE 14. Comparison of the carbon equivalents.

EN 1011-2 Method A	EN 1011-2 Method B	AWS D1.1
100 mm (combined)	50 mm	50 mm

FIGURE 15. Plate thicknesses for determining the preheating temperature.

Summary

Hydrogen content	Heat input	EN 1011-2 Method A	EN 1011-2 Method B	AWS D1.1 Annex XI
5 ml/100 g	1.0 kJ/mm	50 °C	129 °C	150 °C
	2.5 kJ/mm	**No preheating**	106 °C	150 °C
10 ml/100 g	1.0 kJ/mm	125 °C	159 °C	150 °C
	2.5 kJ/mm	**No preheating**	136 °C	150 °C

FIGURE 16.
Comparison of the preheating temperatures.

ture exhibits a linear dependency on the carbon content of the base material (see Fig. 17). A decrease in the CET by 0.01% reduces the required temperature by as much as 7.5 K!

Through the steel order, the manufacturer therefore can exert the largest influence on the preheating temperature that is needed during production. By changing the material procurement from normalized plate to thermo-mechanically rolled steel grades, the CET can easily be reduced by 0.05% and thus the preheating temperature by approx. 40 °C. Judging by Fig. 16, Method A according to EN 1011-2 must be preferred for the chosen example from the viewpoint of the welding contractor, since it demands the lowest preheating temperature. Depending on the conditions at hand, it may also be possible to reduce the temperature further by applying the measures described above.

Summary

Preheating is an effective way of preventing the occurrence of cold cracks. Owing to their hardenable material or large dimensions, many components suffer the risk of cold cracking. This was demonstrated by means of examples from the shipbuilding industry. A number of standardized methods with different approaches are available to determine the preheating temperature. In methods A and B according to EN 1011-2, the heat input during welding is taken into account, whereas this is neglected in the Pcm method according to AWS D1.1. Here the estimation of the preheating temperature is conducted in relation to the residual stress condition. The various methods may be used in competition with each other. The results obtained can then be verified before the start of production, e.g. with the aid of welding procedure tests. For economic reasons, the goal will be to keep the preheating temperature as low as possible. Through the welding process (heat input), the welding consumable (hydrogen supply) and the chemical composition of the material (carbon equivalent), welding production contractors have several effective ways of influencing the preheating temperature.

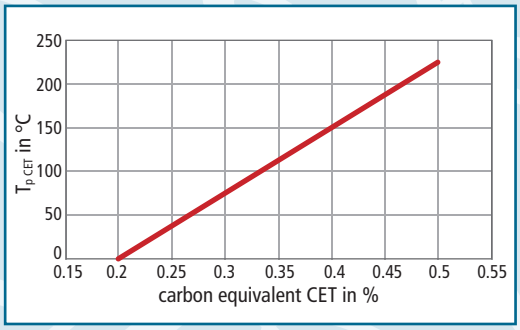


FIGURE 17. Preheating temperature as a function of the carbon equivalent according to EN 1011-2.

Literature

[1] DIN EN 1011-2
[2] Germanischer Lloyd, Rules for Classification and Construction, II – Materials and Welding, 3 – Welding (Edition 1999)
[3] Schmidt, Zwätz, Bär, Schulze – Execution of Steel Structures / Notes on DIN 18800-7 [in German]
[4] Technical Report 1967, IIW Doc. IX-535-67
[5] Uwer, D. und H. Höhne – Characterization of the cold cracking behaviour of steels during welding. Schweißen und Schneiden 43 (1991), No. 4, p. 195–199 [in German] and IIW Doc. IX-1630-91
[6] Ito, Y. und K. Bessyo – Weldability Formula of High Strength Steels, Related to Heat-Affected Zone Cracking. Sumitomo Search, 1 (1969), H. 5, p. 59–70, and IIW Doc. IX-631-69 (1969), 1–18

Secondary Literature

[7] Jahrbuch Schweißtechnik 1988 – 4.8 Welding Production – Preheating [in German]
[8] TWI website – Job Knowledge for Welders – Defects / Hydrogen Cracks in Steel
[9] Kobelco Welding Today – Cold Cracks: Causes and Cures
[10] Linde Sonderdruck 41/01 – Preheating by Flame in the Welding Workshop [in German]

service

Dates at a Glance

SEPTEMBER

21. – 25.09.2010
Exhibition Husum Wind Energy
Booth No. 6B10 Hall 6
Husum, Germany

24.09.2010
PRADS
▸ *Speaker: Mr Rathje "Resistance and impact loads of wide-bodied containerships"*
Rio de Janeiro, Brazil

24./25.09.2010
India Shipping Summit
Mumbai, India

27. – 30.09.2010
9th Annual Marine Money Week Asia
▸ *Lecture Winfried Jaray: "Increase the competitiveness of your investment by reducing life-time cost"*
Singapore, Singapore

27./28.09.2010
Subsea Operations and Technology
Singapore, Singapore

27. – 29.09.2010
Tradewinds Ship Recycling Forum
Beijing, China

OCTOBER

05.10.2010
Greek Shipping Summit 2010 Conference
Athens, Greece

06./07.10.2010
7th Annual Dry Bulk Shipping Market Outlook
London, UK

07.10.2010
GREECE SNAME
▸ *Lecture Dr Loer: "Risk-based optimization of crude oil tanker cargo holds"*
Athens, Greece

07.10.2010
Gas 2010
▸ *Presentation by Arthur Stoddart*
Loughborough, UK

09. – 12.10.2010
13th Numerical Towing Tank Symposium
Duisburg, Germany

11. – 15.10.2010
HIPER 2010 Conference (International Conference on High-Performance Marine Vehicles)
▸ *Friendship Systems is attending the conference as a member of the International Scientific Committee*
Melbourne, USA

