

# MARITIME IMPACT

ISSUE 02-15

THE MAGAZINE  
FOR CUSTOMERS AND  
BUSINESS PARTNERS

TECHNOLOGY &amp; INNOVATION

## UNCOVERING THE POTENTIAL

### SMART APPROACH

Norway is showing the world that tomorrow's shipping industry will be eco-friendly

### LNG MILESTONE

New record: a ship depending entirely on LNG can refuel anywhere in the world

### INVISIBLE THREATS

DNV GL has developed strategies for strengthening maritime cybersecurity







## MARITIME

# PUT THE FUTURE OF YOUR FLEET IN SAFE HANDS

As your classification partner, our extensive maritime expertise, technical knowledge and regulatory foresight will help to ensure that your fleet meets the demands of the future. Our aim is safety, compliance and optimal operational performance throughout the lifetime of your

vessels, benefitting your business and the maritime industry as a whole. With DNV GL your fleet is in safe hands. Can you afford anything else?

[Learn more at \*\*dnvgl.com/maritime\*\*](https://dnvgl.com/maritime)



Tor E. Svensen  
CEO of DNV GL - Maritime

Dear Reader,

The Nor-Shipping trade fair in Norway, celebrating its 50th anniversary this June, is a technology roundtable and a perfect platform for sharing innovative concepts. As a thought leader, DNV GL supports the maritime industry in becoming greener, smarter and more efficient. This triad will be the theme of this issue.

In the quest for green propulsion concepts, the industry places great hopes in battery technology and LNG. The zero-emission concept of the world's first all-electric ferry *Ampere* has just received another award, and the recent journey of the *Kvitbjørn* showed that a ship depending entirely on LNG can refuel anywhere in the world if necessary. Norway's Green Coastal Shipping programme gives a prime example of a smart approach to energy-efficient maritime transport. A growing number of LNG-fuelled ships such as SeaRoad Shipping's new RoRo vessel for Australia demonstrate that this trend doesn't stop at national borders.

In a smarter maritime world, global networks and big data are transforming the way the industry works, helping shipowners and operators improve fleet performance, increase vessel safety and cut operating costs. DNV GL collects, analyses and interprets performance data to unlock its economic potential for customers. DNV GL solutions, such as the performance management portal ECO Insight and the fleet management system ShipManager, support our customers' ship performance monitoring initiatives, and our latest study on energy management underscores the great potential of performance monitoring.

DNV GL has developed strategies and specialized software to help curb hacker attacks and risks inherent in complex on-board networks. Maritime safety has always been at the heart of what DNV GL does. Our Emergency Response Service (ERS) has successfully steered shipping into safer waters. In the offshore segment, a new DNV GL advisory service addresses collision resistance of jack-up rigs, enabling software-based assessment of potential damage after a ship collision and supporting customers in the search for remedial action.

It is more important than ever for owners to go beyond compliance with existing regulations and prepare their fleets for future challenges. DNV GL will assist such strategies with advanced solutions.

A stylized, handwritten signature in black ink, appearing to read 'Tor E. Svensen'.

Tor E. Svensen



# BIGGER IS BETTER

Steel is a wonderfully pliable material. A ship made of steel does not necessarily have to remain unchanged for the rest of its lifetime. You can retrofit the bulbous bow, you can lengthen the ship... or even widen it!



Photo: Reederei NSB



More cargo, higher stability, unchanged operating costs: Reederei NSB has developed and successfully implemented a concept for widening ships that is the first of its kind worldwide. Widening will increase the TEU capacity of a ship by more than 20 per cent, and the IMO Energy Efficiency Design Index (EEDI) achieved will equal that of a newbuild. *MSC Geneva* was the first in a series of three ships to be widened at the HRDD shipyard in China. On 20 April, she was floated out and towed to the shipyard's fitting-out berth. Widening offers high flexibility. Depending on the individual ship, it is possible to add two to

four container rows. *MSC Geneva's* capacity will be increased from 4,860 TEU to over 6,300 TEU.

The project has been carried out jointly with DNV GL. "We were extremely pleased to be given the opportunity to work with NSB on this project," says Marcus Ihms, DNV GL Ship Type Expert for container vessels. "We worked closely with NSB, the yard and the flag state authorities on this major conversion project to ensure compliance with applicable environmental and safety rules. We believe this solution will allow forward-thinking owners to keep their vessels competitive in the market longer."



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## IN BRIEF



**Appointed:**  
DNV GL CEO  
Dr Henrik O. Madsen (r.)  
by UN Secretary-  
General Ban Ki-moon.



### UN Secretary-General appoints DNV GL CEO Dr Henrik O. Madsen to Global Compact Board

United Nations Secretary-General Ban Ki-moon has appointed Dr Henrik O. Madsen, Group President and Chief Executive Officer of DNV GL, as a new member to the UN Global Compact Board, the world's largest voluntary corporate sustainability initiative.

As a Board member, Dr Madsen will join other leaders from business, labour and civil society, and serve as a champion of the UN Global Compact and its mission. He will act in a personal and honorary

capacity for a period of three years, starting from 1 June 2015.

In his letter of appointment, UN Secretary-General Ban Ki-moon welcomed Dr Madsen to "this joint effort to strengthen and guide the United Nations Global Compact", saying he was looking forward to working with Dr Madsen "through the Board towards our shared vision of a sustainable and inclusive global economy".

### New DNV GL GAS READY class notation launched

*Barzan*, the first in a series of six 18,800 TEU container vessels ordered by UASC, was recently named at Hyundai Samho Heavy Industries (HSHI) in Mokpo, South Korea.

The vessel is the first to receive the new DNV GL GAS READY notation. Her five sister ships and eleven 15,000 TEU vessels of UASC's latest eco-ship generation, will be given the GAS READY notation as well.

"We are proud to help realize the world's greenest ultra-large container vessel in close cooperation with UASC," said Dr Henrik O. Madsen, Group President and CEO of DNV GL. "The trust placed in our expertise in alternative fuels has allowed us to implement the 'LNG-ready' concept jointly with UASC as an industry first, and

we are honoured that these next-generation ships are now also the first to receive the DNV GL GAS READY notation. UASC, truly a pioneering customer, now aims to reduce CO<sub>2</sub> emissions even further by converting ships to gas fuel operation as soon as the bunker infrastructure is ready."

**A friendly giant,**  
UASC's *Barzan*  
makes history  
as the first  
DNV GL GAS  
READY ship.





## First German island ferries to be powered by LNG

Two ferries with LNG-powered main engines will enter service in German coastal waters this summer. DNV GL is working with the owner and the shipyards to implement this green-shipping concept.



LNG as a low-emission ship fuel is celebrating its German premiere with the two ferries *Helgoland* and *Ostfriesland*, both scheduled to go into service in summer 2015.

On 30 April, *Ostfriesland* was the first-ever German-flagged vessel to bunker LNG fuel. Owned by operator AG EMS, the retrofitted ferry hailed in a new era of clean shipping in German waters. Meanwhile the affiliated shipping line Cassen Eils is putting the finishing touches to the newbuild *Helgoland*, which will enter service in June. Both LNG projects have been supported and approved by DNV GL.

### Bunkering of RoRo ferry *Ostfriesland*

A cloud of condensed air accumulated around the tank truck when the 94-metre RoRo passenger ferry received her first 40 cubic metres of liquefied natural gas (LNG) fuel, chilled to minus 162 degrees Celsius. "We are very pleased with this successful test, which was completed safely and quickly under the eyes of Bomin Linde LNG," said Dr Bernhard Brons, Managing Director of AG EMS. The ferry is now undergoing sea and shoreside tests and will soon enter daily liner service from Emden to Borkum. The conversion of the ship will allow the vessel to save more than one million litres of marine diesel per year.

Henning Pewe, PTP-Lead Gas Technology Expert at DNV GL, said: "What made this project unusual is the fact that the entire aft section was cut off and replaced by a new section including a new engine room. The flexible, four-engine gas-diesel electric drive concept is tailored to the future operating area."

The landmark project promotes the use of LNG as a ship fuel along with a newly developed LNG bunkering procedure.

## DNV GL opens Singapore Service Centre to be closer to customers

The new Singapore Service Centre (SSC) will streamline customer support and enhance customer experience by creating a single point of contact for all matters.

Singapore is a growing maritime hub from where approximately 1,500 DNV GL-classed vessels are managed by hundreds of ship managers. The new SSC, along with the

existing technical helpdesk DATE (Direct Access to Technical Experts), will provide customers with easy, direct access to DNV GL services.

The SSC is currently available to customers in Singapore with plans for rolling out the service to other countries in South East Asia soon.

**Delivering best-in-class**, streamlined service is the mission of the new SSC.



## IN BRIEF

### Seatrade award for DNV GL-classed e-ship *Ampere*

*Ampere*, the world's first large, fully electric vessel, has received the Seatrade Clean Shipping award for 2015. Owned and operated by Norled and designed and constructed by Fjellstrand, the DNV GL-classed car ferry is a fully battery-driven catamaran made of aluminium. Innovative in terms of both its propulsion system and its highly efficient hull de-



All-electric propulsion using fast-charging batteries fed by hydro-electric power: *Ampere* shows it can be done.

sign, the 80-metre vessel carries up to 120 cars and 360 passengers across the Sognefjord between the villages of Lavik and Oppedal in Norway.

The award was accepted by Sigvald Breivik, Technical Director of Norled, on behalf of the project partners. "Norled is proud to be the first ferry operator to operate the world's first zero-emission ferry," he said.

"We are honoured to have been part of the *Ampere* project and to have received this award," said Narve Mjøs, Director Battery Services and Projects at DNV GL - Maritime. "This has been a very exciting project to work on and we were very pleased we were able to help realize the vision of Norled and Fjellstrand. Vessels such as the *Ampere* demonstrate how the industry can use existing technologies to minimize its environmental footprint while continuing to operate profitably."

### "Vessels for the Future" to spur competitiveness of maritime transport

A new research initiative called "Vessels for the Future" was started recently to improve the safety record, sustainability and global competitiveness of shipping.

More than 50 companies, research institutes, academic organizations and interested associations have signed up to date, ready to support this joint effort towards a more sustainable European transport system. "Building a private-public partnership is important for two reasons: it creates a basis for a coordinated research, development and implementation (RDI) programme to transform vessels and waterborne operations; and it clearly communicates the commitment of all stakeholders to meeting the ambitious goals of the initiative," said Dr Pierre C. Sames, Chairman of the European Research Association and Director of Maritime Technology, Research and Development at DNV GL.

