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the magazine for customers and business partners

SHIPPING

Efficient Concepts

CONTAINER Cleverly Cubed

REFITS A Little-Known Goldmine

ENVIRONMENT Managing Ballast Water

Dear Readers,

Erik van der Noordaa

THE MARITIME INDUSTRY IS WELL KNOWN for facing new challenges and seizing good opportunities. Top of agenda for the shipping world are solutions that are innovative and at the same time economical, offering greater efficiency and lower emissions. The construction of the world's largest containership at the Korean yard Hyundai Heavy Industries for the Chinese shipping company CSCL is a sign of the times: not only can this mega-freighter carry more containers than any other vessel, it also sets new standards for fuel consumption and CO_2 emissions. We are proud to support this project as the classification society – a historic milestone for GL (page 8).

But size is not the only thing that matters. Often, many small advantages together lead to success. The optimisation of certain hull sections can yield significant cost reductions. Bulbous bow refits are an attractive option for fuel savings, especially for containerships in times of slow steaming (page 14).

THE DEMANDS ON A SHIP as a means of transport can vary greatly, depending on its operational area. Nowhere in the world will the transport volume of containers grow as strongly in the coming years as in Asia. To serve the booming trade between the countries of this region, GL has developed a novel design concept for containerships. C-Dragon is the name of the new ship type – offering impressive performance in respect of flexibility, transhipment speed and energy efficiency (page 10).

A major benefit of the concept is that the ships can operate without ballast water for most of the time. Shipowners are spared a lot of problems with stowaways and sedimentary deposits in the tanks. How ballast management systems can already be optimised in the draft design with the aid of computational fluid dynamics is described as of page 38.

THE APPLICATION OF SOFTWARE TOOLS in the maritime industry is growing rapidly. The latest developments were discussed in April at the Conference on Computer and IT Applications in the Maritime Industries (COMPIT). The GL-sponsored conference offered information on advanced IT applications for the lifecycle of ships and offshore structures (page 20).

In fact, shipping without the use of intelligent software would be simply unthinkable today. And yet, only 20 years ago, computers and customised programs were a rarity on board. This transformation is not only due to creative IT experts but also thanks to shipowners with a pioneering spirit, who recognised the value of this trend at an early stage and made the testing of new systems possible under real conditions.

In this field, GL has enjoyed 20 years of close cooperation with Reederei F. Laeisz (page 24). Successful software packages such as GL ShipManager were first trialled in everyday operation by this innovative shipping company.

Sustainability pays off – also in the choice of business partners.

I wish you an interesting read!

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

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Cover: Christoph Papsch

Photo: DNV

Triple Keels Beat Any Weather

Fjellstrand AS is one of Norway's leading manufacturers of aluminium-based vessels. With the launch of the "WindServer", they have responded to the offshore wind industry's challenge of making fuel-efficient vessels to provide safe and effective access to the wind turbines.

GL will be supporting this growing industry by providing classification services for the first newbuildings of this innovative design presented for the first time at Nor-Shipping 2013 in Oslo. GL will class all six of the new vessels in the order, two 30-metre and four 25-metre vessels, built by Fjellstrand for the Danish shipping company World Marine Offshore A/S. The vessels will have a service speed of 25 knots and the capacity to carry 25 and 12 service personnel members, respectively.

"The offshore service sector is currently one of the innovation highpoints within the maritime sector. We are extremely happy to be working with Fjellstrand aganin and to help to bring this exciting new design to life," says Ronnie Westerman, GL's Business Development Manager for North Europe.

TRIMARAN. The innovative "WindServer" is classed GL.

news

Photo: Hasenpusch

EP OPERATION

Protecting the Environment

CERTIFICATE. f.l.: Martin Köpke, Dr Jörg Lampe (GL), Michael Eulrich and Gerd Wessels (Wessels Reederei).

"PELEUS" of German shipping company Wessels Reederei is the first ship to receive the Environmental Passport Operation (EP Operation) class notation. EP Operation is a monitoring/reporting/verification programme whereby a ship's operational emissions are documented, transmitted to GL and verified.

The EP Operation certificate confirms compliance with the MARPOL and the ballast water convention. EP reporting also fulfils the requirements of the Clean Cargo Working Group, the Clean Shipping Index and the Environmental Ship Index. The EP Operation class notation has resulted from a pilot project of the shipping companies Wessels Reederei, Hartmann and TT-Line as well as GL.

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CONTAINERSHIPS

Agreement Marks Historic Milestone

GERMANISCHER LLOYD has signed a classification agreement with Hyundai Heavy Industries (HHI) for five 18,400 TEU containerships, the largest ever built. The ships have been ordered by China Shipping Container Lines (CSCL).

"The agreement marks a historic milestone for GL. We feel honoured to be part of this exciting project and will make sure it will be a success," said Erik van der Noordaa, CEO of the GL Group.

CHRISTENING. "Pacific Osprey" enables fast, accurate construction work.

Photo: Vattenfall/Mogens Holmgaard

EMSA

Emphasis on Safety Aspects

THE EUROPEAN MARITIME SAFETY AGENCY recently published the "Study on Standards and Rules for Bunkering of Gas-Fuelled Ships". Due to the significant number of activities within the field of rule development for gas as ship fuel and bunkering of LNG the objective of the report is to provide a detailed description of the existing rule framework related to LNG bunkering. Prepared by GL, the EMSA study concludes that any future regulatory framework for bunkering of LNG ship fuel, including relevant regulations for the LNG supply chain, could be based on existing standards and guidelines, closing specific LNG bunkering-related gaps by introducing a common EU regulatory instrument.

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CSCL. The next generation of mega container vessels is about to arrive.

CSCL expects the combined effort with HHI and GL to ensure that these will be not only the most advanced containerships of all times, but also a boost to CSCL's international competitiveness and global service network. Apart from sheer size, the new ship type features reduced fuel consumption and CO_2 emissions. According to HHI, fuel consumption will be cut by 20 to 30 per cent per unit, resulting in considerably lower costs per unit.

Each of these mega containerships measures 400 m in length overall, and 58.6 m in width. They will be built according to GL's classification and construction rules. Delivery is scheduled to begin in the second half of 2014.

The vessels will receive the GL class notation RSCS (Route-Specific Container Stowage) recently introduced to allow more efficient and flexible utilisation of available cargo capacity and a greater number of laden containers on board on specific routes without compromising safety.

The EP-D class notation (Environmental Passport Design) prepares the vessels for upcoming ship emission regulations. EP-D is a compilation of relevant ship characteristics for meeting national and international environmental standards.

WTIS

Founded on Six Sea Legs

ONE OF THE WORLD'S LARGEST wind turbine installation ships, the "Pacific Osprey" of Danish shipowner Swire Blue Ocean, will support the construction work on the DanTysk offshore wind farm in the North Sea. Beginning this summer, the vessel will haul 80 Siemens wind turbines across 90 km of open sea from Esbjerg, Denmark, to the DanTysk area west of the island of Sylt. Built by Samsung Heavy Industries, Pacific Osprey is 161 m long, 49 m wide and has a depth moulded of 10.4 m. Capable of lifting herself above the sea level on six legs, Pacific Osprey can install wind turbines in waters up to 75 m deep. The erector vessel has a crane lifting capacity of 1,200 t, can travel at 13 kn when loaded, and offers accommodation for 111 persons. Pacific Osprey was classed by GL.

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NEW STUDY

"Best Practice Ship Management 2013"

SHIP MANAGERS are facing increasing cost pressures. In a difficult market situation they are expected to reconcile low operational costs with high crew quality. In a joint global study, the Fraunhofer Center for Maritime Logistics and Services (CML) and GL experts investigated how roughly 100 ship managing companies go about optimising operations, and what they consider as industry best practice. The results will be presented in the coming months at key shipping locations.

What areas are you working on to improve your business? Are you actively changing organisational processes and approaches, or developing new tools to master the current market? What would you describe as best practice in this respect? Based on questions such as these, the study tries to identify best practices in technical, financial, quality and safety management as well as crewing and procurement.

"Best practice" in this study comprises all approaches, procedures, business models and tools ship managers use to do their business in a smarter, safer and greener way and to stay ahead of the competition.

Ship managers will be able to use the results to identify areas with hidden potential for improvement in terms of cost and quality. Furthermore, they will be encouraged to review their operational practices and build an awareness of hidden issues.

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Cleverly Cubed

Container traffic in Asia is booming. C-Dragon is a new compact container carrier concept for efficiently serving growing markets

Intra-Asian trades are becoming more significant due to the continuous growth of regional economies. At the same time, high fuel prices and new IMO regulations call for more energy-efficient ships. Taking both trends into account, Germanischer Lloyd (GL) has identified the need for a compact container carrier optimised for operating on short roundtrips with many port calls and able to compete with cascading older tonnage.

Growing Asian Container Trades

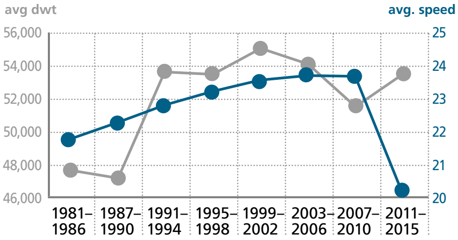
Container traffic in Asia is forecast to grow faster than elsewhere in the world up until 2016. It is assumed that this trend will continue despite apparent moderate growth in China. Container traffic encompasses half of all port-to-port container handling, excluding empty containers and transshipments. Using these figures, GL estimates intra-Asian (regional) container traffic to reach 75 million TEU in 2016, compared to 57 million TEU in 2012.

Intra-Asian container vessels have been relatively small until recently. In 2010, only about 5 per cent of the reported fixtures were for vessels larger than 3,000 TEU (Drewry 2011). Looking at container vessel operators' public sailing schedules, we note that even larger vessels were employed in 2012. At the same time, 22 per cent of the mid-size container vessel fleet (3,000 to 5,000 TEU) is older than 15 years and 14 per cent are on order. Mid-size container vessels have also changed significantly. Built-in speed capacity, measured by the design speed provided in public databases, has recently decreased to an average of 20 knots for vessels delivered after 2010 or on order. This change follows a decades-long increase of design speeds. Ship deadweights remained more or less constant on average. Assuming that larger regional ves-

FOCUS. The new concept addresses regional Asian trades.

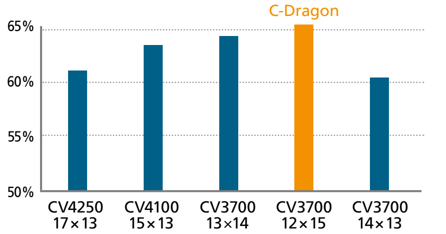
Mid-size (3,000–5,000 TEU) container vessels

1,087 container vessels, Fairplay 2012



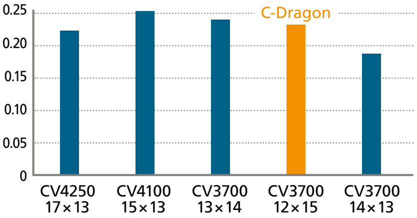
TEU on deck / total TEU (avg. over all bays)

Vessel size: number of 40' bays × number of rows on deck



Variability of deck container slots (stand. dev. TEU on deck per bay)

Vessel size: number of 40' bays × number of rows on deck



sels will preferably be employed on longer routes, several existing intra-Asian north–south route schedules were reviewed to define a typical trading route scenario as follows:

- Roundtrip length: 6,900 nm
- Port calls per roundtrip: 13
- Average port stay: 15 h
- Average transit speed: 15.5 knots

The low average transit speed necessary to meet the published sailing schedules indicates that sufficient speed reserve is available to make up for delays. It is also noted that published port stays vary from a few hours to more than one day for the routes investigated. Current speeds of mid-size container vessels were checked using AIS data gathered for the Taiwan Strait in April 2012. About two thirds of the recorded vessels steamed at 16 to 20 knots, which is below design speeds but faster than the average transit speed derived from public sailing schedules.

Higher Port Efficiency

"The fastest journey is made in port" expresses the fact that a vessel capable of faster port turnaround can benefit from transit speed reductions and the related fuel cost savings, without compromising cargo transport capacity, compared to a competing vessel. This effect is more pronounced for vessels on short routes with many port calls. Apart from favourable stowage planning and adequate container terminal operations as well as smooth piloting and mooring, the vessel layout has an effect on container movement times in port. GL simulated container movement times for five mid-size container vessel designs.

The following design layout features are considered to have an effect on container movement times:

- more TEU on deck, which means less hatch covers need to be removed
- fewer bays, which means cranes need to be moved less often
- low variability of container slots on deck, which means cranes have a more uniform workload

The figures show that, compared to the selected reference vessels, C-Dragon has the highest ratio of on-deck TEU to total TEU and the lowest number of bays. In addition, C-Dragon has the second-best uniformity of deck container slots (i.e. a low variability which is measured by the standard deviation of TEU on deck per bay), giving cranes a better workload distribution. These facts result in favourable container movement times, second only to the CV3700 (14 × 13) design featuring the deckhouse aft (eliminating the need for the crane to move over the deckhouse). It is noted that terminals would need to excel to achieve predicted high ideal TEU rates which assume uninterrupted operation.

The container movement time advantage was predicted by running the new simulation tool for many thousands of load cases to build a statistically meaningful database. Taking the mean values from the simulation runs and assuming 2 to 4 cranes and 800 to 2,000 TEU moved, C-Dragon's advantage against the 4,250 TEU Panamax is easily documented. The advantage is most apparent with few cranes ▷

SIMULATION. *GL developed prototypical software to demonstrate the effect on container movement times in port.*

Container movement times (per TEU groups)

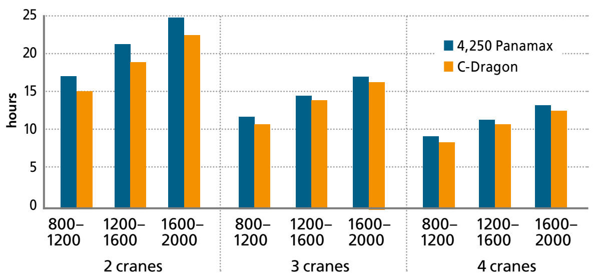


Photo: Yiu Tung Lee | Dreamstime.com

▷ employed, which GL assumes would be the case for mid-size container vessels. Building on the port efficiency simulations, the average port stay for C-Dragon was assumed to be reduced from 15 to 14 hours. This allowed for a reduction in average transit speeds from 15.5 knots down to 15 knots for the concluding economic analysis.

C-Dragon – a Novel Concept

The following objectives were set for the development of the new container vessel design concept:

- Hull form optimised for lower speeds
- Zero ballast water for most operating conditions
- High real cargo intake
- Fast port turnaround

Combining these design objectives resulted in an initial concept for a compact container carrier that was named "C-Dragon". A wide-beam hull allows operation without ballast water under standard conditions. The hull was optimised for low speeds using FutureShip's proven technology.