12. /13.10.2010
MTS Society Dynamic Positioning Conference
Houston, USA

14. – 16.10.2010
China Wind Power
Booth: HA14–HA15
Beijing, China

19./20.10.2010
Lloyd's List 20th International Ship Management Conference 2010
▸ *Mr Volker Höppner, MD of Futureship: "Fit for the future – how to meet emission standards and fuel crunch"*
Limassol, Cyprus

20./21.10.2010
Planned Maintenance for Ships
▸ *Lecture Dr Cabos: "Planned maintenance for ships"*
Hamburg, Germany

20./21.10.2010
Gas Fuelled Ships 2010
Hamburg, Germany

20./21.10.2010
Ship Powering Alternatives
London, UK

26. – 28.10.2010
Exhibition Shiptec China
Booth A169 & 170
Dalian, China

26. – 28.10.2010
Conf. MarineTech Summit 2010 (MTS-2010)
Dalian, China

26. – 28.10.2010
Exhibition Seatrade Middle East
Booth No. R4
Dubai, UAE

27./28.10.2010
TSCF Shipbuilders Meeting
Tokyo, Japan

NOVEMBER

01. – 03.11.2010
Canwea
Montreal, Canada

01. – 04.11.2010
ADIPEC 2010
Abu Dhabi National Exhibition Centre
Booth No. 11430
Abu Dhabi, UAE

02. – 04.11.2010
Conference & Exhibition BWEA32
Booth No. 186
Glasgow, Scotland

03. – 05.11.2010
SNAME 2010 Expo + Conf.
Seattle, USA

04.11.2010
4th Annual Korea Ship Finance Forum
▸ *Lecture Winfried Jaray: "Increase the competitiveness of your investment by reducing life-time cost"*
Seoul, Korea

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 6
Preliminary Rules for Patrol Boats 2010-07-01

VI – Additional Rules and Guidelines

Part 4 – Machinery Installations

Chapter 3
Guidelines for the Seating of Propulsion Plants and Auxiliary Machinery 2010-07-01

Part 10 – Corrosion Protection

Chapter 2
Guidelines for Corrosion Protection and Coating Systems 2010-08-01

Part 11 – Other Operations and Systems

Chapter 5
Guidelines for Extended Dry-Dock Interval 2010-07-01

Photo: Dreamstime

GL Academy

Selected seminars in 2010 (in English) – information and registration: academy@gl-group.com
held by GL Garrad Hassan – information and registration: training@garradhassan.com

SEPTEMBER

09.09.2010
Fatigue Assessment of Ship Structures
Busan, Korea

19. – 20.09.2010
Implementation Workshop ILO Maritime Labour Convention
Dubai, UAE

27. – 28.09.2010
Advanced Management Representative ISO 14001:2004
Limassol, Cyprus

27. – 28.09.2010
Fuel Saving
Lima, Peru

OCTOBER

04.10.2010
STCW 2010 Amendments
Hamburg, Germany

05. – 06.10.2010
Handling and Transport of Dangerous Goods
Piraeus,Greece

07.10.2010
Ship Recycling for Shipyards and Suppliers
Istanbul, Turkey

12.10.2010
Surveys and Certificates
Gdansk, Poland

13. – 15.10.2010
Internal Auditor – Auditor Interno do Sistema de Gestão Integrado ISO 9001, 14001 and 18001
São Paulo, Brazil

14.10.2010
Financing Your Wind Farm
Istanbul, Turkey

18.10.2010
ISM Code 2010 Amendments
Singapore, Singapore

21.10.2010
Containerships – Technical and Operational Aspects
Lázaro Cárdenas, Michoacán, Mexico

25. – 29.10.2010
Superintendent Training Course
Singapore, Singapore

26.10.2010
Introduction to GH WindFarmer
Delhi, India

27.10.2010
Extended Dry Docking
Limassol, Cyprus

NOVEMBER

04.11.2010
Wind Farm Design
Montreal, QC, Canada

09.11.2010
Wind Farm Performance Verification and Optimization
Bristol, UK

09.11.2010
ILO Maritime Labour Convention
Manila, Philippines

12.11.2010
Introducción a GH WindFarmer
Language: Spanish
Santiago, Chile

30.11. – 03.12.2010
Approved HazMat Expert
Hamburg, Germany

30.11.2010
Offshore Wind Energy
Hamburg, Germany

DECEMBER

01.12.2010
MASP – Método de Análise e Solução de Problemas – ISO 9001:2008
São Paulo, Brazil

16.12.2010
Offshore Basics and Dynamic Positioning
Hamburg, Germany

Personalia

Kim Uldahl Haaning has joined GL as Area Manager Scandinavia for Maritime Services.

Petr Hyspecky has been appointed as Country Manager for the Czech Republic.

Lukasz Luwanski has taken on the function of Area Manager ASEAN.

Three new Country Managers in South America: **Marco Aurelio Mandarino Florito** (Peru), **Marcus Vinicius Moreira** (Brazil) and **Jose Arnaldo Maubecin** (Argentina).