The initiative focuses on the three key objectives of the maritime transport cluster: safe and



Ready to take specific action: Dr Pierre C. Sames.

efficient waterborne transport and a competitive maritime sector in Europe. "Vessels for the Future" has set itself ambitious long-term goals: to reduce CO<sub>2</sub> emissions by 80 per cent, SO<sub>x</sub> and NO<sub>x</sub> emissions by 100 per cent and risks by a factor of ten by the year 2050. Advanced technology is seen as vital to unlocking greater efficiencies and improving environmental performance.





Staying abreast of new developments is crucial for executives.

## Learning for success

Today's maritime executives operate in a rapidly changing technical, regulatory and commercial environment.

To run their businesses successfully, they must command a wide range of skills. A new postgraduate diploma programme in Executive Maritime Management offered by the World Maritime University (WMU) and DNV GL Maritime Academy addresses some of the key challenges in today's maritime industry, helping executives retain their competitive edge.

### Overview - the modules

Module  
1

#### Setting the Scene: Contemporary Global Maritime Regulatory and Management Issues

**Learn more about** maritime economics, market challenges and trends, leadership culture and public relations. Close this module with maritime and ocean governance and sustainability matters.

Module  
2

#### Remaining Competitive in a Changing Market: Strategic Financial Tools

**Learn more about** shipping markets, capital budgeting, financial analysis and projects, loans and bank syndication, credit policy and alternative sources of ship financing.

Module  
3

#### Managing Resources: Human Resources Management, Organizational Processes and Leadership in a Maritime Context

**Learn more about** organizational structures, culture and learning, group and organization processes, HR management principles, labour law, management of change and leadership concepts.

Module  
4

#### Mastering Complexity: Effective Management of Safety, Security and Risk

**Learn more about** the human factor, risk assessment in shipping, risk management and ac-

cident investigation, IMO tools and the complexity and implementation of safety measures.

Module  
5

#### Staying Ahead of the Curve: Maritime Environmental Technology, Sustainability and Challenges

**Learn more about** environmental awareness in a market context, energy efficiency, alternative fuels, ballast water and biofouling, innovation and the future of shipping.

### Flexible delivery options

The eleven-month postgraduate diploma programme is offered with unique, flexible delivery options to accommodate the participants' individual needs:

- As a distance-learning programme on an e-learning platform with pre-recorded videos, self-assessments and collaboration tools
- As an open-enrolment, classroom-based learning programme with live instructors, discussions, hands-on exercises and access to online material at selected DNV GL Maritime Academy locations worldwide
- As a combination of distance and classroom-based learning for each module

Diplomas are conferred at the annual WMU graduation ceremony in Malmö, Sweden. ■ US

### Interested?



Registration at [maritime-executive-diploma.com/registration.html](http://maritime-executive-diploma.com/registration.html) is open now and will close at the end of June. Courses will begin in September 2015.



For more information visit the diploma's website [www.maritime-executive-diploma.com](http://www.maritime-executive-diploma.com) or contact us at [exec.pgd@dnvgl.com](mailto:exec.pgd@dnvgl.com).



**Sustainability** plays an important role in the business philosophy of Hapag-Lloyd.

## JOINING HANDS FOR THE ENVIRONMENT

Speed is no longer the only thing that matters in the liner shipping industry. Sustainability is becoming increasingly important. Hapag-Lloyd is sharpening its focus on green technology, frequently cooperating with DNV GL.

Tradition and modernity are just a few metres apart in the foyer of the Hamburg headquarters of Hapag-Lloyd. Marble, stone pillars and an oil painting of a sailing ship in stormy seas greet the visitor. But walk just one corridor further, and you enter the digital world. Three employees are looking at a wall-sized monitor literally showing a sea of lights. Each light

represents one of the liner shipping company's 191 vessels. The display provides the staff with real-time information about ship positions, sea conditions, currents and wind speeds. All this information is crucial for determining fuel consumption across the fleet – and for achieving a goal Hapag-Lloyd has set for itself: being a leader in sustainability.



"Being the fastest has long ceased to be a key advantage," says Richard von Berlepsch, Managing Director Ship Management and what might be called the head of the company's fleet. Today shipowning firms must excel in other disciplines. Hapag-Lloyd has established itself as a specialist in non-standard transport requirements, such as hazardous or out-of-gauge cargo. What is more, the shipping company has long been working to expand into green technologies, often exceeding the environmental or health protection requirements of national or international regulations. For example, in mid-April Hapag-Lloyd signed an agreement with the port of Shenzhen to only use fuel with a sulphur content below 0.5 per cent on board its ships while at berth. Similar agreements had already been signed with the "At-Berth Clean Fuels Program" at the port of Seattle, the "Port Metro Vancouver Blue Circle Award" and the "Fair Winds Charter" programme in Hong Kong.

#### A partnership of long standing

All this is not entirely new though. "We have had a green agenda for quite some time," says von Berlepsch. "To give an example, we have been using ships with exhaust gas turbines installed since many years already. In fact, we are already scrapping the oldest ones." Green shipping has definitely gained momentum, and Hapag-Lloyd not only draws on the expertise of its own specialists but benefits from close cooperation with DNV GL as well. "This



"We have been using ships with exhaust gas turbines installed since many years already. In fact, we are already scrapping the oldest ones. This is an area where class can be very helpful."

**Richard von Berlepsch**, Managing Director  
Ship Management at Hapag-Lloyd



Lower sulphur limits apply while at berth.

Photos: Hapag-Lloyd, Stefan Malzkorn - malzkornfoto.de

is an area where class can be very helpful," says von Berlepsch.

The classification society and the shipping company have been collaborating ever since they were established in the 19th century (see info box, page 15). In spite of the long tradition, the continuation of this relationship is by no means a matter of course. "The standard classification business is rather uniform nowadays, so it no longer gives you a good reason to decide in favour of one classification society rather than the other," says von Berlepsch.

#### Trusted experts

"To us, one advantage of DNV GL is that they are close by." With both companies headquartered in Hamburg, quick response times are guaranteed. So is mutual trust. "It is an entirely different situation to be able to meet up in person rather than making a phone call to some faraway place." Especially so when encountering challenging situations, the Managing Director continues, recalling February 2014 when the *Maersk Tajong* ran into the





> Hapag-Lloyd vessel *Colombo Express* in the Suez Canal. The incident was reported by the media around the world. Being closely watched by a global public, DNV GL experts had to scrutinize the damage and decide quickly whether *Colombo Express* was fit enough to resume her journey. "You need strong nerves in such a situation."

#### Optimizing fuel consumption

The technical expertise and numerous efficiency-enhancing solutions offered by DNV GL are further reasons for the endurance of this partnership. For example, Hapag-Lloyd lowers its fuel consumption by using the ECO Assistant program which has been offered by the classification society since 2009. ECO Assistant comes with software developed by DNV GL which calculates how a ship can optimize its trim by filling its ballast water tanks and distributing its cargo to achieve the lowest possible fuel consumption on each trip.

Erik Heller, Expert Operations at DNV GL, explains: "What sets our software apart is its wide adjustment range. The fore-to-aft draught difference can span as much as 2.5 metres." Hapag-Lloyd has installed ECO Assistant on 38 of its own ships and 24 chartered vessels. More will follow as the integration of CSAV progresses. "With DNV GL's trim optimization software we have been able to achieve further fuel oil savings," says von Berlepsch.

Cutting fuel consumption is also the purpose of ECO Retrofit, another DNV GL program. Over the past several years many shipowners have adopted the slow steaming approach, transporting their cargo

*Antwerpen Express* is one of 38 vessels owned by Hapag-Lloyd that use the trim optimization software ECO Assistant.

The headquarters of Hapag-Lloyd at Hamburg Binnenalster lake opened in 1903.



Photos: Hapag-Lloyd, Hasenpusch, Wikimedia Commons

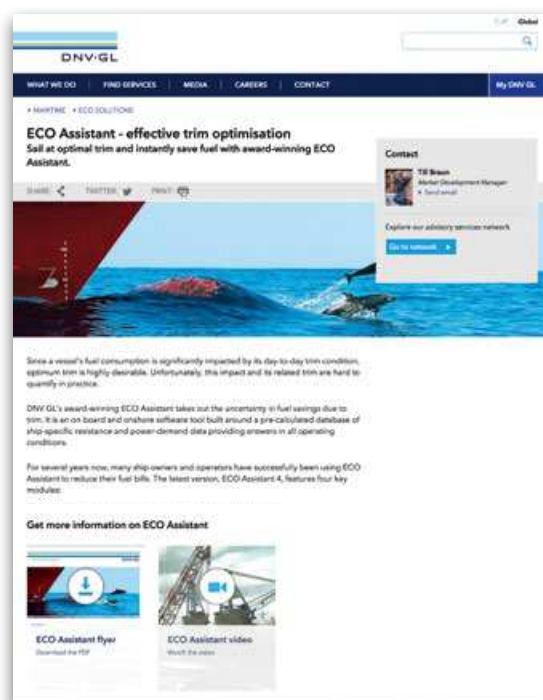


more slowly and cost-efficiently. However, the bulbous bows of many ships are designed to optimize fuel consumption at much higher cruising speeds. ECO Retrofit calculates how a bulbous bow should be redesigned to allow the ship to optimize its average fuel consumption when travelling at various speeds.

Typically such calculations are based upon simulations performed using ship models in towing tanks. But DNV GL lets the ships cruise on computer screens using specialized software developed in-house. "This technology is unique. Instead of trying five or ten variants in a towing tank, we can validate up to 20,000 on a computer," says Heller. The result is a reduction in fuel consumption of more than ten per cent. "This is an innovative way of planning ships," says von Berlepsch. Hapag-Lloyd will have 14 of its Hamburg and Colombo Express class vessels retrofitted before the end of this year.

### The right time for changeover

Operating ships with less HFO is a challenge Hapag-Lloyd and other shipping companies have had to tackle since the introduction of the new, stricter sulphur limits in emission control areas (ECAs) on 1 January of this year. In these coastal areas, ➤



ECO Assistant is an on-board and on-shore software tool developed by DNV GL that uses ship-specific resistance and power-demand data to calculate trim recommendations.

## FROM EMIGRANTS TO CONTAINERS: THE HISTORY OF HAPAG-LLOYD

In 1847, shipowners and merchants from Hamburg founded "Hamburg-Amerikanische Packetfahrt-Actien-Gesellschaft" (Hamburg-American Package Corporation), abbreviated "Hapag", to establish a reliable liner service from Hamburg to the United States, mainly for German emigrants.