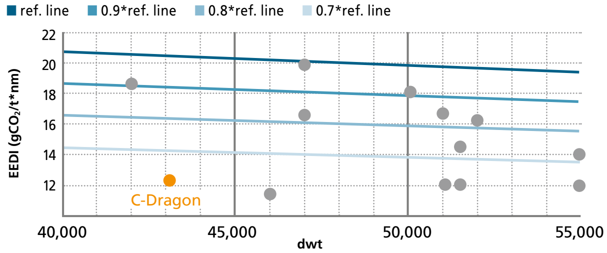
The resulting speed at a design draft with 100 per cent MCR, including a 10 per cent sea margin, is 19.1 knots. At 15 knots only 50 per cent MCR is required, which gives the vessel sufficient reserve power to make up for delays, particularly between neighbouring ports. Further reduction of engine power was considered but dismissed in response to initial feedback from shipowners and operators who favour higher power reserves and flexibility.

C-Dragon offers competitive design features addressing energy efficiency and cargo intake. The reduced design speed combined with the optimised hull form already delivers a favourable EEDI value below the IMO requirement in effect from 2025 onwards. But similarly sized vessels (on order in 2012) promise similar EEDI performance, demonstrating that the EEDI requirement for such container vessels can be met by wide-beam designs and lower speeds.

The real cargo intake is also a major consideration. C-Dragon offers best-in-class dwt utilisation due to zero ballast water usage in standard operating conditions. For each TEU at 14 tonnes, C-Dragon only needs 14.8 tonnes of deadweight, almost 4 tonnes less than the current 4,250 TEU Panamax design. This means that C-Dragon can carry significantly more TEU at 14 tonnes than its competitor (2,920 vs. 2,805), which could yield additional earnings. These design features, as well as the assumptions for the trading route and associated speeds, were used to compare the expected economics of C-Dragon with those of a competitor, a cascading 4,250 TEU Panamax vessel and its resale value-based

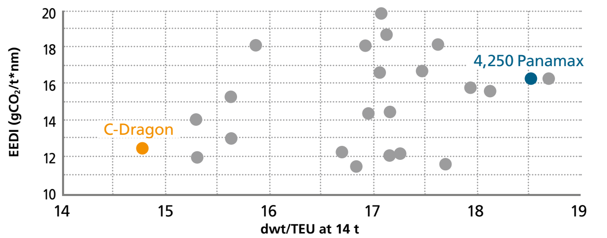
EEDI of mid-size container vessels

75 vessels on order, Fairplay 2012

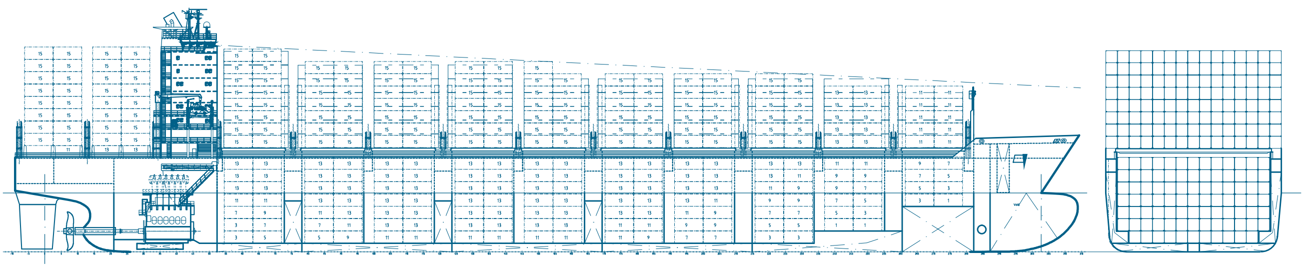


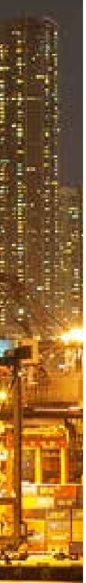
EEDI of mid-size container vessels

75 vessels on order, Fairplay 2012



MAIN DIMENSIONS: LBP = 211.9 m, B = 37.3 m, D = 19.9 m, Td = 11 m **CAPACITIES:** 3,736 TEU, of which 2,364 TEU on deck and 1,372 TEU in hold, dwt = 43,150 t, 2,920 TEU at 14 t **ENGINES:** MAN G60ME-C9 with 15,100 kW, four gensets of 1,750 kW each.





capital costs. The newbuilding price for C-Dragon was estimated at 40 million US dollars according to Clarksons.

The economic analysis assumed a 15-year financial life with 5 per cent interest. The annual operating costs were estimated, resulting in a small advantage for a new C-Dragon against an existing 4,250 TEU Panamax.The largest share of the total annual costs is fuel cost which depends on the speed and the specific fuel oil consumption of the vessels. With faster port turnarounds, C-Dragon spends more of its operating hours at sea. However, thanks to its optimised hull form C-Dragon consumes 30 per cent less fuel than the slow-steaming 4,250 Panamax vessel. The main reasons for this are lower required power and lower SFOC due to advanced main and auxiliary engine technology.

Predicting fuel prices for the next 15 years involves many assumptions. For the purpose of the current analysis, we focused on HFO only, assuming a 0.5 per cent statutory sulphur limit as of 2020, which will effectively increase the HFO/equivalent fuel price. The estimated average annual fuel price for two five-year periods as of 2015 was used as a basis for the economic estimate.

The annual costs were calculated based on capital costs, operating costs and fuel costs. Although C-Dragon demands higher capital costs, it wins out due to its lower fuel costs. Overall, total annual costs for a newbuild C-Dragon are lower than for a cascading 4,250 TEU Panamax vessel. And C-Dragon's advantage will increase as fuel prices rise. This demonstrates the advantages of improved ship and port efficiency.

Improving the Development

In times of high fuel prices and strict regulations, ship efficiency is a concern of paramount importance. Port efficiency, on the other hand, is an important consideration for regional shipping involving short roundtrips with many port calls. The combination of these two challenges led to the development of a new design concept for a compact container carrier we call "C-Dragon". From an economic perspective, the new concept compares favourably with competitive older tonnage. Our work on the C-Dragon concept continues. Using a holistic approach, we seek to further optimise the hull form, structure and layout while exploring the potential advantages of an air lubrication system to further reduce fuel costs. **PCS**

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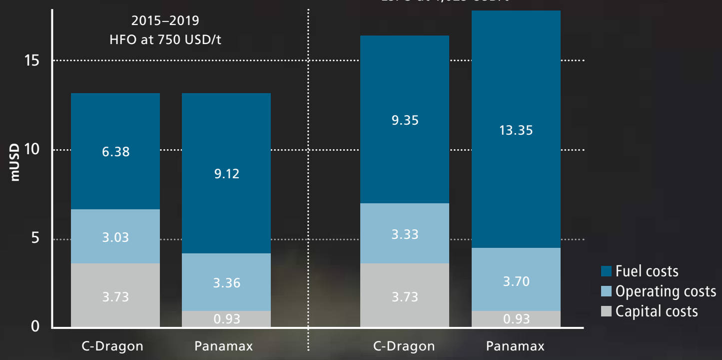
Photo: Yiu Tung Lee | Dreamstime.com

Average annual costs (mUSD)

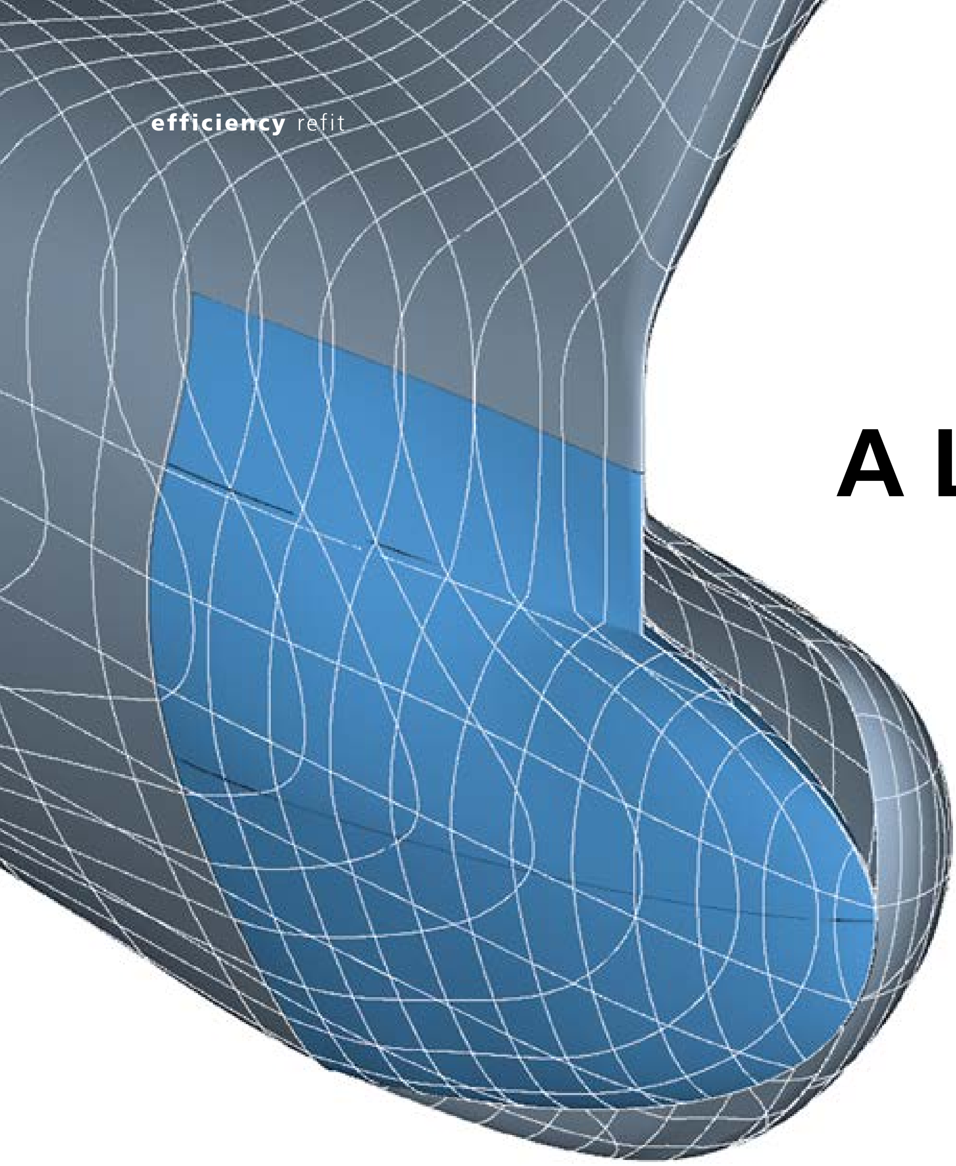


Key economic input data

	C-Dragon	Panamax
Newbuild/resale (mUSD)	40	10
Annuity over 15 years, 5% (mUSD)	3.73	0.93
Operating costs per year (mUSD)	3.03	3.36

Fuel consumption estimate

	C-Dragon	Panamax
Total port time (h/y)	2,417	2,569
Total approach time (h/y)	602	587
Total transit time (h/y)	5,718	5,581
Port aux. engine power (kW)	3,500	3,500
Approaches main engine power (kW)	1,246	2,227
Transit main engine power (kW)	7,546	10,536
Port aux. engine SFOC (g/kWh)	210	220
Approaches main engine SFOC (g/kWh)	175	192
Transit main engine SFOC (g/kWh)	163	179
Port FOC (t/y)	1,776	1,978
Approaches FOC (t/y)	135	259
Transit FOC (t/y)	7,208	10,788
Total FOC	9,119	13,025



A Little-Known Goldmine

Formal optimisation can be applied to complete ship hulls but also to selected portions of a hull. Bulbous bow refits are an attractive option for fuel savings, especially for containerships in times of slow steaming

BOW. *Original hull (port) and FutureShip re-design alternative (starboard).*

Fuel efficiency is bound to remain the dominant topic in shipping for years to come. It is a well-known fact that hull optimisation is a key factor in designing new ships for fuel efficiency. However, the option of re-designing and modifying the bulbous bow of a ship in service is rarely considered, an understandable oversight since the achievable savings are frequently underestimated even by experts.

While optimising a complete hull design will without doubt achieve much more substantial fuel savings, an optimised bulbous bow section still offers rather attractive potential fuel efficiency gains, especially for large, high-powered containerships which now frequently operate in off-design conditions.

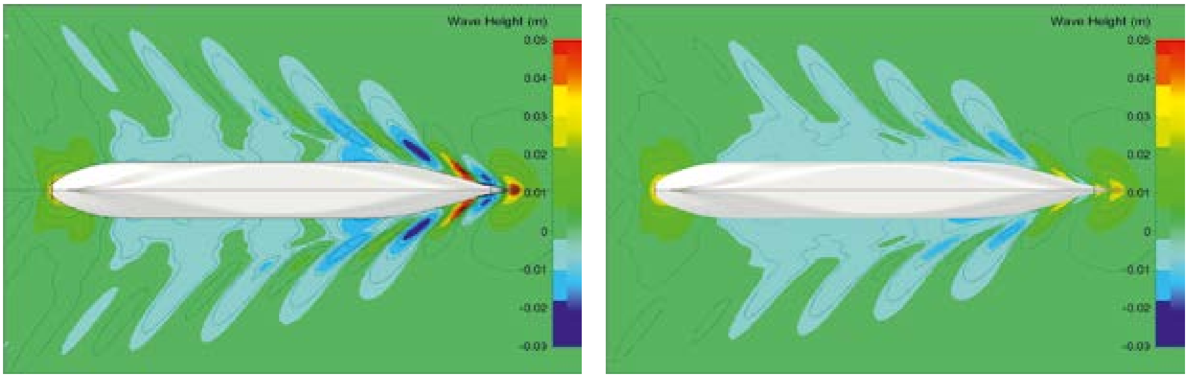
Bow Refit for a 13,000 TEU Containership

FutureShip, the leader in hull optimisation technology, uses state-of-the-art computer technology to modify hull designs based on realistic operational profiles rather than a single, theoretical design point. This opens the door to significant fuel savings even for a bulbous bow refit, as demonstrated in a recent project.

The shipowner had understood the savings potential of bulbous bow refits for his fleet of 13,000 TEU ships. The feasibility issue boils down to the correlation “the larger the cut-out, the higher the potential gains but also the costs of modification”. This resulted in two general choices:

- **OPTION 1:** A larger cut-out covering the ship below the waterline and forward of the collision bulkhead
- **OPTION 2:** A smaller cut-out below the waterline and forward of the fore perpendicular

The shipowner supplied records of operational data for a whole year. This database of speeds and drafts was condensed into eight representative clusters of speed and draft combinations with weightings ranging between 10 and 25 per cent. The objective was then to reduce the combined



BETTER BULB. Original hull (left) and optimised Option 1 (right).

fuel consumption for these eight operational states, accounting for their respective time share in a year of operation.

A parametric model of the bow section was set up, employing as many as 26 free parameters to enable evaluation of a very large number of possible bow shapes. A smooth transition between the bulb and the rest of the hull was achieved by defining appropriate constraints for this area. Roughly 20,000 bow variations were investigated, and two hull shapes were identified that featured optimal performance results across the operational profile.

As expected, the added flexibility offered by Option 1 resulted in the best fuel savings potential. Under off-design conditions Option 1 delivered expected gains of up to 11 per cent, equivalent to annual fuel savings of approx. 3.5 per cent under real-life operating conditions. The expected gains for Option 2 were up to 6 per cent under off-design conditions, equivalent to fuel savings of approx. 1.8 per cent per annum. The results were validated by "numerical sea trials" (high-fidelity CFD simulations on the full-scale ship) and model tests.