Steve Roberts has joined GL Noble Denton as Principal Consultant in Transmission and Distribution.

Addresses

GERMANY
New locations in Germany: Station Kiel has been merged with Station Hamburg, Station Emden with Station Bremerhaven, Station Stralsund with Station Rostock, Station Hannover with Station Magdeburg.
The Site Offices in Lübeck and Mannheim have been closed.

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VIETNAM
The Country Office Vietnam has been moved to Haiphong.

IMPRINT

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news

PIPE DESIGN. With its simulation software package SynerGEE, GL helps planners of water distribution networks find the most cost-efficient design.

Photo: Dreamstime

WATER DISTRIBUTION SYSTEMS

GL Releases SynerGEE Water 4.5

A new software module for the design of water pipes and networks has now been released by Germanischer Lloyd. The "Pipe Design Module" of the SynerGEE Water application enables water utilities to develop least-cost designs for system expansion and rehabilitation projects. The new module applies sophisticated optimization techniques to select the most cost-efficient design subject to the service requirements. SynerGEE Water is a simulation software package used to model and analyze water distribution systems.

Enhanced functionality. "The release of SynerGEE Water version 4.5 represents a significant step forward for the product's usefulness in water system operations and planning," said Joel Johnson, GL Water Practice Director. SynerGEE's core module contains numerous advancements to a unique master scripting function, which will enable the automation of multi-step simulation tasks. In addition, this feature improves integration with SCADA and back-office systems. With master scripting it is now possible to run sophisticated analyses on a pre-set schedule or at the click of a Windows icon, enabling even non-modellers to view analysis results as they need them.

For further information: Joel Johnson, GL Water Practice Director, Phone: +1 717 724-1926
E-Mail: joel.johnson@gl-group.com

NORWAY

New Office to Provide Better Service

GL Noble Denton has opened a new office in Stavanger, Norway's energy capital. The city in the south-western part of the country is the main hub for the oil and gas activity on the Norwegian continental shelf. "Being present in Stavanger is an important step in our growth strategy," says Bjørn H. Brænden, Area Manager for Norway. The Stavanger location offers GL Noble Denton expertise on projects from the wellhead to engineering and operation of installed infrastructure. This includes dynamic positioning and marine operations consultancy, design and integrity assurance services, asset performance and optimization.

HOT SPOT. The new office in Norway's oil capital enables GL to provide better service.

Photo: Gobtian

Customer focus. "For years, GL Noble Denton has been serving the shipping and oil industry in Norway from our locations in Oslo, Brevik and Sandefjord. But we need to be closer to the major oil and gas companies," says Tore Lea, GL Noble Denton's General Manager in Stavanger. The Brevik office is GL Noble Denton's competence centre for general design and FPSOs.

OFFSHORE

GL Runs Research Platform FINO 2

The German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, and Project Management Jülich (PtJ) have appointed GL Garrad Hassan's WINDTEST Kaiser-Wilhelm-Koog GmbH to manage the offshore wind research platform in the Baltic Sea, FINO 2.

For the next three years, GL Garrad Hassan has taken over responsibility for the overall operations and maintenance of the platform. GL's international renewable energy consultancy unit will also manage the research programme and associated technical data, which will include various metrological and hydrological measurements, long term bird migration pat-

SAMSUNG HEAVY INDUSTRIES

Power Software

Samsung Heavy Industries has chosen GL Garrad Hassan's GH SCADA software to manage the installation of its new 2.5-MW wind turbines in the USA and Korea.

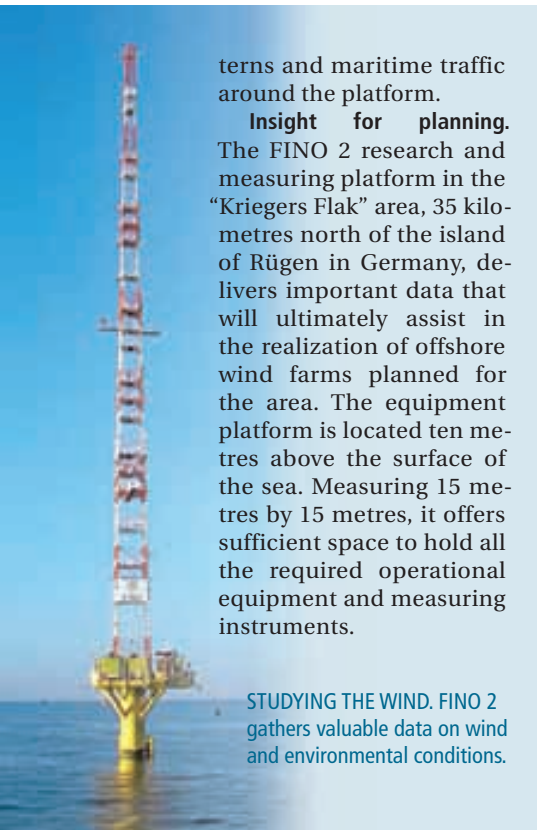
Seamles integration. GL Garrad Hassan developed an interface to link the GH SCADA solution with the Samsung Heavy Industries turbine. The application is currently being utilized to monitor and control the turbines while they are undergoing long-term testing at the two wind farm sites in Lubbock, Texas, USA, and Yeoungheung, Korea. GL Garrad Hassan delivered the two projects as turnkey contracts. The software is also available as a license-only product called GH SCADA Express for deployment by the manufacturers themselves. GH SCADA provides high data coverage, superior information quality, complete independence and access to high-speed data directly from the turbines.