A similar company, Norddeutscher Lloyd (NDL), was formed in Bremen in 1857. Being competitors did not prevent the two companies from cooperating on various occasions during the following years.

In 1888 Albert Ballin was appointed Chairman of the Hapag Executive Board. By organizing a pleasure cruise of Hapag's flagship "Augusta Victoria" to the Mediterranean, Ballin effectively created cruise ship tourism.

The end of World War I resulted in the complete loss of both fleets, but the two companies recovered in the 1920s, and in 1924 Hapag and NDL fully re-established their former services.

Both shipowning companies lost their fleets once again in World War II. Nevertheless Hapag and NDL began

re-conquering their old markets in 1950, now operating nearly all of their services jointly. On 25 October 1968, the Bremen company's ship *Weser Express* opened the first European all-container liner service to New York City, called Hapag-Lloyd Container Linien. The two shipping companies fully merged on 1 January 1970, forming Hapag-Lloyd AG, till today Germany's largest liner shipping company.

On 1 October 1997, the German mining and energy company Preussag AG acquired a majority stake in Hapag-Lloyd AG. In 2000 Preussag, by now the sole shareholder of Hapag-Lloyd AG, changed its name to TUI.

**Albert Ballin** joined Hapag in 1886. Under his leadership the company became the world's no. 1.

**German emigrants** boarding in Hamburg. Hapag started the service in 1847.





"Training courses at the Fleet Support Center provide the shipmasters with an opportunity to share experiences. This is extremely important: to achieve the desired outcome you need to know how to use your tools properly."

**Jörn Springer**, Head of Fleet Support Center

> ships are required to operate on fuel containing less than 0.1 per cent sulphur. A task that is not quite as easy as it might seem at first, says Dirk Lange, Key Account Manager at DNV GL: "Changing over to low-sulphur fuel requires a very attentive crew and numerous preparations on board." The Hapag-Lloyd fleet therefore uses the DNV GL Fuel Change-Over Calculator which computes the ideal time for the fuel changeover based on the amount of residual fuel in tanks as well as temperature and speed data.

But merely complying with the law is not good enough for Hapag-Lloyd. Even outside ECAs the company's ships operate on fuel with an average sulphur content of just 2.1 per cent, significantly below the current IMO limit of 3.5 per cent. "Refraining from doing something just because it seems a bit more costly at first sight is not our strategy," says von Berlepsch.

The shipping company is thus a leader in low CO<sub>2</sub> emissions as well. According to the EU Commission's plans, ships above 5,000 GT calling at EU ports will have to record and document their CO<sub>2</sub> emissions as of 2018. So Hapag-Lloyd and DNV GL jointly

developed a certificate to reflect these Monitoring, Reporting and Verification (MRV) rules. "This is an area where we want to lead the market," says von Berlepsch. A vision the shipping company shares with the classification society. "We find it important to offer our customers a certification service now that they will need in the near future," says Lange. Experts from both companies met many times to discuss the project. "It was like a ping-pong match," says Lange. "The result is a tailor-made solution."

#### Fleet at a glance

Hapag-Lloyd even restructured its organization to better handle the growing sustainability challenges. In 2013 the company created a new department called "Fleet Support Center" which combines all activities related to energy management. "This has allowed us to implement a holistic approach," says Jörn Springer, who developed the concept for the new department. "We not only have a complete overview of all of our own and our chartered ships. We have also optimized collaboration between the experts on board and those ashore."

The Fleet Support Center likewise works closely with DNV GL, and DNV GL instructors regularly conduct training courses for shipmasters at the centre. "We explain the background of these sustainability measures and how they work," says Heller.



The containership fleet makes extensive use of eco-friendly solutions.





"Ocean Carrier of the Year" is one of nine awards Hapag-Lloyd received in 2014.

"These courses also provide the shipmasters with an opportunity to share experiences," Springer adds. "This is extremely important: to achieve the desired outcome you need to know how to use your tools properly."

#### Awards for green commitment

Making customers see the added-value benefits of adopting these measures is a major challenge, however, Springer concedes. After all, there are substantial investments involved. "Many of our clients are not end customers but merely carriers," he explains. On the other hand, major accounts such as DB Schenker or BMW want their partner companies to commit to their corporate environmental agendas so they can promise their customers a "green" supply chain.

At any rate, the "Hapag-Lloyd Loyalty Index" which the shipowning company calculates every year to gauge its customers' satisfaction has remained at a high level for years. Numerous awards received by the Hamburg-based company confirm that it is on the right track. Hapag-Lloyd got nine different awards in the last year alone. They not only included

customer awards such as the "Ocean Carrier of the Year" title from both the aluminium manufacturer Alcoa and the German rail company DB Schenker, which the shipping company had received multiple times before.

Hapag-Lloyd was also recognized for its environmental performance with the "Hanse Globe", a sustainability award given by Logistik Initiative Hamburg, and the "ECOConnexions Partnership Award" from the Canadian railway company CN Rail. Says von Berlepsch: "As a company Hapag-Lloyd has an obligation to society and the environment. We must fulfil this obligation to the best of our abilities." ■ CH/NIS

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# UNTAPPED POTENTIAL

The latest DNV GL study on energy management reveals that awareness and capabilities of ship and shore staff and effective performance management are key enablers of realized savings.

The Energy Management Study 2015, conducted by DNV GL Shipping Advisory, aimed at understanding how the industry handles the need to increase energy efficiency. The study gathered input from ship managers, owners and operators of 80 shipping companies headquartered in 24 different countries. Some 30 respondents represented each of the most important cargo vessel segments – containerships, tankers and bulkers – whereas the offshore, MPV and cruise ship segments were each represented by about ten respondents. Other segments included in the survey were covered by individual respondents.

## Varying levels of ambition

More than three quarters of the participating companies consider saving energy a main topic on their agenda, with more than 80 per cent naming costs as the main driver even at the current low fuel prices. Improved market positioning and penetration, and

the positive marketing effect of a smaller environmental footprint were further reasons given.

While saving energy takes a high priority among most of the participating shipping companies, which were asked about their energy management objectives, few have actually defined ambitious targets. Only about one third of the respondents said they aim for energy savings of five per cent or more. The number of respondents without any defined targets decreased from 44 per cent in the 2013 survey to 28 per cent in 2015 but continues to be rather high. Interestingly enough, 53 per cent want to implement a performance management system or enhance their existing one, while 33 per cent want to improve the awareness, capabilities and behaviour of ship and shore staff.

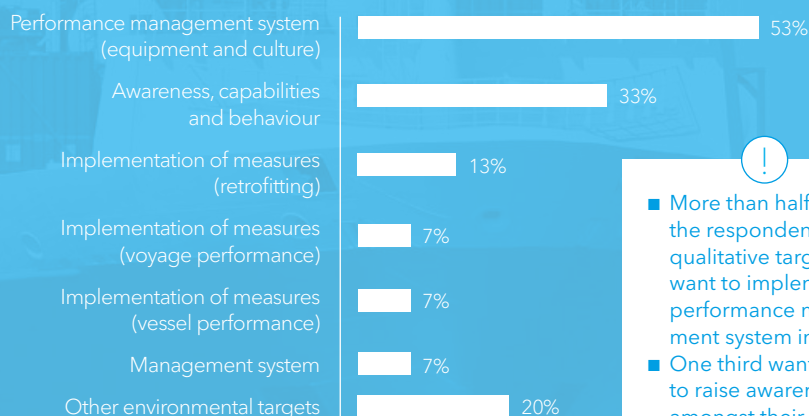
Energy efficiency has not gained a solid foothold in organizational structure as yet. Less than one third of the companies queried have a dedicated



What qualitative targets did you define for 2015?

## TARGET SETTING

Shipping companies define implementation of performance management and behavioural change as targets for 2015



- More than half of the respondents with qualitative targets want to implement a performance management system in 2015.
- One third wants to raise awareness amongst their staff and improve their skills to bring about behavioural changes.



energy manager or energy management team. Most respondents have assigned the task to "everybody", which often actually means "nobody". The industry has mostly contented itself with well-established practices requiring little capital investment. The most significant energy-saving measures implemented in 2014 were slow steaming, hull and propeller cleaning and optimized voyage planning (see diagram below).

### Key enablers

Performance monitoring ranked highest among the enablers of energy-efficient ship operation. "Reliable data collection, monitoring and analysis are key to benchmarking and achieving the energy management goal," claims one participant. Nevertheless, most respondents continue to gather energy data more or less manually, and the ways the data is used vary widely. Most reports, if any, are prepared manually rather than automatically. However, the most successful companies have implemented both an IT-based performance management system and a performance management culture.

Apart from a lack of financial resources, major hurdles preventing implementation of energy-saving measures include lack of time, lack of appropriate capabilities, and resistance to change. Survey participants see the need to build awareness and energy efficiency-related knowledge among crews and onshore staff. "All staff involved in day-to-day

### THE ECA DECISION

To comply with tight sulphur limits in Emission Control Areas (ECAs), shipowners need to decide whether to opt for low-sulphur fuels, scrubber systems or alternative fuels such as LNG. The DNV GL Energy Management Study 2015 shows that most shipping companies (91 per cent) use low-sulphur fuel oil in ECAs in an apparent attempt to buy time for investment decisions. Only six per cent of the respondents said they have installed scrubbers; none have converted their vessels for alternative fuels such as LNG. However, 25 per cent of the respondents said they plan to install scrubbers in the future, while 24 per cent are considering the use of alternative fuels such as LNG.

operation of a vessel should be aware of and willing to implement energy saving techniques, from the wiper on board the ship to the managing director at the main office," says one respondent. One third of the companies surveyed say they want to foster awareness and build skills enabling behavioural change among their employees in 2015. ■ NL/JHH

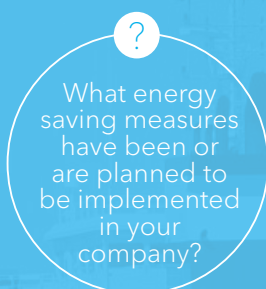
### DNV GL Expert

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Photo: Dedi57 | Dreamstime.com