Payback times will vary depending on fleet size, the contracted repair yard and the development of oil prices, ranging between two and eight months in all realistic scenarios. This result makes a bulbous bow refit a good business decision by anybody's standards. ■ **VB**

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(Partial) Ship Hull Optimisation – Tools Employed

The results of any optimisation project depend on the software tools employed and the skill and experience of the project engineers. Many so-called hull optimisation projects fall short for a variety of reasons:

- **MISLABELLING:** A simple improvement, e.g. guided by CFD (computational fluid dynamics) analyses, is falsely called "optimisation".
- **CHOICE OF OPTIMISATION OBJECTIVE:** A single design point is chosen instead of focusing on annual fuel consumption; then, e.g., only the resistance is minimised rather than the power requirement; or the use of inadequate software instead of high-fidelity CFD code introduces errors into the hydrodynamic assessment of variants.
- **RESTRICTED FORM VARIATION:** The investigated form variations depend on the fundamental (parametric) model. An inadequate set-up of the parametric model may then prevent identification of superior designs.

FutureShip employs a range of state-of-the-art tools in its optimisation projects:

- **FRIENDSHIP-FRAMEWORK** for parametric hull modelling
- **FS-FLOW** – fully non-linear wave resistance code based on potential flow theory
- **FINE/MARINE** as high-fidelity viscous CFD code
- **FS-EQUILIBRIUM** for hydrostatic analyses (as required for constraints in ship stability)
- **FS-OPTIMIZER** – a toolkit for design space exploration and optimisation offering a variety of optimisation algorithms.

Diesel and Electric in Duet

The "Semper Fi" from the Netherlands can be operated with two different engines at the same time: this approach cuts the emission of CO_2 and also saves money. The innovative inland waterway vessel is under way with GL class

Hybrid drives are currently amongst the most efficient technologies used in inland shipping. In cooperation with MARIN, the Netherlands maritime research institute in Wageningen, the Dutch shipping company Carpe Diem Shipping has developed an entirely novel concept: "Semper Fi" is the first inland vessel that can simultaneously be propelled by a diesel engine and an electric motor – a unique combination to date, and one that promises substantial savings in energy consumption.

Hybrid Teamwork

Inland waterways often exhibit considerable variations in elevation and water draught, which takes its toll on fuel consumption. In addition, the statutory provisions for airborne emissions also apply to inland shipping. "Under a full load the diesel engine is on full throttle, while on empty runs or downstream passages the efficient electric motor takes over propulsion. That saves us money," says Wilco Ooms, the owner of Carpe Diem and the responsible project manager.

The result is impressive indeed: in contrast to conventional diesel-electric propulsion plants, the efficient use of the hybrid drive yields a cost-saving yet powerful optimisation of the overall system.

Germanischer Lloyd is also on board with this innovative project. Initially GL took care of plan approval and later the classification of the dry cargo ship. Design and output were optimised to account for the varying conditions to be found in inland shipping. "In a recent study on the operating profile of an inland barge, the finding was that such a ship uses its full engine output for only about eight per cent of the passage. So, for most of the time, it really could do without the diesel engine and switch over to generator operation," says Tom Dorsman, GL Business Development Manager.

Modern Filter Technology

The hybrid drive is not the only sensation of the "Semper Fi" project. Contra-rotating rudder propellers optimise the propulsion system. Propellers turning in opposite directions offer the decisive advantage in that they are not only made

Photo: Binnenvaart

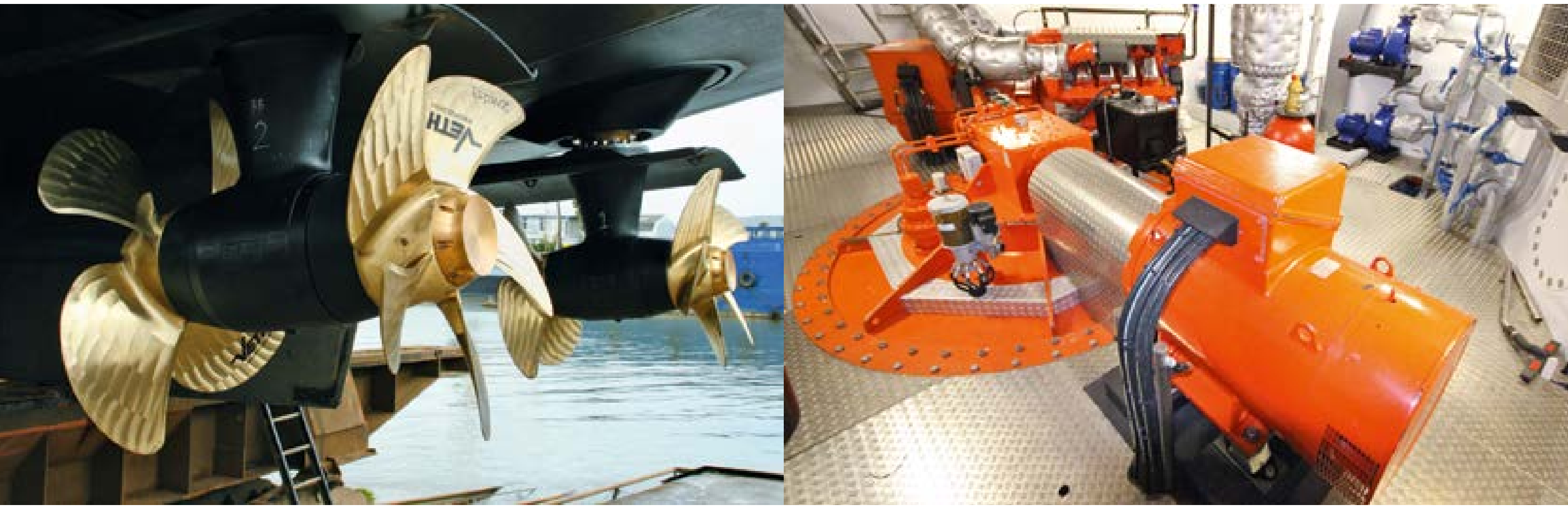
for improved manoeuvrability but also for extremely quiet operation – an important criterion for inland shipping. The streamlined tunnel and the variability of the propeller, which can be controlled in all directions, further add to the system's efficiency and versatility.

Thanks to an integrated exhaust post-treatment system, the "Semper Fi" makes an additional contribution towards minimising noxious emissions in inland shipping. In this process, the combustion gases are chemically cleaned using the so-called AdBlue method. A urea-based liquid is injected to bind the exhaust particulates and reduce the levels of nitrogen oxides. The AdBlue exhaust post-treatment system was supplied to the "Semper Fi" project by Veth Propulsion.

Setting a Clear Course for Inland Shipping

Whether the call is for inland waterway vessels in the transportation of dry cargo, containers or project cargo, whether inland tankers or passenger ships – GL offers wide-ranging technical consultancy services for inland shipping. "With the "Semper Fi" project, the GL engineers were not only responsible for the plan approval, but also supported and certified the entire fitting-out of the vessel, so that the ▸

INNOVATIVE. The inland barge "Semper Fi" boasts an optimised design and a fuel-efficient hybrid propulsion system.



CONCEPT. Contra-rotating rudder propellers and a diesel-electric drive with optimised efficiency at the screw minimise the fuel consumption and reduce the pollutant emissions for the inland barge project "Semper Fi".

▶ acceptance process was completed to our full satisfaction," explains Carpe Diem managing director Wilco Ooms. The classification process generally involves plan approvals, inspections and the certification of materials and components, construction supervision at the yards, and technical surveillance of the fleet in service.

Over and above that, possibilities for efficiency enhancement of the ship are explored early on during the planning and design phase of the ship. Customers are given qualified and comprehensive support with regard to the possible optimizsation of the hull design, the propeller and engine output, and efficient energy management.

Tailor-Made Solutions

The highest possible quality, commitment and reliability are also what characterises the company Carpe Diem Shipping, which operated under the name SVO Carpe Diem up to 2011. In keeping with the motto that "providing customised solutions makes for an enduring customer relationship", which applies to inland shipping too, the Dutch innovators make sure that projects are planned with care and implemented with clarity.

Added to that, the customers benefit from a shallow organisational structure. This makes it possible to respond rapidly, flexibly and with first-rate service to all the customer's needs. With its innovative ideas, the shipping company always pursues the goal of advancing inland waterway vessels in respect of safety and ecology. With "Semper Fi", Carpe Diem Shipping has certainly taken a big step in a promising direction.

LNG as Alternative Fuel

Rising oil prices and increasingly rigorous environmental regulations demand concerted efforts also in the building and operation of inland vessels in order to achieve greater environment compatibility and profitability at the same time. Low-emission fuels, such as liquefied natural gas (LNG), also represent a viable alternative for inland shipping on the way to meeting lower emission limits on an international scale.

On the "Semper Fi", the engines are still powered by diesel oil. "The next logical step would be to convert to LNG as fuel," says Dorsman (see interview next page). "GL has developed a substantial offering for LNG classification and consultancy that also supports inland waterway vessels for the conversion to LNG solutions." ■ **NR**

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"Clear Guidelines Are Needed"

GL Business Development Manager Tom Dorsman on the chances of LNG as an alternative fuel for propulsion in inland shipping

NONSTOP: Mr Dorsman, natural liquefied gas is regarded as the fuel of the future in the shipping world. What role is LNG likely to play for inland waterway vessels?

TOM DORSMAN: The demand for LNG drives is large, but there is still much to be done. The regulatory framework for the approval is still in the development phase. Although a number of projects have kicked off over the past two years, the approval procedures are still cumbersome. If, for example, a Dutch shipowner wishes to build a ship with LNG propulsion, he first talks it over with his classification society. The society must then obtain the recommendations of the competent ministry in the Netherlands and the Central Commission for the Navigation on the Rhine (CCNR) in Strasbourg. And yet the pressure is building up as the demand increases: in the Netherlands and in Belgium, above all, shipowners are pushing for the general approval of inland vessels with LNG propulsion. At the present time, however, we only have recommendations and no clear guidelines. I remain optimistic. Intensive efforts are being made to achieve a solution to the problem. It cannot take much longer.

"LNG is the fuel of the future. Its long-term availability exceeds that of diesel. And LNG is easy on both the environment and your wallet!"

TOM DORSMAN
Expert at GL

NONSTOP: When will the LNG rules be available to inland shipping?

DORSMAN: As a classification society, Germanischer Lloyd is involved in a project with Lloyd's Register and Bureau Veritas to push forward new rules for the utilisation of LNG in inland shipping. This concerns both the implementation of complete LNG gas engine plants and the regulatory framework for the bunkering processes. The rules of sea shipping cannot simply be copied over to inland shipping without any changes; rather, they have to be adapted or even reformulated entirely.

NONSTOP: But there is also the matter of the lack of infrastructure that is necessary to advance the use of LNG in inland shipping. When will we get the critical mass?

DORSMAN: That is like the old chicken-and-egg question: what must come first – the bunkering systems or the customers who want to use them? A vital prerequisite is the fundamental acceptance of LNG as an alternative propulsion fuel by the CCNR. This could also help to dispel the scepticism and reservations displayed by ship operators and investors in Germany with regard to LNG projects.

NONSTOP: As has already happened in Hamburg? The port appears to be gearing up for LNG.

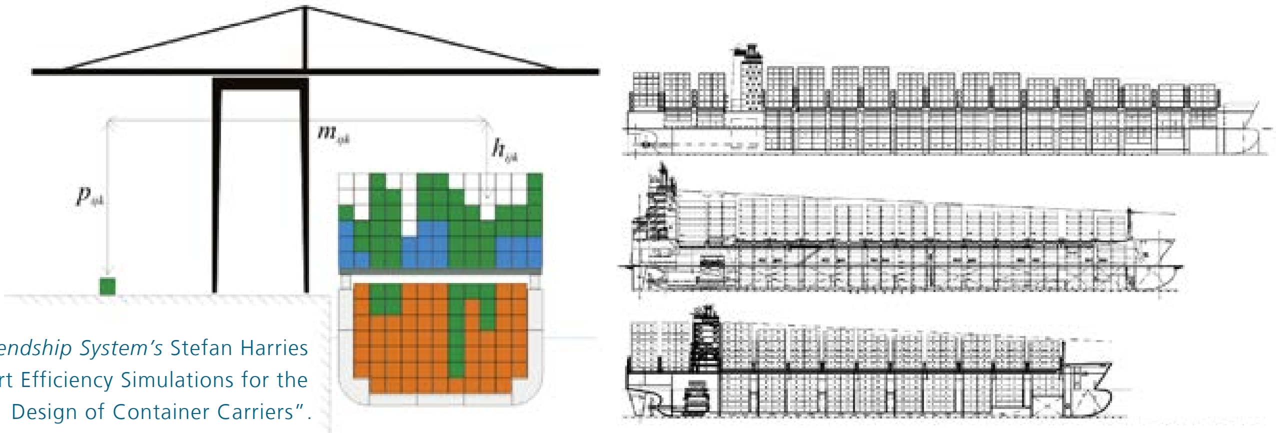
DORSMAN: Yes, Hamburg is moving forward. A bunker station, a bunker ship and grounds for the tank facilities are all planned. In Rotterdam, there is already a large storage area for LNG in the GATE (Gas Access To Europe) Terminal. I believe that this is where the future lies. There are still a few hundred years of LNG reserves to meet current needs, but other fossil fuels – such as diesel – will no longer be available to the same extent in 50 years' time. What is more, LNG is easy on both the environment and your wallet!

CORTONA. The 2013 12th COMPIT conference organised by the GL Group took place in Tuscany.

IT Solutions for Fuel Efficiency

In Tuscany, COMPIT 2013 focused on fuel-efficient designs, product data models for lifecycle support, 3D-simulations and robotics for the maritime IT industry

This year's International Conference on Computer and IT Applications in the Maritime Industries (COMPIT) covered a broad spectrum of latest developments in ship design and shipbuilding, IT trends and marine robot technology. Sponsored by Germanischer Lloyd (GL), the conference took place for the twelfth time, having established itself as a leading conference on IT for maritime industries. The conference, which attracted about 80 participants, also serves as a networking platform for expert recruitment and the prepa-



CONCEPT. *Friendship System's* Stefan Harries presented "Port Efficiency Simulations for the Design of Container Carriers".

ration of international R&D projects. Some 45 presentations were given by maritime software developers and users, providing direct insight into how modern IT applications are evolving within their native organisations and the industry.

The ongoing quest for energy efficiency is driving the development of new IT applications in the maritime industry. One of the speakers, Stefan Harries of GL's subsidiary *Friendship Systems*, presented "Port Efficiency Simulations for the Design of Container Carriers", a technology allowing quantitative consideration of cargo handling times for container vessels already in the conceptual design stage. The method uses a statistical approach to help determine a vessel's required time in port for many randomly chosen combinations of containers on board, containers to be handled in port, and assigned cranes. For the presented case studies, the differences in port efficiency were shown to be considerable.