"Using the GH SCADA solution gives Samsung and other manufacturers a quick and risk-free route to providing a fully internationalized, high-functionality SCADA and reporting system that meets both their needs and those of their clients," said Gordon Smith, Global Practice Head of GH SCADA.

GL Garrad Hassan has provided its GH SCADA monitoring and control solution for over 3,500 turbines world wide, representing over 5 GW of installed capacity.

SKY-HIGH. GH SCADA tells operators what their turbines are doing.

Photo: Samsung Heavy Industries



terns and maritime traffic around the platform.

Insight for planning. The FINO 2 research and measuring platform in the "Kriegers Flak" area, 35 kilometres north of the island of Rügen in Germany, delivers important data that will ultimately assist in the realization of offshore wind farms planned for the area. The equipment platform is located ten metres above the surface of the sea. Measuring 15 metres by 15 metres, it offers sufficient space to hold all the required operational equipment and measuring instruments.

STUDYING THE WIND. FINO 2 gathers valuable data on wind and environmental conditions.

Photo: Shipping Institute Warnemünde

MARINE WARRANTY SURVEY

Service Contract for London Array

London Array will be the world's largest offshore wind farm when fully complete. Located around 20 km off the British coasts of Kent and Essex, offshore construction on the first 630-MW phase of the project is due to start early next year. During the offshore installation of the 175 turbines for phase one, GL Noble Denton will confirm that technical risks are kept within acceptable levels.

Displacing CO_2. The technical service provider to the energy industries has been contracted by London Array Ltd to perform Marine Warranty Survey services for the first phase of the project. The first 630-MW phase is scheduled for completion by the end of 2012. With its capacity it will generate enough energy to supply around 475,500 homes and displace over a million tonnes of CO_2 each year. "The transportation and installation of huge, awkwardly shaped structures offshore involve risks that can only be mitigated by adhering to codes and standards," says Gabor Bohner, who heads GL Noble Denton's Department for Marine Operations and Marine Warranty Survey in Hamburg.

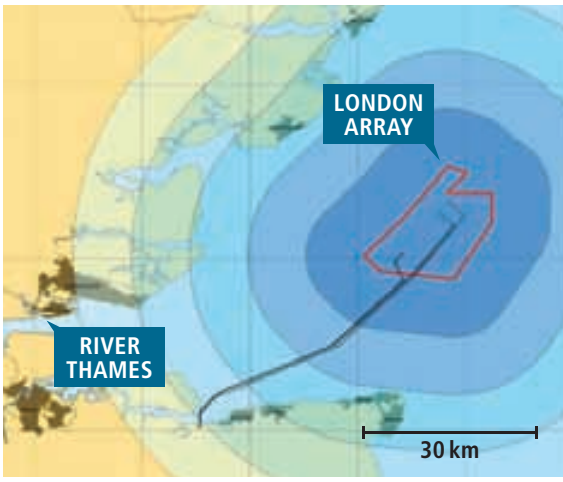


Illustration: British Crown and SeaZone Solutions Ltd.

LOCATION. Around 20 km off the British coasts of Kent and Essex.

Thunder God Ready to Roll

The greatest potential for wind energy is to be found on the high seas. Over the coming years, thousands of wind turbines will be erected there – viable technical solutions for ocean installation are already available

Down the River Elbe, just before Stade: first you see the four long columns reaching high up into the air, 82-metres long and almost 4 metres in diameter each. They belong to the jack-up platform "Thor", named after the Nordic god of thunder. The floating crane platform, 70 metres in length and 40 metres in width, is on the way to Hamburg for its naming ceremony. Shortly before reaching its destination, it has to pass under two high-voltage lines spanning the Elbe. Here Thor pulls its legs in a little and moves along the outermost edge of the channel – where the cables do not hang quite as low as in the middle of the waterway. The manoeuvre is successful; the way to the port of Hamburg is now free.

Thor is one of the world's largest jack-up platforms for the erection of wind turbines on the high seas. The vessel is owned by the company Hochtief Construction AG, which plans to install a whole series of offshore wind farms in the coming years. Thor was classified by Germanischer Lloyd. "We have been occupied with this project since 2007," ➔

Photo: Iken

ON LOCATION. The impressive jack-up platform "Thor" on its way up the Elbe towards Hamburg – where the new installation platform for wind turbines had its naming ceremony.

CREW. Parade on the helicopter deck of the "Thor". The jack-up platform has living quarters accommodating a crew of 48.

➔ says Jochen Künzel, the responsible project manager at GL Group. "We were entrusted with the assessment and approval of the design and were in charge of monitoring the entire construction process."

Stable on Four Legs

The new jack-up rig is needed urgently. Hochtief expects that 800 offshore wind turbines will be installed annually in Europe from 2012. These units will be erected in the North Sea, in water depths ranging up to 50 metres. Depending on the depth in each case, there are different concepts for the foundation structures to be used in anchoring the wind turbines on the seabed: monopiles are driven into the ground, lattice structures – known as jackets – or tripods that look like enormous camera supports, are deposited and fixed to piles in the seabed. Thor is equally well suited to all concepts. Martin Rahtge, Chairman of the Management Board of Hochtief's Civil Engineering and Marine Works division, is pleased: "In the growing market for offshore wind turbines, we are now better positioned than ever before."