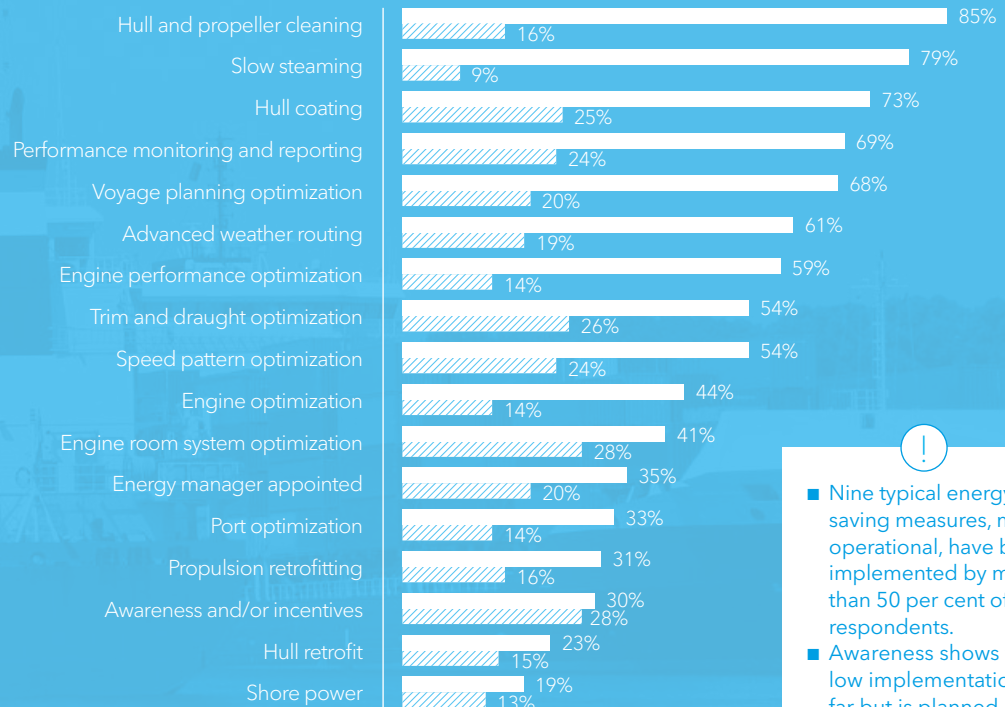


### ENERGY SAVING MEASURES

Many "simple" measures have been taken, but awareness is number one for 2015, indicating that implementation is challenging.

implemented in your company

planned to be implemented in 2015



- Nine typical energy saving measures, mostly operational, have been implemented by more than 50 per cent of the respondents.
- Awareness shows very low implementation so far but is planned as number one for 2015.

It pays to drill down into ship performance data to uncover hidden savings potential.



## THE NEXT WAVE

Imagine six bulk carriers, technically identical sister vessels, sailing fully laden from the ore mining country to China. Yet their fuel consumption differs. Fleet performance management can tell you why.

Even at their current low level, fuel costs are the biggest cost item of ship operation – one that can be influenced significantly, however. Market-leading shipping companies have cut their fuel consumption by 50 per cent over the last six years, and only half of this effect can be attributed to slow steaming. The remaining 25 per cent are achieved by a well-orchestrated bundle of technical and operational measures.

While many shipping companies have implemented some isolated technical measures in the past, such as trim optimization or weather routing, they have only recently begun to look into the potential benefits of taking a coordinated approach and addressing the behavioural aspect.

### Moving beyond

Fleet performance management is the next wave in energy management. It achieves a number of key objectives: it sets a performance baseline, enables performance reviews and helps decide what measures should be applied to what part of the fleet. Furthermore, it induces an immediate change of behaviour among the onshore and on-board teams towards more efficient operation, sometimes even going against “seafarer tradition”. And finally, it demonstrates good governance and transparency vis-à-vis customers and other stakeholders.

The benefits are significant. Anybody interested in finding out why comparable vessels of the same fleet

perform differently, as illustrated in the bulk carrier example above, should opt for a fleet performance management system. To understand the causes of performance differences, shipowners need a comprehensive overview of vessel-specific voyage, engine and system conditions, hull and propeller resistance, and the contribution of fuel quality to any performance gap. Having studied the performance of countless ships, DNV GL has drawn a number of conclusions.

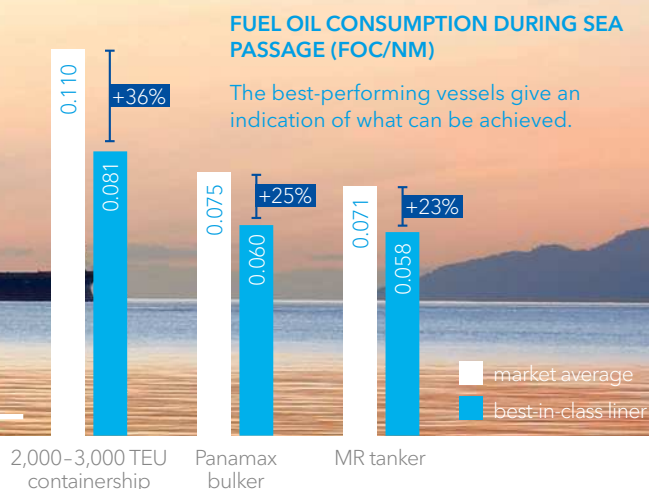
Speed is an important lever; however after most of the industry has adopted slow steaming, there is little savings potential left. Nevertheless, speed management along the voyage may still yield some benefits. On the other hand, weather conditions have only limited influence on fuel consumption differences over a typical review period (e.g. one month).

Many companies do not collect engine performance data systematically enough. A meaningful assessment requires taking simultaneous “snapshot” readings of engine data and ambient conditions.

Two factors that are often underestimated by shipping companies are hull degradation and bunker quality. Computing hull degradation is complex, and coating chemistry is not a ship engineer’s home turf, but the rewards of investigating this matter could be substantial. The same goes for bunker quality; owners and managers who subcontract their bunkering should obtain reliable fuel quality data to improve vessel performance by technical means.

Photo: dan\_prat - iStockphoto





### Getting the facts

A meaningful analysis requires two things: high-quality data and strong references or baselines.

- Good data can be obtained from autologging key parameters on board. Filtered for sensor errors, this data can then be sent to shore at certain time intervals. There are software solutions available, but the cost, implementation and maintenance effort is significant. For most analyses associated with regular performance management reviews, the existing ship-to-shore reporting patterns will be sufficient for performance data reporting as long as technical plausibility checks are performed in between.
- While high-quality statistics and colourful graphs are nice to look at, they may not express much more than the fact that the vessel is moving. What is often forgotten in performance management is the need for high-quality reference or baseline data. Insightful decisions can only be made if the data captured can be viewed in relation to suitable reference values. A vessel comes with a few performance patterns

from the towing tank test; all other data needed to arrive at a proper speed-versus-power (speed-versus-consumption) curve at a certain draft, trim and weather are commonly based on assumptions. The only way to obtain good baselines for vessels in operation is CFD simulation, i.e. hundreds of computer-based virtual towing tank tests, including low speeds and a variety of draft and trim assumptions. Additional useful references might include benchmarks from similar vessels or satellite-based weather data.

In general, establishing reliable reference values is much less costly than the implementation of autologging solutions. ■ TB

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### ABOUT ECO INSIGHT

The DNV GL performance management portal **ECO Insight** offers a comprehensive and easily accessible way to manage the performance of a fleet, including:

- Voyage performance
- Hull and propeller performance
- Engine and systems performance
- Fuel performance

ECO Insight supplements fleet reports with industry data, such as Automatic Identification System

(AIS), satellite weather and fuel quality information, providing unique benchmarking capabilities. Advanced engineering methods, such as hull fouling prediction and CFD-based vessel baseline normalization, are also available on the portal.

**Navigator Insight**, the preferred recording tool for ECO Insight, delivers extensive reporting and analytics functionality:

- High-quality data collection on board

- Smart plausibility checks against specific vessel particulars
- Connects to existing on-board data collection processes
- No change in procedures needed
- No hardware investment required
- Efficient fleetwide implementation within eight to twelve weeks
- Optionally covers all applicable environmental reporting standards such as CCWG, ESI, CSI and the upcoming MRV.

# DRIVE-ON BUNKERING SIMPLICITY

SeaRoad Shipping's new RoRo vessel will feature an LNG bunkering concept that doesn't require any port infrastructure for refuelling.

Dale Emmerton, National Marine Manager at Australia's SeaRoad Shipping, has been watching what has been happening in Europe's short-haul RoRo market for the last couple of years. Faced with the challenges of cleaning up their heavy fuel oil (HFO) exhaust emissions, many European shipping companies have looked to installing scrubbers or burning diesel. Not content with either option, SeaRoad Shipping has come up with an alternative that has turned the eyes of the world towards Australia.

SeaRoad's latest newbuild will feature a novel method for loading the ship's energy requirements. Like in most ports, there is no direct infrastructure for refuelling liquefied natural gas (LNG) where the vessel will call, so locally available LNG will be bunkered by loading LNG road tank trucks directly onto the vessel during normal loading operations.

## Energy for the future

The design features three LNG road tankers connected to a permanent fuel manifold on the ship. They will be changed out after every round voyage for three tankers that will have been filled the previous day at the local LNG plant. The tankers will be secured to the vessel in special loading bays on the weather deck, aft, with multiple twist-locks.