PORT EFFICIENCY. *A key factor in economic ship operation, with direct implications for fuel efficiency and other cost items.*

Another presentation dealt with advanced simulation technology. Volker Bertram of GL's subsidiary FutureShip gave an overview of "Advanced Simulations for Offshore Industry Applications", based on the experiences of FutureShip as a provider of simulation services, and a major vendor of simulation software (CD-adapco). The presentation focused on the benefits for the business processes of customers. The analysed structures included fixed and floating offshore platforms, related ships such as supply vessels, and selected equipment. The simulations addressed key operational ▶

SIMULATION. Jack-up platform in waves during touch-down; a hybrid computation using AQWA & STAR CCM+.

LECTURE. Volker Bertram of GL's subsidiary FutureShip during his presentation "Advanced Simulations for Offshore Industry Applications".

HANDOVER. FutureShip's Stefan Deucker (left) and Volker Bertram (right) present the GL COMPIT Award to Herbert Koelman, SARC.

▹ challenges, such as ensuring low environmental impact, high availability and compliance with regulations, while promoting innovative designs and procedures. Since the scope of the simulations is wide, covering structural analyses, noise and vibration, fluid dynamics, aerodynamics and installation simulations, the presented case studies illustrated the versatility and sophistication of modern simulations in this field.

Remarkable Discussions

FutureShip's Heikki Hansen explained in "Lean ECO-Assistant Production for Trim Optimisation" how streamlined processes brought down total response time and cost for the CFD-based trim optimisation tool. GL's Henner Eisen described in "High-Performance Finite-Element-Based Fatigue Assessment Processes for Ship Structures" how complex processes in structural analysis can be streamlined using the GL ShipLoad software. The software tool demonstrated that fatigue assessments can be performed economically for entire ship structures without requiring more user effort or computational time than classical (design load) methods.

"Future-related topics such as the use of robotic systems to support salvage operations or unmanned navigation through intelligence in networks led to remarkable discussions among the visitors from the different segments and regions," said GL's Volker Bertram. Further conference topics included product data models for ship lifecycle management, process simulation and virtual reality applications. ■ **NR**

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COMPIT Award 2013 – And the Winner Is…

HERBERT KOELMAN has been announced as the winner of the GL COMPIT Award. The Dutch computer-aided-design-expert was honoured at the COMPIT Conference for his paper's contribution to the promotion of innovative approaches in ship design.

The jury singled out Herbert Koelman, SARC, from a shortlist of several highly qualified candidates because his paper outlines a roadmap for advanced ship design approaches over the next decade. His paper: **"MIDTERM OUTLOOK ON COMPUTER-AIDED SHIP DESIGN"** received the highest praise for both its content and form. The jury noted that his highly readable and unpretentious paper offered the industry a number of avenues for exploration.

Of particular note, they said, was his **ADVOCACY OF 3D LASER PRINTING** as a hands-on manifestation of 3D design approaches; his identification of underused opportunities to create numerical design series and rapid design formulas based on CFD and machine learning approaches; and above all, the challenge that the paper puts to the community to avoid complacency and mental standstill and strive for innovation in methods rather than user-interface wizardry.

THIS IS THE SIXTH TIME an outstanding scientist has been presented with the GL COMPIT Award at this prestigious conference. Previous winners of the award are:

2012 **Rachel Pawling,** UCL (UK)
2011 **Denis Morais,** SSI (Canada)

Photo: Dreams

GL Academy – Dates at a Glance

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

JUNE

10. – 14.06.2013
Superintendent Training Course
Riga, Latvia

11. – 12.06.2013
Marine Environmental Awareness Course
Singapore

12.06.2013
Surveys and Certificates
Piraeus, Greece

12. – 13.06.2013
Internal Auditor ISM/ISO 9001 for Shipping Companies
Limassol, Cyprus

12. – 13.06.2013
Efficient Communication in a Maritime Environment
Madrid, Spain

13.06.2013
Personal Protection Equipment for Crews
Hamburg, Germany

13.06.2013
Compiling a Carbon Footprint Inventory
Istanbul, Turkey

14.06.2013
Maritime Security – Developments and Best Management Practices
Madrid, Spain

18. – 19.06.2013
Internal Auditor ISO 9001 for Industry and Service Providers
Piraeus, Greece

19. – 20.06.2013
Accident Investigation in Shipping – Analysis and Root Cause
Madrid, Spain

20. – 21.06.2013
Implementation Workshop ILO Maritime Labour Convention
Genoa, Italy

20. – 21.06.2013
Designated Person Ashore (DPA) Training Course
Makati City, Philippines

24. – 25.06.2013
Security Awareness Training for Seafarers with Designated Security Duties
Hamburg, Germany

24. – 25.06.2013
Internal Auditor ISM-ISPS-MLC for Shipping Companies
Szczecin, Poland

JULY

07. – 11.07.2013
Quality Management Systems Auditor/Lead Auditor Training Course
Dubai, United Arab Emirates

07. – 09.07.2013
Train the Trainer for Shipping Companies
Dubai, United Arab Emirates

09. – 10.07.2013
Implementation of an Environmental Management System according to ISO 14001 for Shipping Companies
Piraeus, Greece

15.07.2013
Ahorro de Combustible
Lima, Peru

15.07.2013
Voyage Optimisation
Genoa, Italy

16.07.2013
Diseño estructural del Buque
Lima, Peru

16.07.2013
Optimised Ship Handling
Genoa, Italy

17. – 18.07.2013
Implementation Workshop ILO Maritime Labour Convention
Singapore

AUGUST

12.08.2013
Air Pollution from Ships in Practice
Hamburg, Germany

27. – 28.08.2013
Vetting Inspections
Copenhagen, Denmark

29. – 30.08.2013
Effective Leadership in a Maritime Environment
Singapore

30.08.2013
Anchor Handling
Hamburg, Germany

Imprint

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20 Years of Teamwork

Today, shipping without the use of intelligent software is simply unimaginable. This progress is thanks to creative IT experts and shipowners with a pioneering spirit

That is something to be proud of: the annals of today's Reederei F. Laeisz go back all of 189 years – and still the company remains true to its declared aim of upholding a proud tradition and, at the same time, looking to the future by implementing the latest technologies.

One building block of the firm's success is the trusting partnership with Germanischer Lloyd (GL). For 20 years now, the ship, software and IT experts at Laeisz and GL Maritime Software have been working closely together in developing a number of software tools that, time and time again, have proved to be pacemakers for the entire industry.

Launched in 1993

The use of on-board computers with customised programs was not at all a matter of course right up into the 1990s. "In 1992/93, software for ship operation was simply not yet

"PEENE ORE". This bulk carrier of Reederei F. Laeisz has a capacity of 322,398 dwt and was classified by GL.

Photo: Hasenpusch

HEADQUARTERS. Following German reunification, the ships of Deutsche Seereederei Rostock (DSR) and F. Laeisz Schiffahrtsgesellschaft were merged to form Reederei F. Laeisz in 1993. The ship management activities and the staff departments are concentrated in Rostock.

Photo: Laeisz

available. We were amongst the very first suppliers," says Heiko Hofmann, Managing Director of GL Maritime Software. And Harald Schlotfeldt, Managing Technical Director at Reederei F. Laeisz, also remembers those turbulent years as pioneers: "Even in the mid-nineties, only 30 per cent of the shipping companies supported their ship operations with software. We certainly took on the role of trailblazers."

Then, in 1992, development started on a comprehensive basic tool for the administration of a merchant vessel. The components designed to ease the workload on the ship's command were relatively straightforward to begin with. They covered the acquisition and systematic listing of the canteen costs, the keeping of the cashbox and the transparency of the communication costs. Crew data had to be collected and documented to create electronic crew lists and be ready for immigration formalities. Things became more complicated with the processing of wages – but even this nut was cracked and payroll accounting for the crew became part of the overall package.

A quantum leap was achieved in 1996. The IT experts of GL Maritime Software implemented a program with the acronym SAMS on the Laeisz ships "Pommern" and "Potsdam". SAMS proved to be very effective, and thus provided the basis for further developments. Soon, two modules formed as the technical pillars supporting the ship operation suite: the Planned Maintenance System (PMS) and the Material Management System (MMS).

The PMS supports planned maintenance based on time intervals and hours of operation, enabling full maintenance documentation. It was the very incarnation of ship management with an uncompromising focus on safety. As a logical step, PMS was added to the SAMS package early on, in 1996. Today, Reederei F. Laeisz is still a leader in the implementation of data processing to assist the ships' officers in their work and to make complex operational processes more transparent. "We're very happy to be an innovation driver and would like to remain so in future," says Harald Schlotfeldt.

MMS, the second technical pillar, secures the provisioning with spares, lubricants and whatever else is needed for smooth running on board a modern ship. In 1999, MMS also underwent its baptism of fire: Laeisz rolled the system out to its entire fleet.

Driver for Innovation

Stand still and you get left behind, as the saying goes – and so the software remained under constant development. In the years that followed, many different modules were added – on a new foundation, however. "From 2006, the legacy systems were incorporated into the GL ShipManager," explains GL expert Hofmann. And then, in 2007, the complete transfer of all module-specific data was released as part of the conversion of internal processes at the Laeisz shipping company. Thanks to intelligent data synchronisation, the software ensures that the information on board and ashore is kept in step. Today, other tools, such as the GL HullManager, GL FleetAnalyzer and Fleet Online, can be coupled to the GL ShipManager. "In many cases, the idea came from Reederei F. Laeisz," says Heiko Hofmann. ▹

Photo: Laeisz

"The implementation of new software tools means that we have to review existing processes."

HARALD SCHLOTFELDT
Managing Technical Director
Reederei F. Laeisz

Photo: Laeisz

"MV PAGANELLA". The eight pure car/truck carriers each have a capacity of 5,000 vehicles.

▶ In contrast to the turbulent early years, every change to the data processing architecture has, since 2008, had to pass via the desk of the system administrator: "My job is to keep the system well organised and, above all, transparent for the users," says Catherina Martens. This centralised control is essential, because the GL ShipManager is not only gaining in significance but is also becoming increasingly more complex with each new interface to other GL software products. ShipServ concentrates on data exchange with the spare parts suppliers. GL FleetAnalyzer combines various tools to generate a total assessment of the ship's performance. "Yet another initiative from Laeisz," says Schlotfeldt. For him, the GL FleetAnalyzer is a logical "dashboard" for all the previous developments. "After all, when you have so much information, you also need to analyse and present it properly."

Apart from the tangible cost reductions that are yielded primarily by the efficiency tools, the software developments offer an additional gain that should not be underestimated: "The implementation of new tools often means that we have to review existing operational processes," Harald Schlotfeldt points out. In fact, reassessment of the process steps in the enterprise yields benefits of similar value to actual optimisation of the technical efficiency. ■ **JI**

Photo: Colette6 | Dreamstime.com

"PADUA". The four-masted barque was one of the legendary "Flying P-Liners". Until today the freighter continues to sail under the name "Krusenstern".

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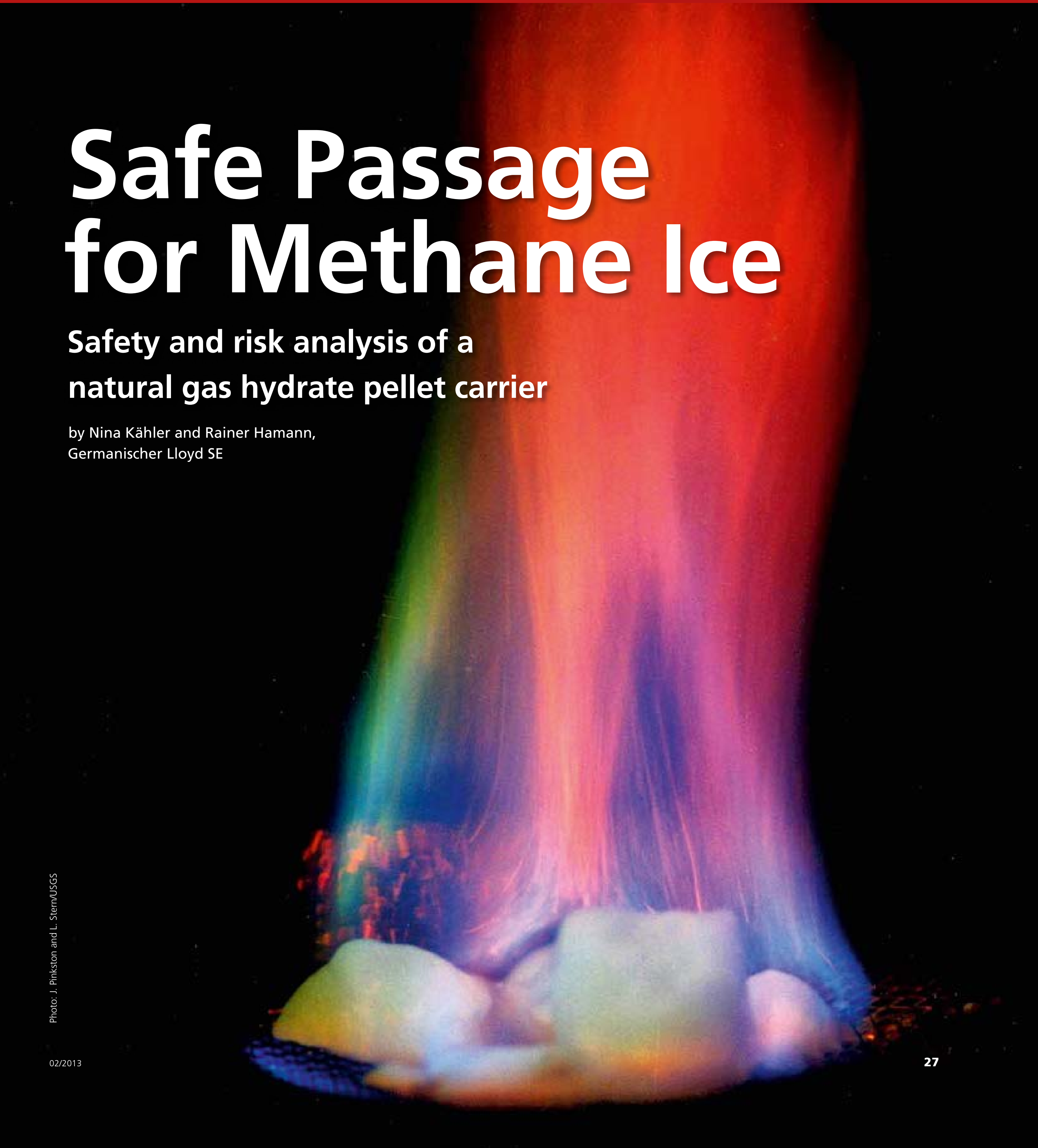
… Beginning with "P"

Whenever you take part in a quiz and are asked regarding a ship's name beginning with the letter P, you would do well to make a call to the F. Laeisz Group. Here there are some 120 commercial employees, brokers, superintendents and engineers who are hard at work to secure the continued success of Reederei F. Laeisz – the shipping company that, for more than 150 years, gives its ships names starting with P. The four and five-masted tall ships of the "Flying P-Line", which sailed the crossing to South America in record time, were more famous than any others.

In 1824, Ferdinand Laeisz set up a hat manufacturing company. Ships and the shipping company only played a role from 1839. A major step for the shipping company came in 1993 with the acquisition of the commercial shipping of the formerly state-owned enterprise Deutsche Seereederei Rostock (DSR) of the former GDR.