The installation of the foundation structures is Thor's first task and erecting the turbine itself will be the next major challenge. The nacelle of a 5-MW turbine, which has to be lifted 100 metres into the air, weighs almost 300 tonnes. Depositing this load onto the tower flange is as much precision work as the pulling and erection of the rotor star with blades of 50 to 60 metres in length.

To complete this demanding assignment, the crane, which is able to lift 500 tonnes with an outreach of 15 metres, needs a stable base – which brings us back to the legs. This involves some heavy hydraulics, extending to the current limits of what is technically feasible today, says Künzel. Thor can push its legs right down to the seabed, thus lifting itself out of the water. The load to be borne here is 10,000 tonnes. Once it has been elevated, the crane then has a fixed platform from which it can perform its work precise to the millimetre.

Despite all the enormously heavy components, the jack-up platform is independent of the weather. "In operational mode, the significant wave height can be 2.5 metres and the wind is allowed to reach a maximum of 12 m/s. As long as these limits are not exceeded, the crane is able to do its work perfectly."

Thor has its own propulsion unit, enabling it to move autonomously from one plant to the next within the offshore wind farm, and to take up the correct position at the erection site. "However, this is only a positioning system using thrusters and developing an output of 3,000 kW," Jochen Künzel points out. "This means Thor is far from being a ship, and so SOLAS does not apply."

GL Sets the Rules

Jochen Künzel first had to come to an agreement with the responsible authority, BG Verkehr, on the right instrument to be used for the certification. "The regulatory situation remains rather unclear. In the end, we agreed on the Code for the Construction of Mobile Offshore Drilling Units," says Künzel. "Strictly speaking, it doesn't really fit, because no drilling takes place on Thor. But the characteristics of a jack-up platform – which is therefore a 'self-elevating platform' in terms of the Code – are so dominant that there were no objections."

Challenging operational situations will certainly be encountered by Thor, Künzel explains. Much depends on the composition of the seabed on which the gigantic legs have to support the vessel. "After all, the hydraulics must lift 10,000 tonnes out of the water. In addition, the tilting moments produced by the wind and waves are substantial," is

SHIPS PASSING. The 82-metre legs of the jack-up platform were visible from afar, even for the crews of containerships.

IDYLLIC ELBE. For now, there is blissful quiet on the open deck, spanning 1,850 m² in area. Once it reaches its place of operation in the North Sea, "Thor" will have to brave the elements.

Photos: Iken

how he describes the possible risks. The situation could become critical in the event of a "punch through" – when one leg of the platform sinks into a part of the seabed falsely considered to be hard enough. "For this reason, the platform conducts a preloading test, in which it puts down two diagonally opposed legs on the seabed and presses itself up. In this way, we can simulate the worst possible operating case," says Künzel. Certification of the vessel includes the appraisal of such conditions by means of global strength analyses. This also applies to the "survival mode": the platform must be able to withstand giant waves. For the North Sea, this is equivalent to a significant wave height of 10 metres – which corresponds to a maximum wave height of 17 metres.

The technical solutions to be seen on board Thor are not the only impressive features it has to offer; the working and accommodation facilities are also exceptional. "We carried out the certification of the living and sleeping quarters according to the Norwegian standard NORSOK," Jochen Künzel emphasizes. The members of the installation crew, who work in shifts and remain on board for one to two weeks at a time, are even able to make use of a fitness centre – assuming they still have the energy after finishing a hard day's work.

The reasons for the high-quality outfitting of the accommodation and leisure area is that Thor is also designed for purposes other than the installation of offshore wind farms in the North Sea and the Baltic. No one thinks it is likely, but if gaps arise in the orderbook as a result of delays in the planned expansion of offshore wind farms, Thor is also fully fit for service in the conventional offshore business. ■ JI

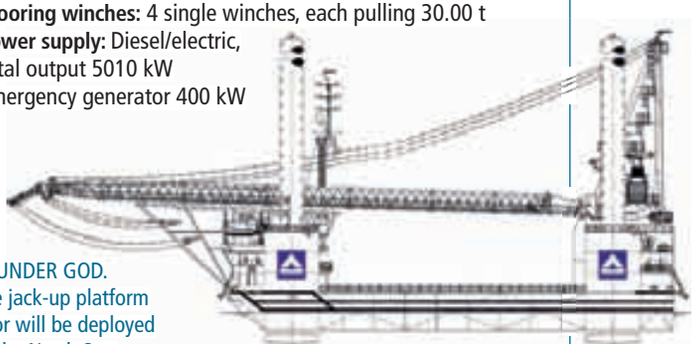
For further information: Jochen Künzel, Offshore Installation,
Phone: +49 40 36149-7424, E-Mail: jochen.kuenzel@gl-group.com

THOR

The vessel is one of the world's largest jack-up platforms for the erection of wind turbines. Thor was built at the Crist shipyard in Gdańsk; the owner is Hochtief. The construction company intends to push forward the development of offshore wind farms in the North Sea through the use of the new jack-up platform, which was classified by Germanischer Lloyd. Initially, Thor will be deployed in the erection of BARD Offshore 1, some 90 kilometres northeast of the island Borkum.