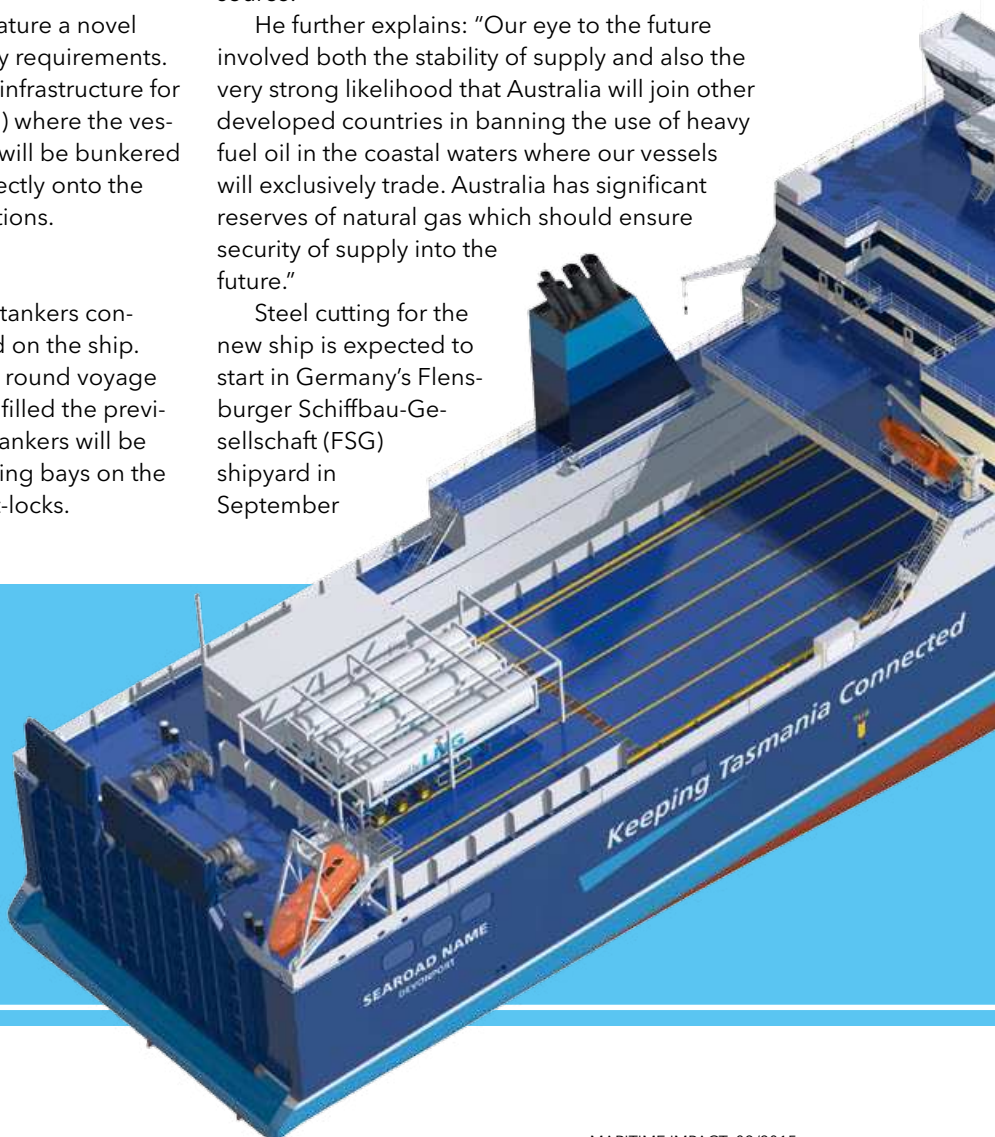
This process is a relatively simple logistic task, particularly when compared to bunkering heavy fuel oil. "LNG as the primary fuel was chosen with an eye to both the present and the future," says Emmerton. "Currently our ships burn heavy fuel oil which is sourced overseas and imported into Melbourne by a single company for resale and delivery to the vessels. LNG is available locally from multiple sources and is seen as a more reliable and certainly cleaner energy source."

He further explains: "Our eye to the future involved both the stability of supply and also the very strong likelihood that Australia will join other developed countries in banning the use of heavy fuel oil in the coastal waters where our vessels will exclusively trade. Australia has significant reserves of natural gas which should ensure security of supply into the future."

Steel cutting for the new ship is expected to start in Germany's Flensburger Schiffbau-Gesellschaft (FSG) shipyard in September

## SEAROAD SHIPPING'S NEW RORO VESSEL

- Length: 182 m
- Beam: 26.6 m
- Draught: 6.3 m
- Service speed: 20 kn
- Cargo capacity: >1,960 lane metres
- Propulsion: 2 x MaK dual-fuel engines rated at 7.2 MW each
- Power generation: 2 x MaK gensets rated at 2.5 MW
- Start of construction: September 2015 at FSG shipyard, Germany





"I think we can safely say, our idea was met with dismay around the industry."

**Dale Emmerton**, National Marine Manager at SeaRoad Shipping



SeaRoad's legacy ferries have been powered by imported heavy fuel oil which is going to be replaced by domestic LNG.



Built by FSG shipyard in Germany, the new RoRo design takes a surprisingly simple approach to refuelling.

2015, and DNV GL is providing full classification services including interpreting the novel concept in terms of the draft IGF Code that is currently passing through the IMO implementation process and also liaising with Australia's Maritime Safety Authority on its statutory requirements.

The project began back in 2008, says Timothy Holt, Area Manager Australia & New Zealand for DNV GL - Maritime. "We saw the project as a pre-emptive partnership. LNG was just coming on as an option when SeaRoad needed to replace tonnage. DNV GL had been pushing for the adoption of LNG globally, and we felt we could step in as a technical partner both on the class side and the advisory side. So, both parties saw the opportunity and had the intent to make it succeed."

#### Navigating regulations

Having won the tender for the groundbreaking project, Timothy Holt's enthusiasm led to a meeting of the SeaRoad Shipping team with a group of engineers in Oslo led by Torill Grimstad Osberg. The team conducted risk assessments and eventually granted Approval in Principle for the concept.

"Initially, I think we can safely say, our idea was met with dismay around the industry," says Dale Emmerton. "At that stage all the development and rules were being based on large permanent tanks fitted below deck, but our local DNV GL surveyor was most supportive. Our method simplified the task of bunkering compared to conventional methods and made it much safer. This was quickly understood by the team in Høvik, and after the initial meeting, the DNV GL team was very quick to assist with solutions for achieving our idea. The rest of the story is



Photos: FSG/SeaRoad

> almost history with the various codes and rules now taking into account portable-type tanks for short-haul, quick-turnaround ships."

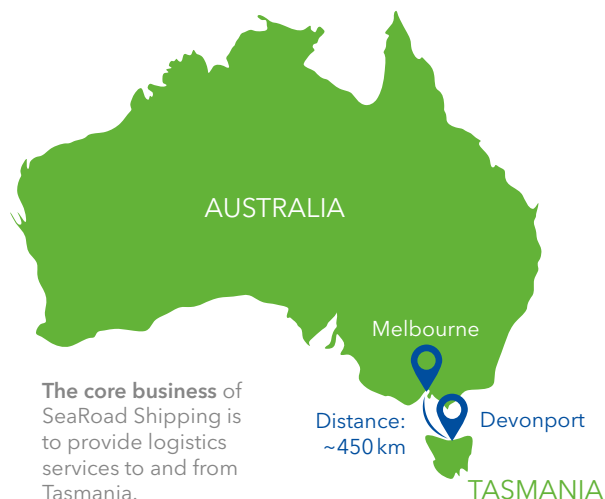
FSG, DNV GL and the Australian Maritime Safety Authority all participated in the risk assessment. Like heavy fuel oil, LNG is classified as a dangerous product, says Emmerton. "In the end the logic was quite simple. HFO is stored in tanks that are part of the ship's structure, and by proving that the LNG tanks can be securely fastened to the ship, they could also be seen as part of the ship's structure," he says.

The risk assessment led to the incorporation of a number of safety features to ensure appropriate levels of stability and fire safety. Heavier cargo units than an LNG tank would normally be secured by four twist-locks, however the gas tanks will have six.

#### Smart design ideas

The tanks take three cargo slots on deck, but the LNG piping system has no effect on cargo capacity. There are two main parts to the system, cryogenic and non-cryogenic. The cryogenic part includes the flexible pipes connecting the fuel tanks to a common manifold that feeds the LNG to a deck-mounted gas handling room where waste heat from the machinery plant is used to convert the -160 °C liquid into a gas in specially designed heat exchangers. The cryogenic pipes have to be stainless steel and double-walled because of the very low temperatures.

The new SeaRoad ship will transport mixed cargo, including containers, trailers, reefers, cars and other freight.



Once the liquid has been heated and converted to gas, the piping is simpler but still requires ducts that are vented and monitored for potential leaks. When the gas reaches the engine room it is supplied to the engines via gas valve units which regulate the gas pressure according to power demand.

"The uniqueness of the design means we had to go through a detailed approval process with DNV GL to take care of all the rules and regulations which are not yet 100 per cent established with respect to the draft IGF Code," says Raimon Strunck, Vice President Sales at FSG.

"The cargo mix has driven the design, because SeaRoad wants double-stack cassettes for shipping of containers on the main deck, a mix of trailers and cars in the lower hold and LNG trailers on the weather deck," says Strunck. There is also a specially designed area for the transport of livestock. "An-





other cargo-related design driver is the fact that we have dangerous goods cargo in the forward part of the weather deck and, right behind it, reefers. This is rather unusual and normally not allowed due to explosion risks, but together with DNV GL we have found a design solution that ensures that this can be done safely and in compliance with class rules."

#### Purpose-built for Bass Strait

The vessel's principal dimensions are 182 metres length overall, 26.6 metres beam and a maximum draught of 6.3 metres. Service speed will be 20 knots. The vessel's stern ramp is a split design to enable loading and unloading of two decks simultaneously. The design will streamline operations for truck drivers.

The newbuild will be twin-screw, powered by two MaK dual-fuel engines rated at 7.2 megawatts each. Two MaK gensets of 2.5 megawatts each will be installed to give the ship 100 per cent electrical power redundancy, something that is critical considering the schedule that the vessel will keep and the high-value cargo that it will carry. "The main engines and auxiliaries are dual-fuel and the auxiliaries are unusually large for a RoRo, double the size in fact," says Strunck. "Melbourne experiences very hot summers, so SeaRoad needs the auxiliary power to run the reefer containers while they are in harbour."

The vessel is designed for the Bass Strait trade although it will be classed for worldwide operation. It will travel between Melbourne and Devonport where high manoeuvrability is needed for turning and mooring at the pier. "We have installed a specially designed flume stabilization tank so rolling is reduced to a minimum, and we have optimized

the hull shape to suit Bass Strait's prevailing conditions and provide good seakeeping behaviour while ensuring that the vessel's manoeuvrability meets the operational requirements," says Strunck.

#### A model for other short-sea routes

FSG is accustomed to meeting the unique and specific needs of shipowners. "The cargo mix is unusual, but it is a type of vessel you might also find here in Europe. Even though RoRos might look similar from the outside, they are all purpose-built to the specific requirements of each customer," says Strunck.

"Whilst LNG-powered RoRo vessels are relatively new and we know there will be many new developments along the way, we feel that the basic principle of our idea will lead to a growth in clean reliable short-haul shipping that can be bunkered safely and quickly," says Dale Emmerton. Raimon Strunck agrees the principle has significant potential in Europe and other parts of the world.

The newbuild is expected to commence service in late 2016. "Our masters have already manoeuvred the new vessel in the ship simulator in Western Australia after the hull design had been extensively tested in Denmark," says Emmerton. "We will definitely consider similar bunkering arrangements for our next newbuild. Some say we may not have a choice in the future." ■ WL

#### DNV GL Expert

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#### ABOUT SEAROAD SHIPPING

SeaRoad Shipping and its predecessor companies have been servicing Bass Strait between Australia and Tasmania since the 1890s. With its current fleet of two RoRo vessels, *SeaRoad Tamar* and *SeaRoad Mersey*, the company provides twelve overnight voyages per week between the Australian mainland and Tasmania.