The F. Laeisz Group is still a family-operated firm. Container carriers make up almost half of the fleet of over 60 units. The remainder consists of bulk carriers, gas tankers, RoPax, RoRo and PCTC vessels.

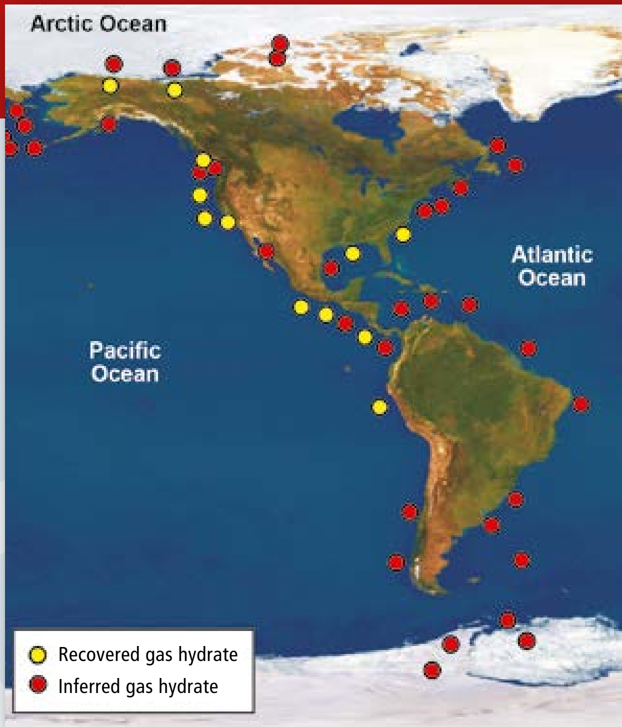


Safe Passage for Methane Ice

Safety and risk analysis of a natural gas hydrate pellet carrier

by Nina Kähler and Rainer Hamann,
Germanischer Lloyd SE

Photo: J. Pinkston and L. Stern/USGS



Methane clathrate, also known as methane hydrate, natural gas hydrate or methane ice, is found in cold sea regions embedded in the sea bottom at water depths between 400 and 2,000 metres. It consists of methane (CH_4) and water molecules – and burns when ignited.

Methane ice forms at around 2 °C when natural gas stemming from microbial activity meets cold water molecules seeping into shallow sediment layers. When the two substances meet under sufficient pressure, water molecules will form a cage-like structure around the tiny methane molecules. According to current estimates, the world's methane clathrate deposits range between one and five million cubic kilometres and might eventually become a major energy source. Research efforts continue to assess the feasibility of large-scale mining. Among the technical challenges is the transport question. In a study, a group of scientists investigated the safety aspects of transporting gas hydrate by ship.

The natural gas hydrate (NGH) carrier was developed by the German shipyard MEYER WERFT as part of the German SUGAR project (Submarine Gas Hydrate Resources), a joint effort of a consortium of academic and industry partners developing technologies to enable commercial production of methane from methane clathrate. It was promoted by the German Ministries of Economics and Technology (BMWI) and Education and Research (BMBF). Designed to transport natural gas hydrate in pelletised form, the vessel will take advantage of the so-called self-preservation effect of methane clathrate, which remains stable at a higher temperature than liquefied natural gas (LNG), requiring refrigeration at only –20 °C, rather than –162 °C.

Methane, the main ingredient of natural gas, is a highly hazardous substance due to its flammability and enormous global warming potential. The "Transport" subproject of SUGAR therefore evaluated the risks of transporting pelletised NGH on board the carrier when compared to LNG carriers.

The proposed carrier ship is 180 metres long and has a cargo capacity of 20,000 cubic metres (approx. 1,800 tonnes of CH_4). It is equipped with dual-fuel propulsion engines capable of running on boil-off gas.

Two variants of the containment system were proposed: design option 1 consists of eight horizontally arranged cylindrical cargo tanks, each with an intake capacity of 2,500 cubic metres (223 tonnes of CH_4), whereas option 2 uses 15 vertically arranged cylindrical tanks each holding 1,335 cubic metres (119 tonnes of CH_4). In both cases the tanks are arranged in four insulated, actively-cooled compartments and

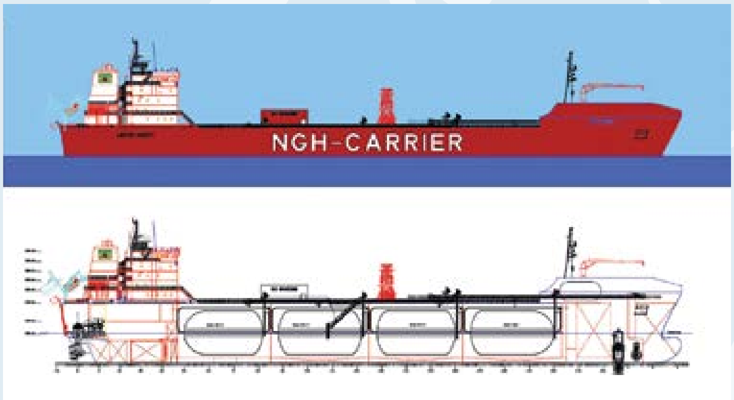
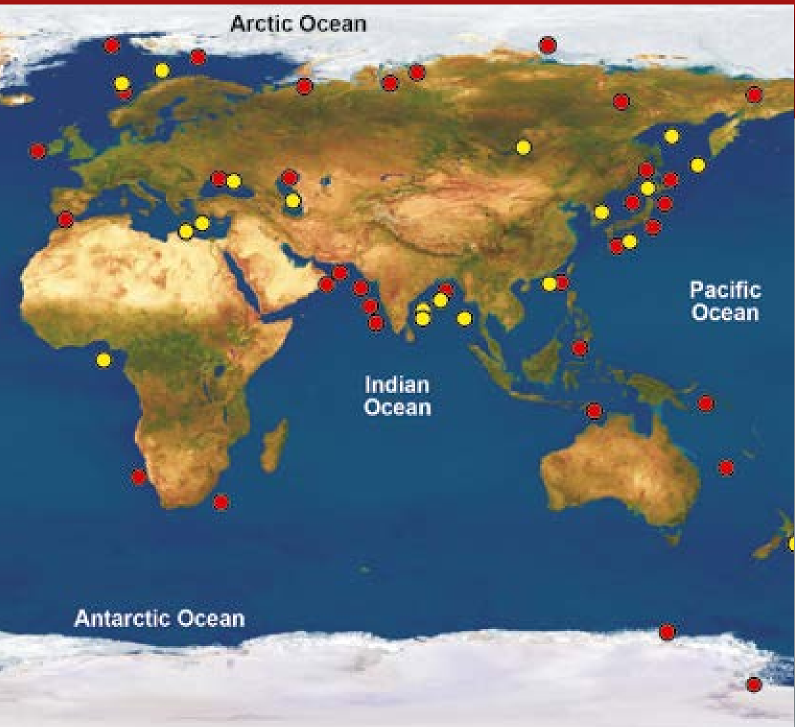


Illustration: MEYER WERFT

ICE TANKER. For the SUGAR project MEYER WERFT designed a vessel specifically for carrying methane hydrate pellets.



Source: Council of Canadian Academies (2008). Energy from Gas Hydrates: Assessing the Opportunities and Challenges for Canada, 2008.

RESERVES. Distribution of known methane hydrate accumulations.

connected to a custom-designed cargo handling system for loading and unloading the hydrate pellets.

Risk Analysis

The NGH carrier represents a new concept for the transport of methane, and there are currently no specific design and construction rules for such a vessel.

The risk analysis followed the process shown in Figure 1, with the hazard identification (HazId, step 1) and the quantitative risk analysis (step 2) as core steps. The risk assessment can be done either by referencing an explicit acceptance criterion (a value) or by comparing the analysis results with a reference design that complies with existing rules, or by taking the risk ALARP (As Low As Reasonably Practicable) approach. This would involve systematic identification and evaluation of all cost-related risk mitigating measures, applying cost criteria specified by the regulator (step 4).

In the SUGAR project, Germanischer Lloyd was tasked with supporting and assessing the ship development under risk aspects. A comparative analysis method was chosen using existing gas transport technologies by ship as a reference, focusing on step 1 and step 2 of the process shown in Fig. 1.

Hazard Identification

In step 1, risk analyses for comparable ship types were investigated, i.e. LNG carriers and crude oil tankers. Based on the formal safety assessments (FSAs) for LNG carriers (FSA, 2007) and crude oil tankers (FSA, 2008), the accident categories "collision" and "grounding" were recognised as being relevant for evaluation of the innovative NGH transport concept. The HazId was carried out applying the well-established failure modes, effects and criticality analysis (FMECA) method.

For the purpose of ranking the identified hazards, the probability of occurrence and the severity of the consequences were estimated using index tables. The frequency index (FI) and severity index (SI) tables are based on logarithmic scaled graduation for incident frequency and consequences. The hazards were ranked according to the risk index (RI), which is the summation of FI and SI. ▶

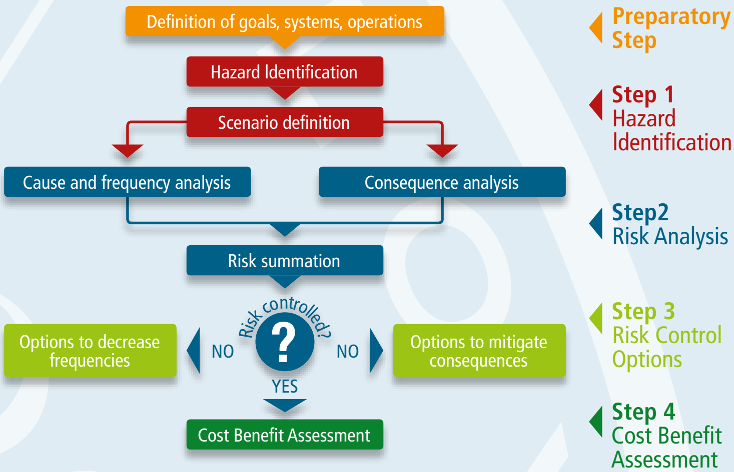


FIGURE 1. Steps of a risk analysis.

Photo: Suzanne Weedman/USGS

Table 1: Frequency index table

FI	Frequency	Definition	F (per ship year)
7	Frequent	Likely to occur once per month on one ship	10
5	Reasonably probable	Likely to occur once per year in a fleet of 10 ships / a few times during the ship's life	0.1
3	Remote	Likely to occur once per year in a fleet of 1,000 ships / in the total life of several similar ships	10^{-3}
1	Extremely remote	Likely to occur once in the lifetime (20 years) of a world fleet of 5,000 ships	10^{-5}

▶ The FI (Table 1) and the SI (Table 2) tables for human safety were taken from the IMO FSA Guidelines (2007).

Since no SI tables for the release of greenhouse gases have been incorporated into the FSA Guidelines nor any other guidelines, a new table was developed for these analyses (Table 3). Similar to the IMO FSA Guideline, this table uses logarithmic scaled graduation for incident consequences. It includes CH_4 quantities far greater than the capacity of the analysed NGH carrier so as to allow assessing larger pellet carriers as well as LNG carriers. The CH_4 emission levels also account for other emission sources accepted by the society.

FMECA sessions were performed to investigate the sailing, loading and unloading scenarios. Experts in the fields of naval architecture, basic methane hydrate properties, ship machinery, gas tanker design and use of gas as a ship fuel were recruited for these sessions.

Following a review by the participants, the final RIs were calculated from the FI and SI. The highest risk indices for human safety were identified in the "collision" accident category, whereas the highest risk indices for environmental safety were found to result either from leakage caused by equipment failure (safety valves) or from failing insulation, cooling plants or machinery causing the tank pressure to increase due to accumulating boil-off gas.

Risk Model

Based on the identified hazards and a review of existing risk analyses for LNG and crude oil tankers, a risk model was de-

Stability – a Rare Gift of Nature

Methane hydrate is characterised by a very slow dissociation rate at relatively mild conditions far out of the stability field. This so-called "self-preservation effect", occurring at temperatures slightly below the freezing point of water, is a kinetic anomaly in which thermodynamically unstable hydrates dissociate at rates several orders of magnitude slower than what should be expected. Experimental studies, focused mostly at ambient pressure localise the anomaly in a temperature window between 0 °C and approx. –33 °C.

Studies suggest that gas hydrate transport technology may be economically more feasible than other forms of transporting natural gas, especially under the boundary conditions of small production capacities (stranded gas) and short to medium transportation distances. Since offshore gas hydrate reservoirs are expected to fall into this category, efforts continue to develop an appropriate transport technology.

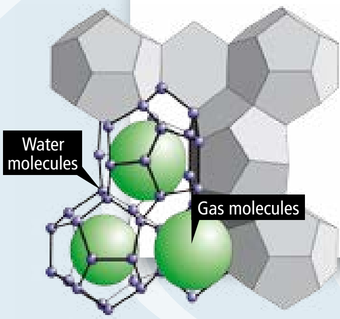


Illustration: Jens Greinert/GEOMAR

STRUCTURE. When conditions are right, water molecules will form cage-like structures encasing methane molecules.

Table 2: Severity index for human safety

SI	Severity	Definition	S (Equivalent fatalities)
1	Minor	Single or minor injuries	0.01
2	Significant	Multiple or severe injuries	0.1
3	Severe	Single severe fatality injuries or multiple	1
4	Catastrophic	Multiple fatalities	10

Table 3: Severity index for CH_4 release

SI	Severity	CH_4 released (tonnes)	Remark
1	Negligible	10	This amount of CH_4 is equivalent to the natural release of 100 cattle per year
2	Significant	100	Capacity of one tank of current design (option 2)
3	Severe	1,000	About 50% of total capacity of current design concept
4	Catastrophic	10,000	CH_4 emissions in Germany in 2009 from traffic = 7,000 t
5	Disastrous	100,000	CH_4 emissions in Germany in 2009 in the field of energy production = 76,000 t

veloped for the accident categories Collision, Grounding and Accidental Release of Methane. So-called high-level event sequences were developed for these accident categories, shown in Figures 2 and 3 for grounding and collision, respectively. The quantitative risk model for the three accident categories was developed in the form of event trees accounting for damage to the crew and the environment.

In the absence of input data suitable for the risk model, the study used data provided by the FSAs for LNG carriers and crude oil tankers, updated where possible by the latest available data for these ship types.

Grounding

The grounding scenario relies on loading condition and sea area data taken from the tanker FSA, according to which 80 per cent of grounding events occur with the ship in loaded condition; 9 per cent of them on the open sea, 42 per cent in coastal waters, and 49 per cent in limited waters. Damage severity increases with ship speed; according to the tanker FSA, 83 per cent of grounding incidents happen with the ship under propulsion power.

For the NGH carrier a potential loss of life (PLL) of 1.0×10^{-4} was calculated, while the FSA for LNG tankers states a PLL of 2.9×10^{-3} in case of grounding (approximately a factor of 30). Here again the probability of fatalities due to fire is a major concern for LNG tankers only. The potential loss of cargo (PLC) for the NGH carrier is 2.6×10^{-2} tonnes per ship year for design option 1, and 2.3×10^{-2} tonnes per ship year for design option 2, which compares favourably with the FSA-based reference PLC of 4.1 tonnes/ship year, and the Yanagi et al. study's 13.6 tonnes per ship year.