TECHNICAL DATA

Classification: GL + 100 A5 Self-Elevating Unit, + A - MC Audit
Hull dimensions: length 70 m; width 40 m; height 60 m
Leg dimensions: length 82 m; diameter (spudcans) 3.7 m (8.5 m)
Operational conditions: draught (without spudcans) 3.5 m; draught (with spudcans) 7.4 m; operating depth 50.00 m; payload 3,300 t; deck load 15.00 t/m²; hoisting capacity 10,000 t
Gear: heavy-lift crane Liebherr BOS 14000, capacity 500 t/15 m
Mooring winches: 4 single winches, each pulling 30.00 t
Power supply: Diesel/electric, total output 5010 kW
Emergency generator 400 kW



THUNDER GOD. The jack-up platform Thor will be deployed in the North Sea.

Knowing Which Way the Wind is Blowing

As the world's leading consultancy for renewable energies, GL Garrad Hassan is known for its technical reports. At the offshore wind conference in Liverpool, the specialists presented their latest production: the "Offshore Market Report"

MEASUREMENT. The anemometer indicates the wind speed and direction.

Having a global presence pays off: "Thanks to our network of branch offices all over the world, we have a very good knowledge of the market in the wind energy sector," says Daniel Argyropoulos, Head of the Strategic and Policy Studies Group at GL Garrad Hassan in Bristol. Argyropoulos and his colleagues prepare renewable energy reports that examine in fine detail the market situation in the various countries. Their latest work was recently presented at the offshore wind conference "RenewableUK" in Liverpool: the "European Wind Energy Offshore Market Report 2010".

Information Concentration

"The report is targeted at the entire offshore industry, including developers who wish to enter the market or to government agencies who want to obtain an overview," says Argyropoulos. "Many hundred hours of work went into its making."

For twelve European countries, the report describes in detail how the industry is positioned, where offshore wind energy is currently trending, and what may be expected in the near future. The review offers a treasure trove of energy-related topics: from the first offshore installation installed worldwide (225 kW off the coast of Nogersund in Blekinge county, Sweden, in 1991)to the necessary expansion of the Irish electrical grid and the power plants of the globe's biggest net importer of electricity, Italy. To collect this stock of know-how, the specialists at GL Garrad Hassan are able to tap into a world-spanning network of competence.

"GL Garrad Hassan is represented in more than 22 countries. Our local experts are well-connected, know the systems in that area and speak the local languages," says Daniel Argyropoulos. These offices provided the input which Argyropoulos and his team then sorted, concentrated and conditioned. "We are already known for our technical ser-

Photo: Vestas

HORNS REEF. 80 wind turbines off the coast of Denmark produce 600 GWh of power a year. But the wind energy pioneer has started to lag behind in the offshore sector, says Daniel Argyropoulos of GL Garrad Hassan.

vices and we would like to increase our profile with a whole series of market reviews," he points out. Spanning a hundred pages, the report on the European offshore market has now been published in its second edition.

And it has appeared at just the right time. At present, the offshore boom is gaining momentum. In view of the climate change and the question of energy security, this subject is in the focus of discussions in many parts of the world. Although a major offshore farm has been built off China's coast (Dong Hai Bridge, 102 MW) and the first projects are also taking shape in North America, the epicentre of the offshore wind scene is currently in Europe – with Great Britain, Germany, Denmark, the Netherlands and Sweden as the key players.

"Round 3" Within the scope of the expansion programme, Great Britain alone has set itself the development goal of 25 gigawatts of installed wind energy capacity – almost a quarter of Britain's power demand. These "primary markets" are described in depth by the report, which is published in English. This includes countries that have already made concrete efforts and implemented their first projects. Annual offshore installations in double-digit gigawatts are expected for these markets from 2015. In addition, the review identifies "secondary markets", i.e. the countries Poland, Belgium, France, Ireland, Spain, Italy and Norway. Considerable potential is projected here for the near and midterm future. The following topics are addressed for each of the twelve countries:

- **Market Development**
- **Targets, Incentives and Policy**
- **Grid Access**
- **Planning, Regulation and Licensing.**

To highlight an example: Denmark. The trailblazer for wind energy has lagged behind in recent years. Political changes have made it difficult for the industry to continue its growth – above all on the open sea. Another hurdle is that this small Scandinavian country, with a population of only 5.5 million, is already an electricity exporter today.

Basis for Investment Decisions

The market in the Netherlands has also been influenced decisively by public policy. With an installed capacity of 249 megawatts, the country is still far from realizing its former plans. Still, the prospects are good: within the scope of the National Water Plan of 2008, the target was increased by an additional 450 megawatts. Then, in 2009, this bar was set even higher: to 950 megawatts. However, the experts at GL Garrad Hassan believe that this goal will be missed, because the kilowatt-hour prices are higher than initially assumed. Then again, the electrical grid in the Netherlands is well developed – with good cross-border connections. As a cooperative venture with Denmark, the "COBRAcable" link is in the planning stage. From 2016, it is to accept electricity predominantly from sustainable sources and distribute it in the grids of both countries.