In addition SeaRoad, established in its current form in 2007, offers freight forwarding services throughout Australia as well as cargo handling, warehousing, distribution and bond storage. When commissioned, the new, LNG-powered vessel will greatly enhance the fleet capacity across Bass Strait, supporting future growth of the Tasmanian economy.

Photo: FSG/SeaRoad



**Keeping it green** means reducing our CO<sub>2</sub> footprint. Norway takes the lead in green shipping.

# A BLUEPRINT FOR GREEN SHIPPING

Norway is going to show the world that tomorrow's shipping industry will be eco-friendly. The Green Coastal Shipping programme, initiated and headed by DNV GL, has high ambitions. Short-sea shipping is only the beginning.

In January, the Green Coastal Shipping programme was kicked off with a roundtable conference at DNV GL's headquarters. Minister of Trade and Industry Monica Mæland and State Secretary for Climate and Environment Lars Andreas Lunde signed a declaration of cooperation with key players in the Norwegian coastal shipping industry, and soon the programme had obtained the support of more than 20 Norwegian players. The entire value chain, from cargo owners and logistic companies to shipowners, yards, ports, authorities and suppliers of electricity, gas, equipment and services, is cooperating.

DNV GL Programme Director Narve Mjøs wants the world to look to Norway to find the most eco-friendly technologies and the smartest solutions for energy-efficient maritime transport. A DNV GL analysis shows that biofuels and electrical propulsion will be keys to greener shipping, but the road there is long. During the initial stages, LNG, biodiesel and battery hybridization will be energy sources of choice. The technologies are readily available and

will pave the way towards a zero-emission future. "In this programme we envisage a fleet of offshore vessels, tankers, cargo, container, bulk and passenger ships, ferries, fishing and aquaculture vessels, tugs and other coastal vessels running entirely or partly on batteries, LNG or other eco-friendly fuels," says Narve Mjøs.

## Green fuels

"Norway is already leading the way in the usage of LNG. Most of the world's 61 ships running on gas are Norwegian. We intend to maintain this lead," Mjøs says, adding he expects exponential growth. "It usually takes six to seven years to introduce a new technology but this is really taking off now. Every time the number of installations of a new technology doubles, the price typically falls by 12 to 14 per cent. That causes the number of installations to rise even faster," he explains.

Another evolving topic for shipping is battery technology, since the price of batteries is plummeting. "For the Norwegian maritime industry, it is important to maintain its knowledge leadership," Mjøs contin-

Photos: DNV GL, Maygutayak - Fotolia, Norled



"We have a vision that Norway will establish the world's most efficient and eco-friendly coastal shipping fleet powered entirely or partly by batteries, LNG or other environmentally friendly fuels."

**Narve Mjøs**, Director of the Green Coastal Shipping programme



ues. "It's not enough to be the first out of the starting block. We have to finish the race so that business can grow and the world can benefit from the results. To do so, we must act now and involve all key players."

### Strategy implementation

The Green Coastal Shipping programme will help implement the government's new port and maritime strategies, reducing air pollution and making a major contribution to the achievement of national and global climate goals. Furthermore, it is expected to be a driver of innovation and green workplaces while providing major export opportunities for the Norwegian maritime, energy and supplier industries.

The programme is subdivided into four phases. Phase 1 comprises business and socio-economic as well as cost-versus-benefit analyses to assess the potential for battery and gas-based transport in Norway. It also includes five pilot project studies, one of which is battery hybridisation of Nor Lines' CargoFerry (see page 28). Phase 1 is funded jointly by the industry and Innovation Norway, a governmental body.

Phase 2 aims to further develop and evaluate business cases involving all key players: cargo

owners, logistics companies, financial and shipping companies, ports, shipyards and suppliers. It will define regulatory, financial and procurement policy incentives and instruments, working closely with the authorities. It will also establish a consensus on how to overcome key barriers and challenges. This phase is scheduled to start in 2016. In Phase 3 and 4 the programme will investigate how all this can be implemented, and facilitate implementation.

### Important role of authorities

"Authorities play a key role as drivers and facilitators of technical innovation and greener shipping," says Narve Mjøs, pointing out it was authorities that decided to launch a project involving LNG-run ferries in 1995 to boost the Norwegian maritime industry. *Glutra*, the world's first LNG-powered ferry, was commissioned in 2000. Today, 15 years later, LNG is used as a fuel on 19 Norwegian ferry routes. In another example, authorities in 2013 called for bids for a ferry that was to run between two western Norwegian villages. The vessel was to be as energy-efficient and eco-friendly as possible. Operator Norled won the tender and development contract. The result is *Ampere*, the world's first all-electric, battery-powered car ferry which recharges in ten minutes.

A third example is the NO<sub>x</sub> Fund. All vessels emitting NO<sub>x</sub> in Norway must pay a tax into this fund, which is used for grants helping shipping and other companies invest in NO<sub>x</sub>-reducing measures. "We're on our way. We're going to make Norway a showcase for green coastal shipping and attract international attention," Narve Mjøs promises. ■ EH



**Ampere**, the world's first all-electric car ferry.

### DNV GL Expert

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# FROM HIGHWAY TO WATERWAY

A new competitive and eco-friendly maritime transport concept, the CargoFerry, is now ready after more than two years of development work. The concept presents an alternative transport solution for containers that are carried on land across more than 200 kilometres in Norway.



#### Norwegian industry-led project

CargoFerry is studying the possibility of faring short sea shipping routes using advanced technology.

The CargoFerry report presented recently in Oslo showcases a logistics solution, concept ship and market analysis while also documenting the CargoFerry's potential profitability. A group of 27 Norwegian companies with interests and expertise in short-sea shipping, led by DNV GL, Shortsea Services and Marintek, cooperated to develop the concept.

#### Taking long-distance truck cargo off the roads

The main market for the CargoFerry (GodsFergen) concept is goods that are currently transported by truck across long distances to and from Norwegian coastal towns. After conducting extensive customer analyses and interviews, the project identified this market as covering some 17 to 20 million tonnes of goods each year. Every day 2,500 trucks cross the bridge crossing the border between Norway and Sweden. "Our analyses show there is a significant potential market for an intermodal maritime-based logistics solution," says Eivind Dale, DNV GL Project Manager for the CargoFerry project.

The concept offers transport to and from destinations interlinked by four main maritime transport routes and includes distribution to and from ports. It covers transport of goods from one freight terminal or warehouse to another but can also include transport from a sender to a consignee, or be limited

to port-to-port traffic only. The solution primarily aims at customers who, whether individually or collectively, fill up entire container loads or at least ship large, less-than-container loads.

#### Eco-friendly ship concept

CargoFerry is built around a concept for a new lift-on/lift-off (LoLo) vessel. Equipped with cranes and cell guides, the vessel can carry 110 to 140 40- or 45 foot containers. The LNG-fuelled ship operates at service speeds of twelve to 15 knots, has a battery for hybrid operation and can use shore power. As a result its emission profile is extremely low. Its automated mooring system allows it to moor without shoreside assistance.

A fully developed solution with the capacity to handle the cargo volume identified in the report will require 14 ships transporting the equivalent of 220,000 to 270,000 45-foot containers annually. However, the overall cost of transport will be 20 to 30 per cent lower than the current truck-based method. What is more, the concept is flexible, punctual, eco-friendly and has daily departures.

One of the CargoFerry project partners, the Norwegian shipowner Nor Lines, is a leading provider of short-sea logistics. Nor Lines is determined to realize the CargoFerry concept. Their brand-new LNG vessel

Photos: DNV GL, GodsFergen/Rolls-Royce Marine



*Kvitbjørn* (see page 30) is one of many steps taken to make this ambition become a reality, not only in Norway but also in other northern European regions.

### Super-efficient port logistics

The CargoFerry solution is built around a so-called super-efficient port logistics concept. This means that the specialized ships, equipped with automated mooring and two automated cargo cranes, will have access to ports at dedicated quays around the clock. The analysis shows that in addition to efficient logistics, the costs associated with port operations could be reduced to up to 30 per cent of current levels.

Asked how this concept could be implemented, DNV GL Project Manager Eivind Dale agrees that it is a challenging proposition. As a prerequisite, he says, it is important for the multimodal shipping solution to be considered as superior to conventional road transport. In addition a set of government measures and incentives must be in place, such as improved port infrastructure and efficiency, temporary short-sea shipping incentives and a balanced taxation system. Investment guarantees for green ships and prototype developments are also important.

"It is possible to transfer five million tonnes of cargo from the road to the sea at minimal cost to the authorities. This represents an annual benefit to society of some 1.3 billion Norwegian Kroner (approximately 175 million US dollars). On top of that, the reduction in road traffic means fewer accidents, reduced road maintenance and a dramatic drop in CO<sub>2</sub> as well as SO<sub>x</sub> and NO<sub>x</sub> emissions, all of which are major benefits to public health," says Eivind Dale. ■ EH