Collision

For the collision accident category, the frequency of collision accidents as well as the distribution for struck vs striking ship, the operational state (sea area) and the loading conditions (ship loaded or in ballast) were determined using data from the IHS Fairplay database as well as results of FSAs for LNG carriers and crude oil tankers. The frequency of collision was assumed to be 1.6×10^{-3}. The distinction between the striking ship and the struck ship is necessary because damage ▶

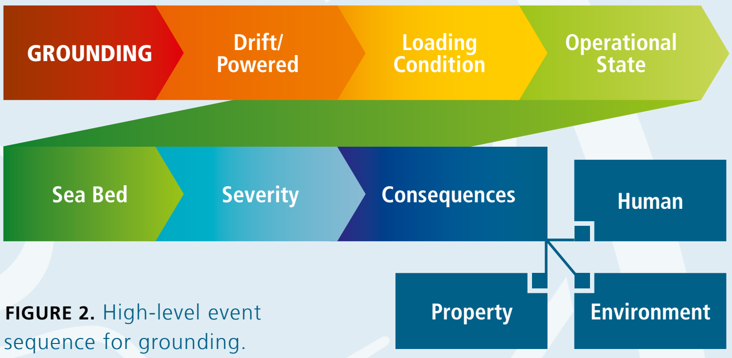


FIGURE 2. High-level event sequence for grounding.

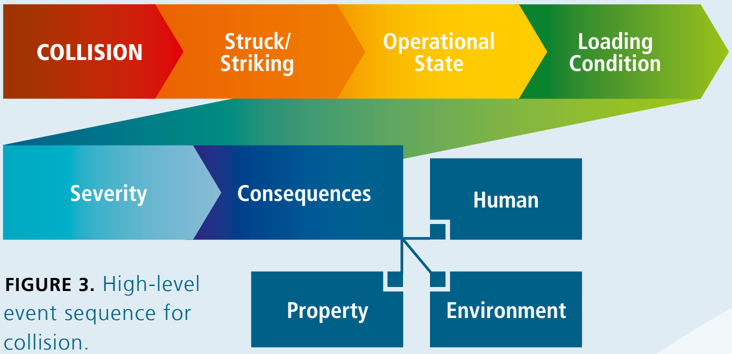


FIGURE 3. High-level event sequence for collision.

Photo: Hasenpusch

RISK. Ship collisions are a major concern for gas transport.

▶ to the striking ship is often located in the bow section where no cargo is stored. In accordance with the tanker FSA it was assumed that in 80 per cent of incidents the NGH carrier will be the struck ship.

Damage to the struck ship can be located anywhere; probabilities for the location and depth of penetration were estimated using the relevant part of the oil outflow model of MARPOL (2010): In 46 per cent of collisions the hull of the carrier will be penetrated, and in 64 per cent of these cases penetration occurs below the waterline. In about 14 per cent/21 per cent (design option 1/design option 2) of all collisions with hull penetration, one cargo tank will be penetrated as well.

It was assumed that the ship will sink in 4 per cent of all collisions with hull penetration below the waterline, and in 8 per cent of all collisions with both hull and tank penetration below the waterline. In a conservative estimate it was assumed that 50 per cent of the crew will die in case of sinking. The operational state describes the sea area where the collision takes place, which correlates with the availability of rescue teams and the number of persons involved in an accident. The following distribution of collisions was taken from the tanker FSA:

- Open sea: 26 per cent
- Coastal waters (<12 nm off); 7 per cent
- Confined waters (port/river/canal): 67 per cent

The loading condition data was taken from the FSA for crude oil tankers; statistics show that 69 per cent of all collisions of this ship type occur with the ship carrying load. The risk model provided a basis for calculating characteristic risk values for human safety, expressed in terms of PLL, and environmental safety, expressed in terms of PLC. The PLL result for collisions was 2×10^{-4} per ship year, equivalent to two fatalities in ten years in a fleet of 1,000 ships. By comparison, the FSA for LNG carriers indicates a PLL of 4×10^{-3}, a value 20 times that of the NGH carrier. The main reason for this large difference is the behaviour of the cargo in a collision. In the case of an LNG carrier, a collision penetrating the cargo hold not only involves the risk of sinking but also the possibility of a large pool fire endangering the crew's lives.

The methane on board a NGH carrier is not pressurised but captured in an ice-like molecular cage structure, decomposing in a highly endothermic process. A fire, if any, is likely limited to the cargo space. Furthermore, the low temperature of LNG (–161 °C) can cause cryogenic damage to the ship's hull, increasing the probability of structural damage and sinking. On a methane ice pellet carrier the cargo temperature of –20 °C does not present a threat to the hull material.

The PLC for the NGH carrier in a collision was calculated at 1.7×10^{-1} tonnes per ship year for both design options. For reference purposes, Germanischer Lloyd determined a PLC of 8.5 tonnes per ship year for LNG tankers using data from the relevant FSA, while a study by Yanagi et al. whad calculated a PLC of 19.7 tonnes per ship year. The large discrepancy results from the difference in cargo capacity between the investigated ships: while the pellet carrier can transport approximately 1,800 tonnes of CH_4, the GL FSA assumed a medium-sized LNG carrier with a capacity of 130,000 cubic metres (equivalent to 54,400 tonnes of CH_4), and the large LNG carrier analysed by Yanagi et al. had a cargo capacity of 266,000 m³ (113,000 tonnes of CH_4).

Leakage

This category investigates cargo leakage not caused by collision or grounding. The following possible failures were identified in the Hazard Identification step:

- Leaking connection between the cargo transfer device and ship
- Malfunctioning safety valves
- Damage in the ship's internal cargo piping system
- Leakage of cargo tanks

Contributing factors included the location of the damage, which strongly influences the probability of leakage detection (alarm), and the separation of the defective device from the rest of the cargo system.Failure frequencies were estimated by the experts in the FMECA sessions. For the risk model developed, a PLL of 7.6×10^{-5} was set for both design options, along with a PLC of 2.7 tonnes per ship year for option 1 and of 1.5 tonnes per ship year for option 2. Since most of the failures in this category affect only one tank, design option 2 turned out to be more advantageous because of its smaller cargo capacity per tank (119 tonnes vs 223 tonnes). There are no reference values for LNG carriers available in this category.

Conclusion

At first glance the NGH carrier appears to be less at risk of potential loss of cargo. But while an average LNG ship can carry about 50,000 tonnes, it would take 25 pellet carriers, each carrying 2,000 tonnes of CH_4, to move the same amount of gas; the risk increases accordingly.

However, the risk assessment for the sea transport of gas hydrate pellets did not reveal any unacceptably high risks for the technology. The risk level is in the same range as for LNG carriers, and any differences resulting from ship size could be reduced by further optimising the NGH carrier design. Generally the NGH carrier features a reduced fire risk compared to LNG. An economic comparison of both transport options (hydrate vs LNG) was not the subject of this part of the project. ■

GEOMAR. The Helmholtz Centre for Ocean Research in Kiel, Germany, was project coordinator of the SUGAR project.

SUGAR – Mining for Submarine Methane

From 2008 to 2011, a consortium of 30 universities and companies joined for the Submarine Gas Hydrate Resources project to explore ways of harvesting natural gas hydrate from the bottom of the sea. These were the objectives:

- Develop hydroacoustic, seismic, electromagnetic and autoclave drilling methods to locate and quantify hydrate deposits
- Conduct laboratory experiments and build simulation models to investigate ways of producing natural gas from methane hydrates
- Develop new technologies for production and transport of methane hydrate pellets.

The "Transport" subproject researched technologies to develop a competitive transport technology for this new energy source.

Photo: GEOMAR

An Innovative Family

In an interview with *nonstop*, Hans M. Schaedla, CEO of Abeking & Rasmussen, talks about innovative concepts, versatile staff and demanding customers

NONSTOP: Abeking & Rasmussen has been building ships for a hundred years – and sees no sign of the shipyard crisis. What is the secret behind your success?

HANS M. SCHAEDLA: From the very beginning, Abeking & Rasmussen faced the developments and demands of the market head on. We always looked to the future. My father initiated the transformation from a small boatbuilding firm to a full-blown shipyard at an early stage, and so our products have always been very innovative. Up to the present day, a key element for success has been that we have not relied only on a single line of products, but have been supported by a stable tripod of business segments: industry, navy and yachts. This diversification strategy has continued to lend us strength, and permits a continuous utilisation of the yard's production capacity. This in turn gives us greater room to manoeuvre, even in a difficult market environment, and also makes us more flexible in our thinking. But the customer always has the last word in deciding what is really innovative and what is not.

NONSTOP: How does this work in practice?

SCHAEDLA: There are two possibilities: either the client comes to us with his own project to be built, or we develop our own line, which we then market ourselves. In the process, it is important to consider where the markets are moving and what strategy is the best for our own company. To cover this aspect, we have project teams which also work innovatively and independently of the day-to-day activities, in order to think about new avenues of business. There are many areas outside of shipping in which shipyard competence is needed – for example, in the offshore segment or in marine research.

NONSTOP: Your father headed the yard for 50 years. Could there be any alternative to Abeking & Rasmussen for you?

SCHAEDLA: I am a shipbuilder and, naturally, had the good fortune to grow up here on the yard. My path was already marked out for me. After finishing school, I spent two years at the Bremer Vulkan yard. During my period of study here

EXCELLENCE V. With a length of 60 m and a beam of 12.80 m, this yacht offers the latest technology and highest level of comfort.

YARD CEO. Hans M. Schaedla learnt the trade from scratch and has been at the yard for 25 years. He took over the management of Abeking & Rasmussen from his father.

Photos: Abeking & Rasmussen

in Bremen at the University of Applied Sciences, I passed through all sections of A & R as an intern, obtaining my degree in naval architecture. But the most important step for me was going to the USA for three years after completing my studies.

NONSTOP: Yacht building is very strong in the USA. Were you able to learn much from the American engineers?

SCHAEDLA: The projects we worked on there were certainly very interesting. But the engineering is different. In Germany, for instance, you have safety regulations that are universally applicable. That is not the case in the States. What is more, the identification of the workforce with their company is not particularly high. Frequent job-hopping leads to frictional losses in the team.

NONSTOP: Is it really different in Germany?

SCHAEDLA: At least it is different at Abeking & Rasmussen. In fact, our philosophy is that every single employee has an important role to play in the success of the company. There is a bond of trust between the workforce and management. We cultivate an open and fair relationship, and bank on continuity. Like me, some of our staff have been here their entire lives. Apprentice, journeyman, master artisan – all those years forge a tight bond. And many are already working here in the second or third generation.

NONSTOP: How versatile are your staff members?

SCHAEDLA: Our designers and sales staff, above all, should have a firm knowledge of the three core segments of industry, yacht building and navy, and should be able to work there without first having to adapt. This is already a fundamental requirement for our innovative hull concept SWATH, which is being applied successfully to various ship types.

NONSTOP: SWATH is indeed very innovative. It is probably viewed sceptically by many prospective customers.

SCHAEDLA: That is certainly true; our more conservative ▸

> *We have a very good utilisation of yard capacity – thanks especially to the yachts.*

OPTIMIST. Hans M. Schaedla, CEO of Abeking & Rasmussen.

▶ clients have to be won over to the idea through positive experience. After a trial trip, they are usually very interested in taking their project in our direction. SWATH is based on an idea that had already been tried out many years ago on Hawaii, but it failed there in the end because of poor execution. Our technical manager resurrected the concept again as a development project.

NONSTOP: Who was the first customer for this new ship type?

SCHAEDLA: The first SWATH went to the Elbe River Pilots in 1999. From the Elbe, this system spread out along the North Sea coast over the Netherlands right through to Belgium. Orders from Dutch and Belgian customers followed. In addition, the German navy had also taken this ship type under consideration as a minehunting platform. A & R then made the ship available to the Navy for trials lasting a year. We ourselves implemented a research vessel with this hull configuration, together with five patrol boats for the Latvian naval forces.

NONSTOP: How high is the cost advantage of a SWATH in relation to a ship with a classic hull shape?

SCHAEDLA: Admittedly, the capital outlay is higher than for a comparable monohull. The added value results from the extended range of possibilities offered by the ship’s independence of wind and weather. And that is a hard-hitting sales pitch.

Photos: Abeking & Rasmussen

“CECIS“. SWATH@A&R patrol boat for the Latvian navy.

NONSTOP: What does the yard’s workload look like?

SCHAEDLA: We have a very good utilization of capacity – thanks especially to the yachts. Over the past five years, this division made up 70 per cent of our total business. The largest market, with a share of 35 per cent, is the USA. About 25 per cent of our customers come from Eastern Europe and the remainder from the Arabian-speaking countries. The demand from Central Europe is very low.

NONSTOP: What do you think of the Chinese market?

SCHAEDLA: China is not yet playing a role in the yacht market. Small boats may do well there if they are available right away. Wealthy Chinese are very impatient; they do not want to wait three years for the goods. But, in the long term, the market is definitely of interest. We will continue to watch it closely.

NONSTOP: How is your sales team organised?

SCHAEDLA: Centrally from Germany. In the USA, we found that the customer prefers to speak directly to us, as the people in charge, instead of with a sales representative. This approach works quite well and, during a face-to-face meeting, we can find out right away whether the project is suitable for us at all or whether we can make some other interesting offers.

NONSTOP: You actually turn down orders?

SCHAEDLA: It does happen. After all, we have to keep an eye on our future. This also means not biting off more than we can chew. Apart from that, we also want to take each of our projects further in its development.

NONSTOP: What are the challenges of yacht building?

SCHAEDLA: The spotlight is firstly on design and quality. The first impression always counts the most. But the air conditioning, electrical system and – very important because of piracy – the security arrangements on board must also be considered. Cruising speed plays less of a role; more emphasis is placed on optimum use of available space. An important aspect during the course of a project is maintaining close contact to the client. We like to visit them at home, to get a picture of how they live. This is vital for matters of design, for example with the interior furnishings and fittings of a yacht. Of course, every customer has his own ideas and frequently chooses his own designer, with whom we then work closely.

NONSTOP: What does this cooperation look like? The designer does the interior and you build the ship?

SCHAEDLA: Naturally, the yard is responsible for all the aspects of shipbuilding and engineering – gearbox, speed, stability, ventilation and so on. In terms of the "look", the designer may lay down certain lines, which we then use in our technical design drawing. On this basis, the designer can then go wild with the layout. In the end, we have to make sure that the ship will still float and that there are enough ventilation ducts. This is what we coordinate with the designer.

NONSTOP: The yacht business is characterised by private customers. In your other segments, you have to deal with government authorities. What public-sector order from overseas makes you particularly proud?

SCHAEDLA: There was a big project for Turkey, which we handled in cooperation with a Turkish yard. The prototype was built here and the remaining units of the fleet were constructed in Turkey. We sent entire packages of material which were then assembled on site. Everything ran smoothly, even though the project took over eight years and diverse decision-making levels were involved. It was one of the largest contracts we were ever given.

NONSTOP: And what do you enjoy most in your work?

SCHAEDLA: The teamwork with so many different people, the coordination and the distribution of work that is needed to get everything moving ahead properly – all that is what gives me great satisfaction.