Background facts for decision-makers: The comprehensive knowledge base of GL Garrad Hassan can, in the view of Daniel Argyropoulos, help to clarify many of the questions that have plagued offshore technology thus far. "Offshore wind is relatively new compared with onshore wind and therefore fraught with risk. The offshore scene requires support. The success of the industry depends strongly on the prevailing political framework. The farther a technology is from market maturity, the more it needs funding instruments to give it market acceptance – for example Renewable Energy Certificates or feed-in-tariffs." Argyropoulos is pleased that the market report is meeting with a positive response from industry players: "It is possible that the report will be published yearly in future." ■ DH

Photo: iStockphoto

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Simulation – Preparing for the Worst

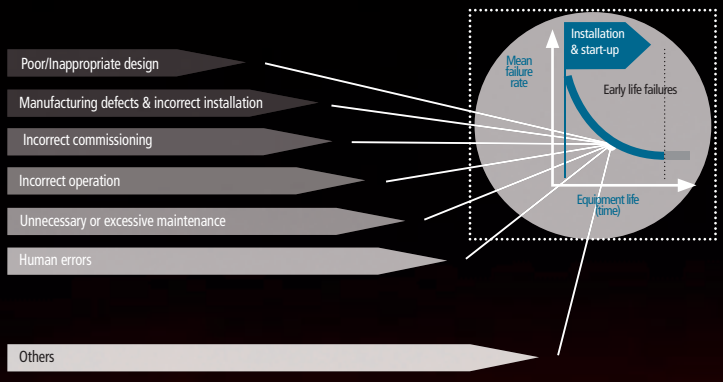
When complex assets in the oil and gas industry fail and repairs are time-consuming, the operator faces high costs. Optagon, a so-called RAM application, helps to manage the operational consequences of equipment failure proactively and efficiently

A key to boosting the Reliability, Availability and Maintainability (RAM) of complex process systems in the oil and gas industry is understanding and managing short, medium and long term failure rates, repair rates and impacts of plant configuration.

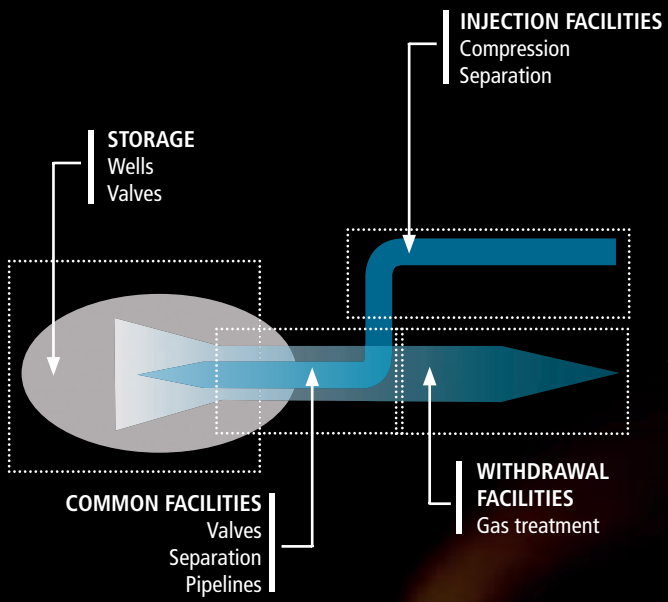
Jonathan Minnitt, Senior Process Engineer with GL Noble Denton, explained how this can be done through simulation during his presentation at the ERTC Asset Maximisation Conference in Budapest. The probability and effects of encountering early life failures depend, among other aspects, on the complexity, age of the technology and location of the installation. From a reliability, safety, failure management and commercial point of view, it is important to identify and deal with these possible early life challenges according to the availability of the parts in question, as the consequences of incurring such failures are likely to be far-reaching. Severe failures need to be considered as they may lead to either costly repairs or major overhaul work that would take excessive periods of time. Most typically, these are equipment items that are very expensive in the first place or have a very long lead time for replacement.

Case Study: Underground Gas Storage Facility

GL Noble Denton was commissioned to use its Optagon software to carry out a RAM study for an underground gas storage facility. "The cyclical nature of operations for gas injection and withdrawal systems needed to be captured in the simulation. Additionally, the consideration of low-



EARLY LIFE FAILURE. Causes of premature severe failure and costly repairs of complex assets.



CASE STUDY. Underground gas storage facility.

frequency but high-impact failure rates, in this case the compressor failure, was the key to the study," Minnitt explained.

A number of scenarios showed that a good spares holding philosophy would enable the operator to limit exposure to unavailability due to compressor failure. The operator was therefore able to better quantify the benefits of sparing certain components with minimum capital expenditure. In addition, the RAM study identified critical production items and the potential benefit of holding spares to shorten repair delays.

RAM tools, benefiting from years of field experience and software refinement, allow asset owners and design contractors to assess and more accurately predict what is happening and what will happen during any particular process.

Optagon uses information technology to enable effective reliability management, while managing the impact that these issues have on effective asset utilization. "This is a keenly watched sector that enjoys dynamic growth, and a key area of convergence in the oil and petrochemical sectors", said Minnitt. It is well suited to large, complex processes found in the oil and gas refining sector and similar process-driven industries, including water and chemicals.