### DNV GL Expert

Eivind Dale, Senior Principal Consultant, Shipping Advisory

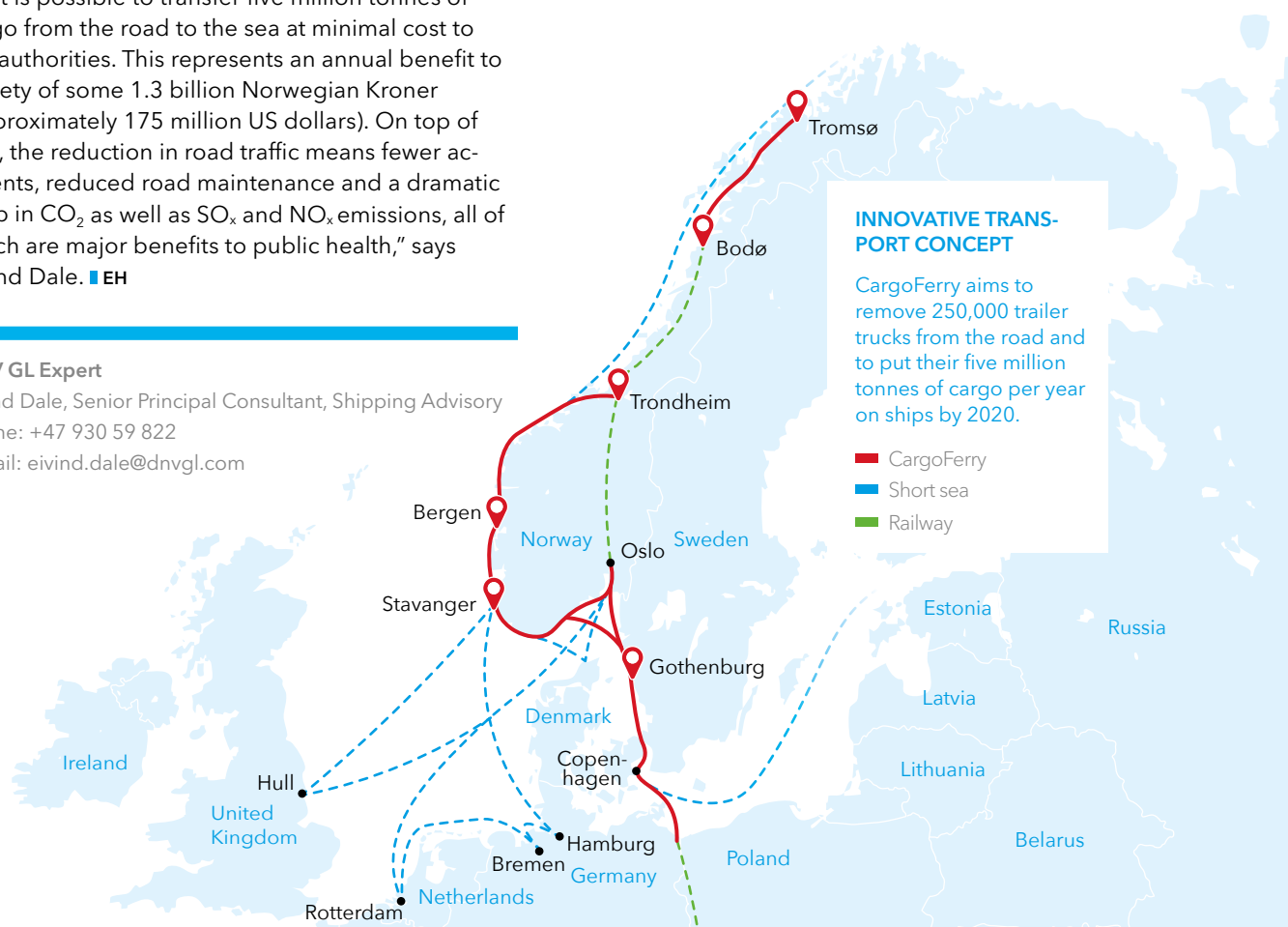
Phone: +47 930 59 822

E-Mail: eivind.dale@dnvgl.com



"Our analyses show there is a significant potential market for a maritime-based logistics solution."

Eivind Dale, DNV GL Project Manager for the CargoFerry project



# A MILESTONE FOR LNG

The maiden voyage of the *Kvitbjørn* from China to Norway has shown that a vessel running solely on liquefied natural gas can get fuel anywhere in the world if necessary.

Nor Lines' new DNV GL-classed flagship was built to Rolls-Royce's award-winning "Environment" concept. Apart from being powered by liquefied natural gas, the design incorporates innovative hull design, propulsion and on-board power generation technologies which reduce energy consumption by 18 per cent, CO<sub>2</sub> emissions by 38 per cent and NO<sub>x</sub> emissions by nine per cent while completely eliminating SO<sub>x</sub> and particulate emissions.

The *Kvitbjørn* is the first of two sister vessels replacing older tonnage in regular service between northern Europe and the west coast of Norway. The 400-cubic-metre LNG fuel tank enables the vessel to travel between Hammerfest and Cuxhaven without refuelling. *Kvitbjørn* lifts bunker, provided by Skangass, from a pipeline in Risavika (Stavanger). During transfer she was refuelled from trucks.

*Kvitbjørn* could become part of the new eco-friendly lift on/lift off concept CargoFerry (GodsFergen), an industry-led initiative which aims to remove 250,000 trailer trucks from the road and to put their five million tonnes of cargo per year on ships by 2020 (see page 28). ■ NL



Photo: Nor Lines

**WAYPOINT #5**  
 📍 Cartagena, Spain  
 ⌚ Arrival 13.03.2015  
 ⓘ LNG bunker lifted by trucks  
 ⌚ Departure 15.03.2015

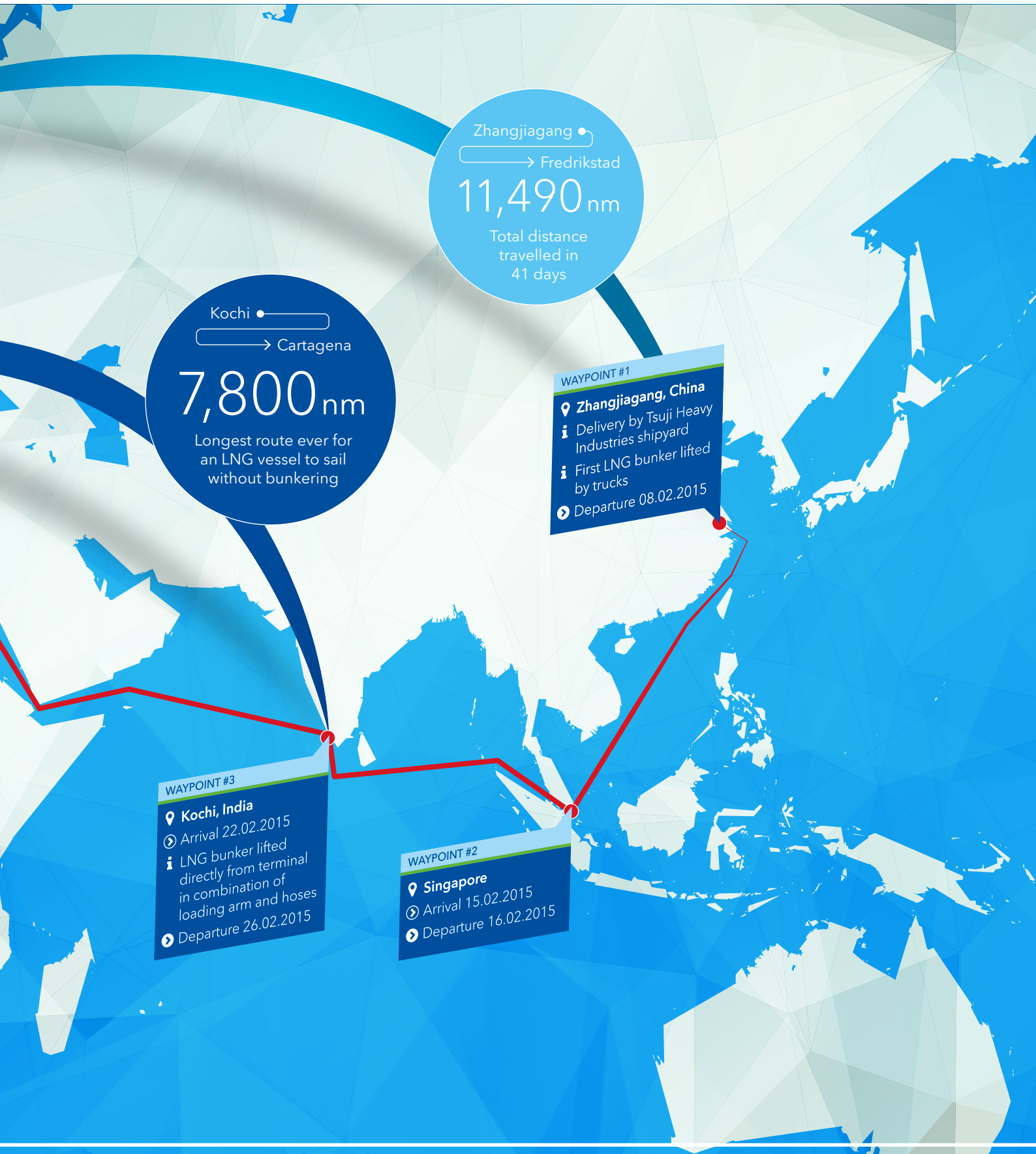
**WAYPOINT #6**  
 📍 Fredrikstad, Norway  
 ⚓ Arrival 21.03.2015

**WAYPOINT #4**  
 📍 Suez, Egypt  
 ⚓ At anchor 07.03.2015  
 ⌚ Departure 08.03.2015

## ABOUT KVITBJØRN

- Name: *Kvitbjørn* ("polar bear", literally "white bear")
- Sister vessel: *Kvitnos* ("white-beaked dolphin")
- Type: multi-purpose vessel
- 120 m x 21 m (394-feet long)
- Tonnage: 5,000 dwt
- Owner: Det Stavangerske Dampskibsselskab AS (DSD)
- Class: DNV GL
- Engine: Bergen B35:40 pure gas engine





# HEADING FOR

The Polar Code is the first of many regulatory steps to be taken as more shipping companies head for the Poles.

In 2006, polar explorers Mike Horn and Børge Ousland were the first humans to reach the North Pole on foot unaided during Arctic winter. It took them 60 days and three hours, and during that time they risked everything in the face of extremely harsh conditions.

Their journey contains lessons for the maritime industry as the polar seas become increasingly accessible due to improved technology and melting ice caps, says Morten Mejlænder-Larsen, Discipline Leader for Arctic Operation and Technology at DNV GL. Proper preparation, adequate equipment and thorough training are decisive for successful polar operations. Companies such as Fednav, Norilsk Nickel and Royal Arctic Line are already operating regularly in polar waters, but as the Arctic opens up to newcomers, the journey needs to be taken one step at a time just as the explorers took theirs, Mejlænder-Larsen says.

Ships and people operating in the Arctic and Antarctic are exposed to a number of unique risks. Poor and rapidly changing weather conditions and the frequent lack of good charts, communication systems and other navigational aids pose challenges.

The remoteness of the areas and lack of infrastructure makes rescue or clean-up operations time-

consuming, difficult and costly. Cold temperatures may reduce the effectiveness of on-board equipment, from deck machinery and emergency equipment to sea suction. Ice can subject the hull, propulsion system and appendages to additional loads.

## Planning the journey

Often the variety of Arctic conditions and their changeability from year to year is underestimated, says Mejlænder-Larsen. Horn and Ousland are experienced explorers and would have understood this, but few ships today are built to deal with the wide range of Arctic challenges.