NONSTOP: Do you still remember the last ship you handled as a project manager?

SCHAEDLA: It was the "Hetairos", a 40-metre ketch made of mahogany. That was a very good job, but that was all of 20 years ago. ■ **OM**

Abeking & Rasmussen

The yacht- and boatbuilding firm Abeking & Rasmussen was founded in 1907 in Lemwerder. Today, there are five production halls for ships up to 90 metres in length.

The yard facilities include an inner basin, a syncrolift and environment-friendly workshops in which steel, wood, aluminium and non-magnetisable steel can be processed. The yard enjoys an excellent reputation in the industry for its first-class design and superior craftsmanship.

"WANDELAAR". The station ship is classed by GL.

Managing Ballast Water Concerns

Ballast water management is a challenge for both ship designers and operators. CFD offers solutions for design, type approval and troubleshooting

REGULATION. *The IMO convention for ballast water management will come into effect twelve months after it has been ratified by at least 30 states representing 35 per cent of the world's merchant shipping tonnage.*

Computational fluid dynamics (CFD) is used to solve equations that describe the physics of moving fluids. While the use of CFD is well-accepted practice in the maritime industry, it is usually associated with flows around the hull and propellers. However, CFD offers many other advantages that make it far superior to classical model testing. The same CFD software can be applied to a variety of flows, including flow-related issues inside ship cavities.

A key benefit of CFD is the way it provides insight into flow details. Flow quantities are computed and stored for many discrete locations in space, so-called computational cells, and for many time increments, allowing the design engineer to look at arbitrary cross-sections and zoom in and out at will when post-processing the data.

With new IMO ballast water management regulations impending to curb the spread of invasive species, ballast water management systems have moved into the spotlight for ship operators. But apart from the implementation requirements and the capital cost aspects involved, there are certain physical challenges associated with ballast water handling that can be addressed using CFD simulation. The following case studies may illustrate some of these issues and highlight solutions derived from industry experience.

Case Study 1: CFD-Based Type Approval

Ships discharging ballast water often introduce plants and animals from far-away sea regions into new environments,

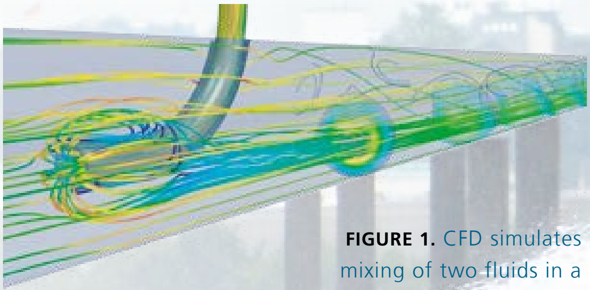
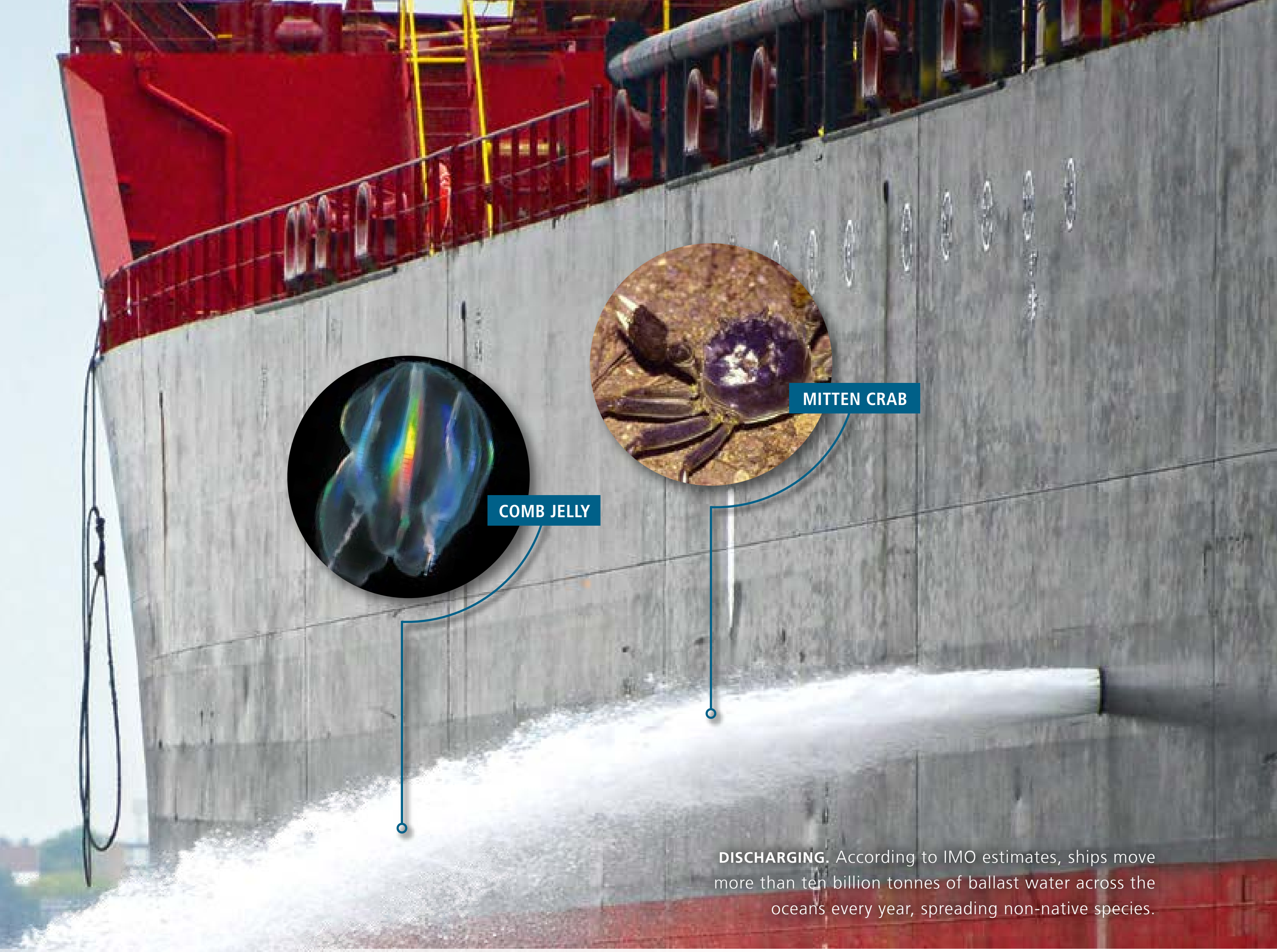


FIGURE 1. CFD simulates mixing of two fluids in a pipe for type approval.



DISCHARGING. According to IMO estimates, ships move more than ten billion tonnes of ballast water across the oceans every year, spreading non-native species.

Photos: Christian Fischer, Hasenpusch, NOAA/Kevin Raskoff, USGS

where they become a threat to the indigenous aquatic environment. Increasing ship traffic has intensified this threat considerably. The IMO's "International Convention for the Control and Management of Ships' Ballast Water and Sediments" requires a ballast water treatment system and management plan on board every vessel in international traffic as of 2016.

Chemical ballast water treatment systems require rapid and effective mixing of the biocide with the ballast water to ensure homogeneous concentration. Simulation can be a valuable tool in type approval of such systems. In one particular case, FutureShip simulated the mixing of chlorine and ballast water in pipes during the ballasting operation. CFD simulations showed that the initial design failed to achieve efficient mixing. By implementing some simple, cost-effective modifications to the inlet geometry, FutureShip was able to increase the turbulence level significantly, thereby cutting the pipe length required for thorough mixing. Figure 1 shows computed streamlines and chlorine concentration in the mixing pipe resulting from one such simulation. The authorities accepted the simulations as engineering proof for type approval.

Case Study 2: Ballast Water Sediments

Sediments collecting on the bottom of ballast water tanks compromise the payload, delay de-ballasting by restricting water flow, and increase the ship's draft and fuel consumption. The owner of a Capesize bulk carrier who wanted to reduce sediment accumulation tasked FutureShip with detailed analyses, requesting suggestions for re-design to minimise sediment settling in the ballast tanks.

In this case, rather than modelling the actual sediments, FutureShip began with some basic assumptions: Sediments settle in regions of low water speed found typically in ▶

▹ areas of recirculation and flow stagnation, which are commonly referred to as dead-water regions. Figure 2 shows sediments in an actual ballast water tank. In the next step, two-phase, water-and-air flow simulations were run to identify dead-water areas corresponding to the observed sediment accumulation in the original design. Figure 3 shows the computed velocity distribution near the bottom wall. Based on these studies, FutureShip developed various design alternatives for the ballast water tanks to explore variations of stiffener spacing and cut-outs. Additional simulations then identified the design variant with the least amount of sediment settling, i.e. the smallest dead-water regions, for implementation in future bulk carrier orders.

FIGURE 2. Sediments accumulate in ballast water tanks in areas with flow stagnation.

Case study 3: Ballast Water De-Ballasting

A busy coal terminal in Latin America had given a bulk carrier strict time limits for de-ballasting at quay. The ballast pump was taking in air during de-ballasting, forcing the crew to stop de-ballasting intermittently. The vessel, unable to comply with the imposed time limit, had to leave port with 3,000 tonnes of ballast water still in the tanks. As a consequence, 2,600 tonnes of cargo could not be loaded, resulting in damage claims of 125,000 euros and the vessel being blacklisted by the terminal.

A detailed analysis is usually the first step in troubleshooting. Once the problem has become transparent, the solution is often straightforward. In this case, the first step was to simulate the de-ballasting process, setting up a three-dimensional model of the ballast water tanks and mimicking the pump by assuming a prescribed flow rate at the outlet of the suction pipe. The outflux was set to the maximum pump capacity. The simulation of the two-phase flow during de-ballasting revealed that the water level in neighbouring fields was much higher than in the field with the ballast pump intake.

Figure 4 shows the uneven water levels in various tank sections. The size of the water-flow openings in the longitudinal frames was too small for the de-ballasting rate of the pumps. The simulation provides information about the time-dependent flow rate through each opening, predicting the

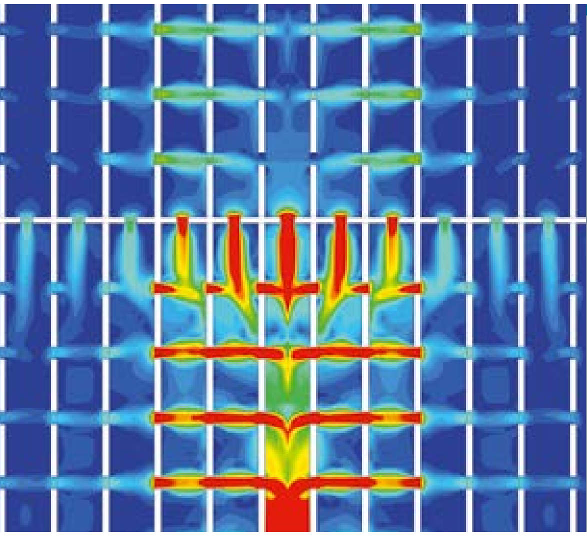


FIGURE 3. CFD simulation of velocity distribution in ballast water tanks, close to bottom wall.

CFD: The Maths Behind It

In these case studies, the simulation employed CD-adapco's CFD software STAR-CCM+, an application capable of simulating turbulent flow with resulting eddy formation and turbulent mixing, as well as multiple fluids with resolved liquid/gas interfaces. The application captures all relevant physics for the analysis of ballast water flows as described above.

The solution method is based on conservation equations in integral form with appropriate initial and boundary conditions. The solution domain is subdivided into a finite number of control volumes which can be of an arbitrary polyhedral shape and are typically locally refined in regions of rapid variation of flow variables. The time interval of interest is also subdi-

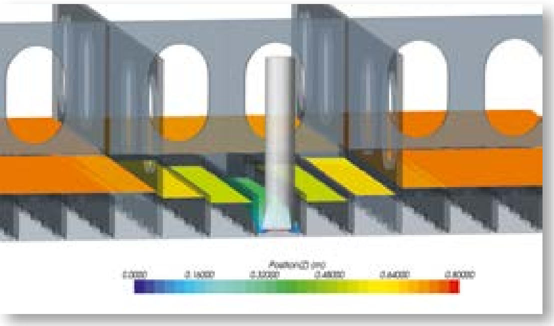


FIGURE 4. De-ballasting simulation reveals uneven water levels due to the insufficient size of the cut-outs (pump intake section is almost depleted).

Photo: Hasenpusch

TRIM. Ballast water is an essential means of ensuring safety at sea, especially when ships are only partially loaded or light.

time at which air begins to be sucked in by the pump. The animation of free surface motion and velocity distribution in various cross-sections gives engineers direct insight into the physics of the flow, allowing easy assessment of the problem. The necessary geometric modifications can then be accomplished with ease.

Based on the analysis of simulation data, more and larger water passages in frame members in the vicinity of the pump were suggested to synchronise the flow through these openings with the pump intake rate. The size and locations of the openings were then modified to keep the inflow toward the pump above the pump rate, thereby avoiding the risk of the pump taking air.

CFD simulations have proven to be a versatile and powerful tool to support design and operation of ballast water management systems. Advanced computational software in the hands of expert users will yield detailed insight and reliable answers. ■ **TZ/JK/MP**

FOR FURTHER INFORMATION:

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vided into time increments of appropriate size. The governing equations contain surface and volume integrals as well as time and space derivatives. These are approximated for each control volume and time level using suitable finite approximations, leading to an algebraic equation system which can be solved efficiently on a multiprocessor computer.

The flow is assumed to be governed by the Reynolds-averaged Navier-Stokes equations. Turbulence effects can be accounted for by a variety of models, from simple eddy-viscosity-type models to Reynolds-stress models. Thus the continuity equation, momentum equation and up to seven equations for turbulence properties are solved. Large-eddy simulations, which model only the small-scale turbulence and resolve large-scale eddies, are also possible.

Multi-phase, multi-component systems (e.g. water/air or water/chlorine) can also be simulated. The spatial distribution of the phases (liquid and gas) is obtained by solving an additional transport equation for the volume fraction of each additional phase. To accurately simulate the convective transport of immiscible fluids, the discretisation must be nearly free of numerical diffusion. For this purpose a special high-resolution interface-capturing scheme is used, providing sharp resolution of free surfaces and allowing flow simulation with gas bubbles trapped in liquid or liquid blobs in gas.

Reducing Your Carbon Footprint

A certified carbon footprint is by no means an attestation of environmental idealism. It contributes significantly to a company's public and financial appeal

Sustainability has entered the main stream. There is a general trend across all industries towards seeking competitive advantage by adopting a green business agenda. An improved "carbon footprint" is one of the key ingredients of a corporate annual sustainability report, as it provides a quantified value for a company's environmental impact on for example climate change. Especially in highly competitive markets, this indicator is today an important differentiator.

The organisational carbon footprint reflects the total amount of greenhouse gases (GHG) emitted by an organisation, measured in tonnes of CO_2 equivalents as an absolute and relative value (e.g. per dwt, per product or per site square foot). To support carbon reduction initiatives, GL Systems Certification is introducing a new service line based on the ISO 14064 standard, which specifies the principles and requirements for quantification and reporting of greenhouse gas emissions.