GL Noble Denton uses Optagon directly with end users, maintaining a direct link with the customer. "We use our own consultants to manage contracts," said Minnitt. "It is important for us to ensure that the client has direct contact with us to minimize time delays and to have fast access to direct experience." ■ SNB

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The presentation and the full paper are available on the GL Noble Denton website: http://www.gl-nobledenton.com/news/news_18947.php

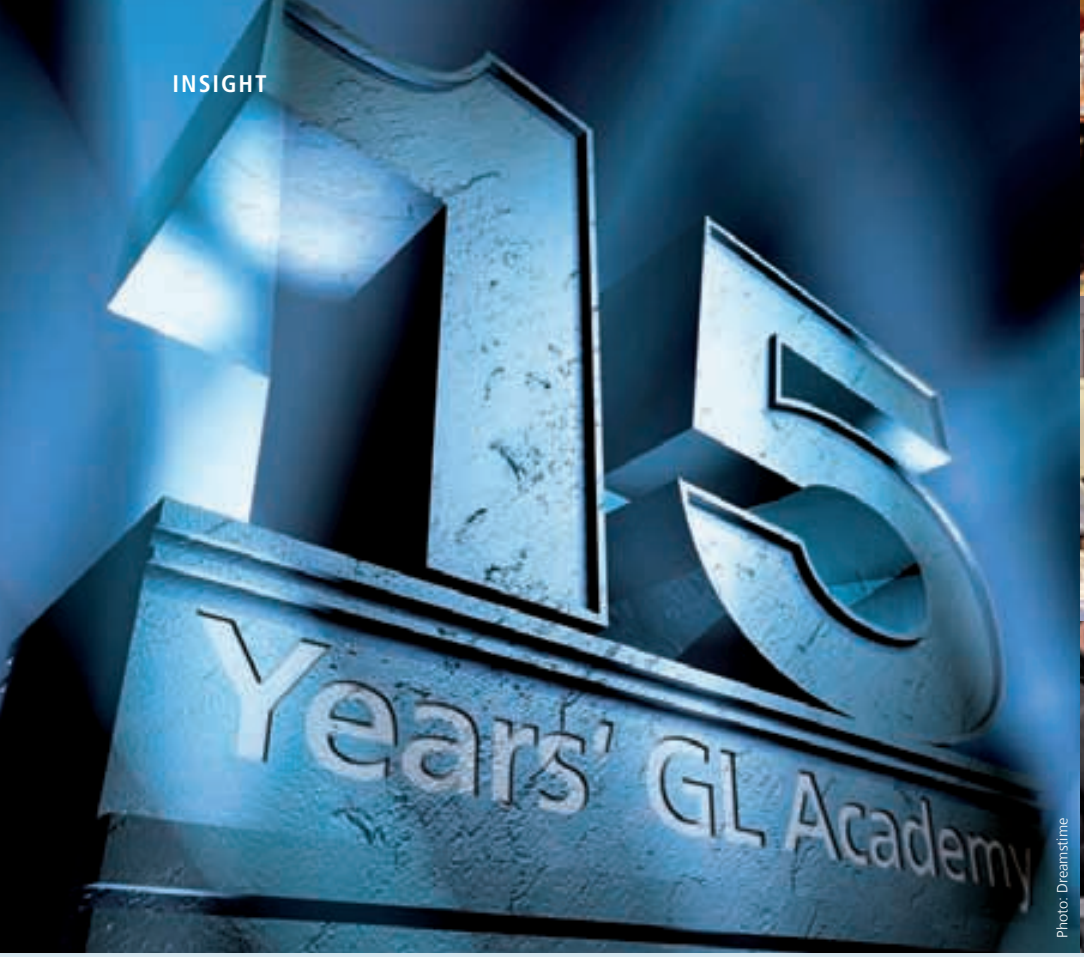
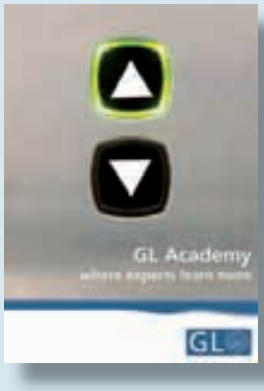


Photo: Dreamstime

Knowledge Transfer on a Global Scale

Advanced training as a success factor: Where the experts study and review

Are you investing enough in your most valuable resource – your employees?" This question has been the mantra of the GL Academy since its inception in 1995 when it offered its first small series of seminars. Today, clients can choose from over 80 different seminar topics covering maritime, management systems and renewable energy subjects. Over the past 15 years, more than 23,000 professionals participated in over 1,500 GL Academy seminars worldwide.



The idea is to share with the industry the expertise and know-how available at GL Group. Under the motto "where experts learn more", seminar participants receive professional training with practical reference. Topics cover maritime regulations and environmental protection, maritime security, marine safety management systems, ship technology, risk management and quality and environmental management systems. Beginning this autumn, the GL Academy will offer seminars on renewable energy subjects as well.

International Network

The curriculum responds to current demand and latest developments. Besides open seminars, the GL Academy offers customer-specific courses and in-house training. Interactive case studies and a practical approach are integral parts of all classes. Moreover, participants receive tools and checklists that help them simplify daily business activities long after the course is over.

Following the first seminars in Germany, the GL Academy systematically expanded its international network of training institutes, establishing new local branch offices. Today, coordinators manage local academies in 19 different locations worldwide. In addition to the academy in Hamburg, Germany, new training institutes have been opened in Greece, Cyprus, Italy, the United Arab Emirates, Turkey, the USA, Brazil, Peru, Mexico, China, Korea, Singapore, India, Spain, Poland, the Philippines, Canada and Japan. The country-specific programmes are adapted to the respective local requirements in terms of content and language.

Extending its reach into countries around the globe, the GL Academy has not only established numerous new offices but also expanded its international network of trainers. Today, 300 instructors are disseminating GL know-how, promoting personal, professional and corporate success. ■ US

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