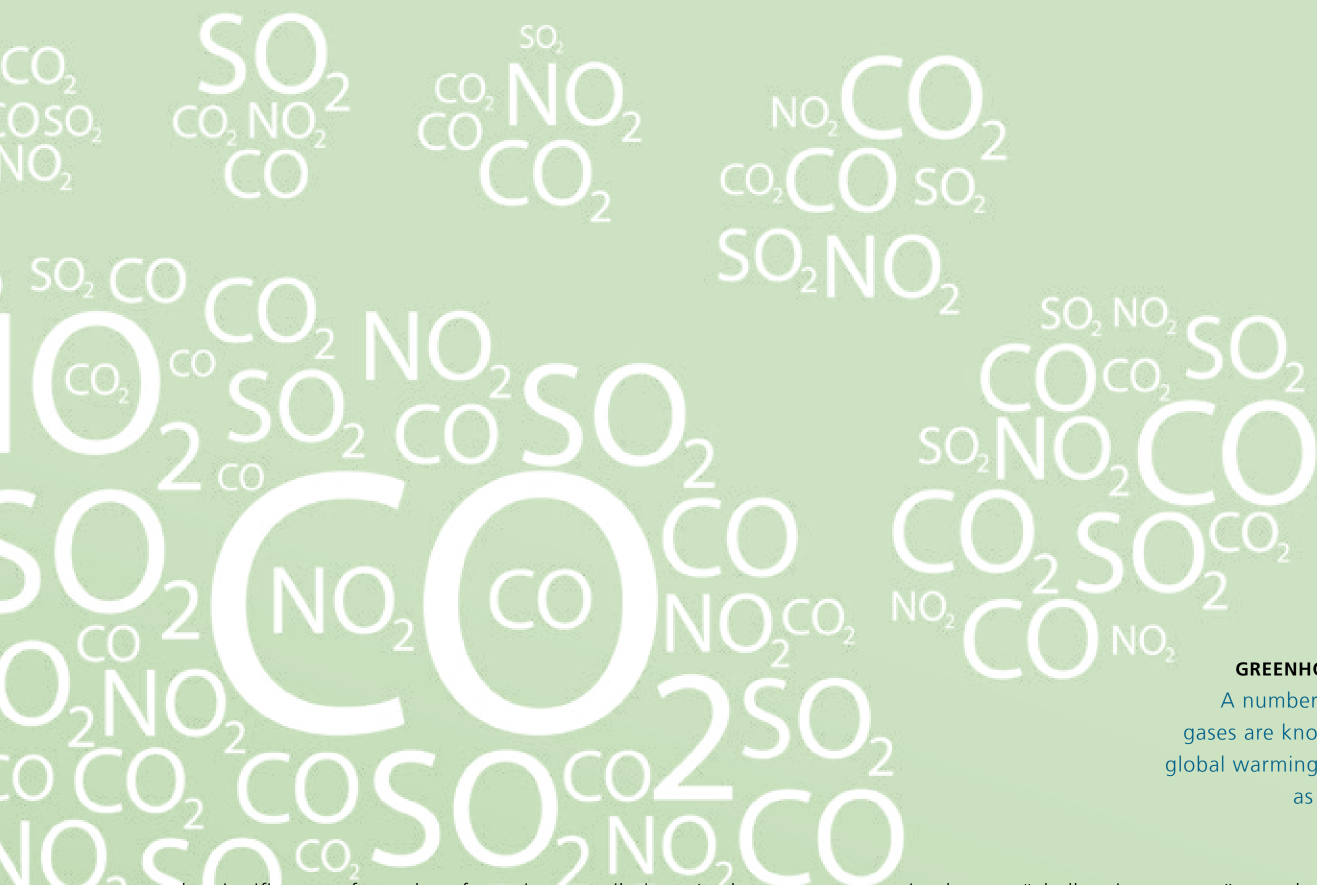
There are several reasons for organisations to invest in carbon measurement/management and reduction. These include investor transparency, client green goals, potential governmental and cost reduction pressure. A global survey conducted by the Harvard Business School in 2011 shows the increasing interest of investors in the greenhouse gas balance of a company. Respondents showed that most participating investors view climate change issues as a material investment risk/opportunity across their organisation's entire investment portfolio.

The fact that high-profile companies such as Wal-Mart and Apple have made attempts to not only reduce their own environmental impact, but those of their suppliers, shows

0.8 °C

APPROXIMATE AMOUNT OF GLOBAL WARMING OVER THE LAST 130 YEARS

Illustrations: Cobiestacio | Dreamstime.com



GREENHOUSE GASES. A number of different gases are known to cause global warming. CO_2 serves as a reference.

the significance of a carbon footprint compilation. In the UK, telecommunications giant BT has recently introduced a scheme to encourage their vendors to reduce carbon emissions during the production, delivery, use, and disposal of products and services supplied to BT.

The new scheme has three expectations that vendors must adhere to. Initially, each vendor has to demonstrate that it has implemented a policy to address the challenge of climate change. Secondly, vendors should be actively measuring and reporting their carbon footprint. Lastly, a vendor must implement "challenging targets" to reduce emissions and report on the progress.

"A well -designed organisational carbon footprint inventory that delivers credible, transparent key performance indicators will attract investor capital without revealing sensitive information," says Geraldine Findlay, Carbon Product Manager, GL Systems Certification. Furthermore, she adds, "carbon footprinting helps businesses by pinpointing the right areas for investment and hotspots where reductions in carbon and costs can be made. This can also include the ▸

Organisational Carbon Footprint Seven Stages of Analysis

Stage 1 Establish organisational boundaries

Stage 2 Establish operational boundaries

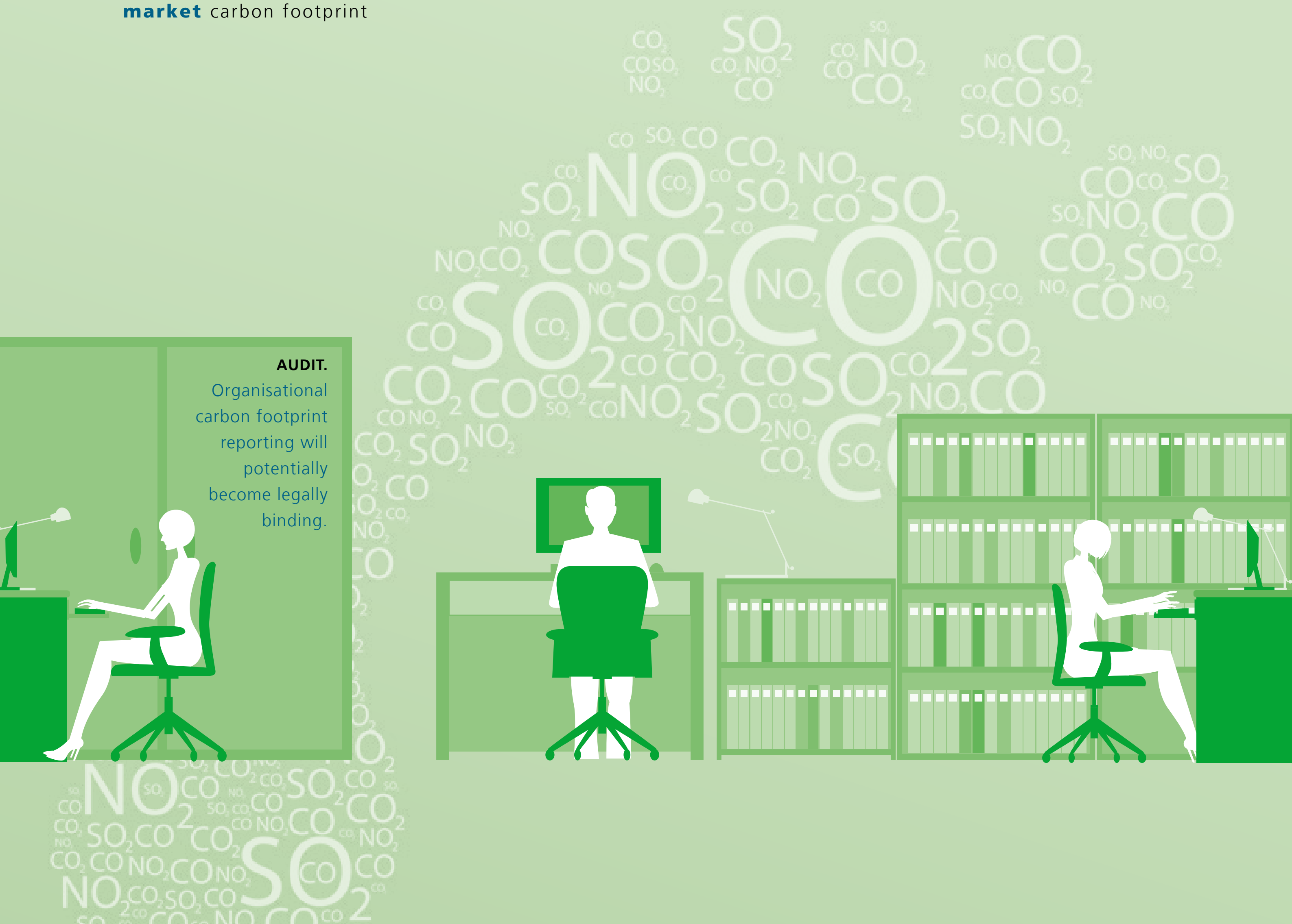
Stage 3 Identify GHG sources (and sinks) for the chosen scopes

Stage 4 Define quantification methodologies

Stage 5 Determine corporate carbon footprint

Stage 6 Third-party verification of carbon footprint

Stage 7 Report carbon footprint



AUDIT. Organisational carbon footprint reporting will potentially become legally binding.

GLAC SEMINARS. *Carbon footprint training and seminars can be booked online through the GL Academy. In addition, GL hosts a new type of conference called "Green Wednesday", where business professionals from different industries meet to share knowledge on green subjects such as CSR and the green supply chain. The next event, set for 7 August 2013, is now open for speaker and participant registration.* ***E-Mail: glc-scs@gl-group.com***

entire supply chain." With environmental awareness and climate change high on the agenda of many governments, it is likely that organisational carbon footprint reporting and other, similar environmental regulations and initiatives will potentially become legally binding in the future.

For example, in the United Kingdom in 2010 the UK government launched the Carbon Reduction Commitment (CRC). This is a mandatory reporting programme aimed at large non-energy-intensive companies to incentivise them to reduce their greenhouse gas emissions. In France, the "Grenelle II" requires companies with 500+ employees to calculate their GHG inventories according to modalities defined by a decree published in July 2011. The deadline for the first inventory was December 2012; inventories must be updated every three years.

Likewise, greenhouse gas regulations are being released by the financial sector. By April 2013, all companies listed on the London Stock Exchange will be required to submit annual sustainability reports including their carbon footprint in order to continue trading. It will be one of the first mainstream exchanges in the world to make reporting mandatory as part of the UN's Sustainable Stock Exchanges Initiative along with others from Johannesburg, Istanbul and Mumbai.

"It is highly advisable for organisations to introduce carbon monitoring and management systems sooner rather than later to avoid having to do so under pressure at a later time," Geraldine Findlay points out.

Getting a Head Start with GL

In addition to the organisational carbon analysis, GL's Carbon Footprint Service also includes seminars and training. The process of the carbon footprint inventory consists of five stages, with an optional 6th stage of "third-party verification" and a further optional 7th stage of "reporting carbon footprint" (see diagram).

First, the company defines the goals and boundaries of the GHG inventory (steps 1–2). Once this is complete the company experts collect the relevant data and with this compile the greenhouse gas inventory (steps 3–5). In stage 6 the audit is undertaken. During this stage, the GL auditors will conduct on-site interviews, evidence checks and recalculation of figures to ensure that the GHG inventory is consistent, robust and in line with the ISO standard.

If the company wants to assure prior to the audit that no material discrepancies are to be expected, it can ask the auditors of GL Systems Certification to do a pre-audit ("readiness review"), in which a first check of the most important parts of the inventory will be done. Another advantage of this is that it reduces the extent of the main audit.

If during the audit non-conformities are identified, they will be discussed with the client. Then, the audit report and final verification statement will be created. In this it will be stated if the GHG inventory of the company is in line with the ISO 14064 standard and is free of material misstatements. Once the verification is complete the company can publish its verified carbon footprint with confidence that it will stand up to public scrutiny.

"The carbon footprint helps to bring a different perspective to the business and strategic decisions," concludes Geraldine Findlay. "Investment that leads to lower emissions will enhance cost efficiency and competitive advantage. Avoiding this investment is tantamount to maintaining an unnecessarily high carbon output, which will ultimately drive up costs. Carbon accounting is going to be an integral part of every corporate balance sheet." ■ **GD**

93%

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GL Environmental Services

GL offers a range of sustainability and carbon services, many of which can be combined and built upon to increase corporate environmental awareness and introduce carbon management:

- Organisational carbon footprint
- Product carbon footprint and lifecycle assessment
- Windmade label verification
- Corporate social responsibility (CSR)
  - Clean development mechanism (CDM) and voluntary emission reduction schemes (GS, VCS)
- World commission on dams (WCD)
- Water footprint services
- Training courses

For more information on these and other environmental services please visit the GL Sustainability and Carbon Services website: www.gl-group.com > Maritime > Management Systems Certification > Sustainability and Carbon Services

INFO.

Direct link to GL's Sustainability and Carbon Services webpages.

FOR FURTHER INFORMATION:

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Photo: Dreamstime

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

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- One-column format for a better structure
- Improved readability for mobile devices
- Clearer orientation for users due to new header information, source reference and table of contents

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Dates at a Glance

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

June

11. – 14.06.2013
Brasil Offshore
Macaé, Brazil

18. – 20.06.2013
UDT – Undersea Defence Technology
Hamburg, Germany

18. – 21.06.2013
Offshore Support Vessels
Accra, Ghana

19. – 20.06.2013
UTC Underwater Technology Conference 2013
Bergen, Norway

19. – 21.06.2013
Offshore Wind China 2013 Conference & Exhibition
Shanghai, China

21.06.2013
Seatrade Asia Awards 2013
Hong Kong, China

24. – 27.06.2013
4th Annual Asia Green Shipping Conference
Singapore

25. – 27.06.2013
Seawork 2013 International – Commercial Marine Exhibition & Conference
Southampton, UK

August

06. – 08.08.2013
Navalshore
Rio de Janeiro, Brazil

September

03. – 04.09.2013
Donsö Shipping Meet
Donsö, Sweden

03. – 05.09.2013
Baltexpo
Gdańsk, Poland

10. – 12.09.2013
Marine Maintenance World Expo
Brussels, Belgium

11. – 12.09.2013
Gas Fuelled Ships
Stockholm, Sweden

19.09.2013
Brazil Offshore Finance Forum
Rio de Janeiro, Brazil

24. – 26.09.2013
World LNG Series: Asia Pacific Summit
Singapore

24. – 26.09.2013
International Conference on Computer Applications in Shipbuilding
Busan, South Korea

24. – 26.09.2013
Seatrade Europe – Cruise & River Cruise Convention
Hamburg, Germany

24. – 27.09.2013
Neva
St Petersburg, Russia

25. – 28.09.2013
Monaco Yacht Show
Monaco

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