The recent development of the Polar Code to boost the safety of polar shipping was no easy feat. The idea of linking the operational envelope of different ship types to regional maps was abandoned. "The variation in ice conditions, both geographically and annually, is so big that you have to consider the actual operation of each vessel on a case-by-case basis," says Mejlænder-Larsen. "It is very dangerous to rely on a predefined map. An area might be totally ice-free one year and be covered by heavy ice the next. Ships must be designed to cope with a wide range of possible conditions." >



# THE POLES

Photo: eugeneseergeev - Fotolia

**Due to harsh conditions,** sailing polar waters exposes ships to a number of unique risks.



**“The shipping industry must work together to ensure Arctic safety.”**

**Morten Mejl  nder-Larsen,**  
Discipline Leader for Arctic  
Operation and Technology  
at DNV GL

> The Polar Code as it stands now is a very positive start to protecting assets, people and the environment, says Mejl  nder-Larsen. “The minimum requirements set out in the Code will definitely exclude operators who don’t prepare properly or lack the experience.”

Over time, more detailed specifications will clarify the requirements set out in the Polar Code, and new guidelines will be added. As the Code is goal-based,

more specific requirements must still be identified and agreed on.

For those experienced in Arctic operations, adhering to the Polar Code will not be a big step, says Mejl  nder-Larsen, since most of the requirements are part of their daily operations already. “For newcomers, it will definitely be a big step.” He has mapped the DNV GL Winterization notations against the Polar Code and found only minor gaps, which will be filled soon. Some requirements, such as the Polar Certificate for the vessel and the Polar Water Operations Manual, will remain Polar Code-specific.

### A journey shared

People sailing polar waters face darkness and the effects the cold can have on mobility and speech. Single-year and multi-year ice pose serious challenges to navigation, and open water carries the risk of small icebergs and submerged ice.

A risk-based approach to regulation is well-established now at IMO and has been incorporated into the Polar Code. “It is a good way of identifying

### IMO’S POLAR CODE

In November 2014 the International Maritime Organization (IMO) adopted the International Code for Ships Operating in Polar Waters (Polar Code) and related amendments to the International Convention for the Safety of Life at Sea (SOLAS).

The SOLAS amendments are expected to enter into force on 1 January 2017 under the tacit acceptance procedure. It will apply to new ships built after that date. Ships built earlier will be required to meet the relevant requirements of the Polar Code by the first intermediate or renewal survey, whichever occurs first, after 1 January 2018. The Polar Code will be mandatory under both the SOLAS and MARPOL regulations.

**For more information:**  
[www.imo.org](http://www.imo.org)

### DESIGN & CONSTRUCTION



#### Ship categories

Ships which may operate in Polar waters based on:  
a) medium first-year ice; b) thin first-year ice; c) open waters / ice conditions less severe than A and B.



#### Intact stability

Sufficient stability in intact condition when subject to ice accretion; the stability calculations must take into account the icing allowance.



#### Materials

Any ship intended to operate in low air temperature must be constructed with materials suitable for operation at the ship’s polar service temperature.



#### Structure

The structure of an ice-strengthened ship must be able to resist specific structural, both global and local loads.

### OPERATIONS & MANNING



#### Navigation

Receive information about ice conditions.



#### Certificate & manual

A Polar Ship Certificate and the ship’s Polar Water Operational Manual must be carried on board.



#### Training

Masters, chief mates and officers in charge of a navigational watch must have completed appropriate basic training (for open-water operations) and advanced training for other waters, including ice.



the risks you have for a particular operation, compared to just using prescriptive general rules," says Mejlænder-Larsen. "However, when you take a risk-based approach you need to have data about the actual area where you plan to operate, and you need to involve competent people with experience. These are the key factors for the quality of the risk evaluation."

A lack of people with relevant cold-climate experience has been identified as a challenge to the safe introduction of the Polar Code in 2017. Mejlænder-Larsen says that a hazard analysis is only as good as the people participating in it. "After a while the industry will get more experience in carrying out the risk analysis. Success will depend on the involvement of experts who have experience with the actual vessel and know how to operate the equipment on board," he adds.

In identifying the hazards, the shipping industry can draw on the methodology and experience of the offshore drilling industry, supplemented by lessons learned as the Arctic opens up slowly, allowing for

the shipping industry to extend its range of operation gradually into more heavily iced areas.

### Looking back

Explorer Horn undertook most of his expeditions around the world solo. He was no stranger to the Arctic, but law prevented him from doing the Arctic walk alone. He was not sorry. "I now appreciate why this expedition can never be done alone," he said afterwards.

That is the most important lesson his adventure has for shipping, says Mejlænder-Larsen. "The industry must work together to tackle the challenges posed by moving deeper into Arctic waters." ■ WL

### DNV GL Expert

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Photos: DNV GL, Fednav / Tim Keane, IMO



### EQUIPMENT



#### Windows on bridge

Means to clear melted ice, freezing rain, snow, mist, spray and other conditions.



#### Clothing I

Adequate thermal protection for all persons on board.



#### Lifeboats

All lifeboats must be partially or totally enclosed.



#### Clothing II

On passenger ships, an immersion suit or thermal protective aid for each person on board.



#### Ice removal

Special equipment for ice removal, such as electrical and pneumatic devices; hand tools such as axes or wooden clubs.



#### Fire safety

Extinguishing equipment operable in cold temperatures, protected from ice; suitable for persons wearing bulky and cumbersome cold-weather gear.

In 2014, the icebreaking bulk carrier *Nunavik* became the first cargo ship to make an unescorted voyage through the Northwest Passage. The ship is operated by Canadian shipping company Fednav.

**Star Clippers** bring the grand era of sailing ships back to life, providing a cruising experience of a very different kind.





# STAR- STRUCK

Star Clippers President Mikael Krafft grew up in the Stockholm archipelago, sailing and in love with sailboats from a young age. While his peers idolized footballers, Krafft had a T-shirt featuring the legendary “father of the clipper ship” Donald McKay. Some decades later he commissioned the world’s largest sailing cruise ship.

Mikael Krafft doesn’t go for the small stuff. His five-masted *Royal Clipper* was modelled on the giant German windjammer *Preußen*, deemed the fastest sailing ship on the water when she took to the seas in 1902, and the only five-masted full-rig sailing ship ever built – until *Royal Clipper* in 2000. “I loved sailing and the tall ships, and this was a way to bring those two passions together.”

The passion has become a way of life. The first cruises were more like experiments, but Star Clippers eventually got it right. So right, Mikael says, that they consistently get new passengers with vast cruise experience who say they will never go back to the big cruise ships. And they remain loyal.

## Loyal teams

Star Clippers’ niche is mostly European, some American, and a sprinkling of Asian and other guests. Entertainment on a Star Clippers cruise is largely do-it-yourself. “The ship is the main attraction, not jet skis or gambling,” Krafft confirms. With sailing as the main attraction on a Star Clippers cruise, the captain and crew must be as passionate about it as their president. “We really go sailing,” Krafft guarantees. “If I see a captain who is not really sailing, he’s not going to remain captain for long.”

And even if crew members with sailing experience are hard to find, they are generally not hard to keep. “We have a lot of crew members who have been with us since I founded the company,” he says. Most of them like this concept and they are very keen to keep their positions. We also have the Star

Photo: Star Clippers

>



Sailing in style on board a sailing ship has a special appeal for many.

> Clippers Marine Academy in Mumbai, where we train those who may someday become captains."

#### The next "model ship"

Star Clippers has no intention to follow the steep growth curve of the cruise industry, but with things going well, there is room for another ship in their fleet. The fourth, and largest, Star Clippers ship is modelled on the five-masted barque *France II*, another icon in sailing history, built in 1911.

"The French wanted to match the Germans and their vessel *Preußen*, so they built their flagship a bit longer but with a lower aspect. This is the ship I am building now, for the most part right down to the millimetre. The length is the same, but we did have to widen the beam to accommodate modern stability regulations." Krafft got the plans from the National Navy Museum in Paris and commissioned the ship at Brodosplit shipyard in Croatia.

DNV GL will provide classification services for the new vessel, as they have for the entire Star Clippers

fleet. At a length of 162.22 metres, a width of 18.5 metres and a depth of 6.4 metres this will be the largest square-rigger cruise ship in the world. She will have five masts, and her sails will cover an area of 6,350 square metres.

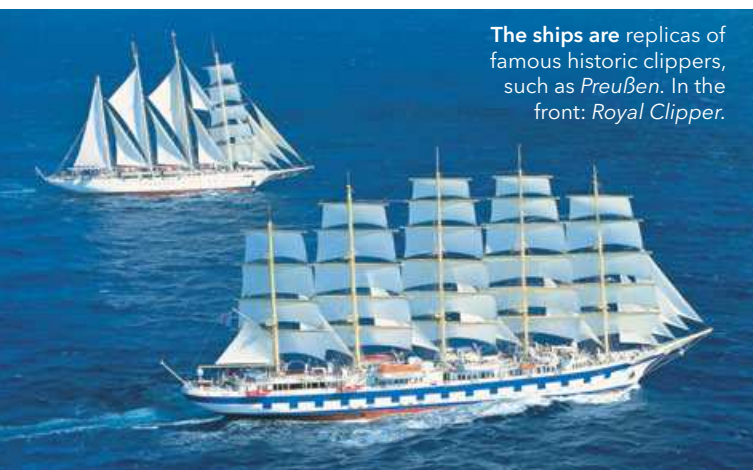
In addition to classification, DNV GL Maritime Advisory will carry out a Safe Return to Port Assessment for the ship. "Since 2010, passenger ships longer than 120 metres, or with three or more main vertical zones, have been required to comply with these requirements. The main intention is to design the ship in such a way that it functions as its own best lifeboat," explains Andreas Ullrich, Specialist Passenger Ships Fleet Service at DNV GL.

The Safe Return to Port Assessment evaluates essential systems and arrangements which must be functional following predefined casualty scenarios. "One of the measures we took is to have redundant safety and machinery systems such as power generation," says Daniel Povel, Team Leader Risk Assessment at DNV GL - Maritime.

#### Innovation and tradition

Star Clippers is also committed to designing and building a ship as quiet as possible to avoid disturbing both passengers and marine mammals. DNV GL has been asked to carry out a noise and vibration analysis. Experts will review the ship's layout and feed all relevant sources of noise into extensive simulations to identify noise reduction mechanisms that need to be implemented. "This can include elastic storage solutions for the machinery, hardening the structures or installing flexible structures that are similar to free-floating floors," Povel explains.

After her delivery scheduled for February 2017, the new Star Clippers vessel will be equipped with 150 luxury cabins. She will be able to accommodate a total of 300 passengers and 140 crew members.



The ships are replicas of famous historic clippers, such as *Preußen*. In the front: *Royal Clipper*.



"I built models of sailing ships as a young boy, and I still do. My wife says I never grew up. But back then I built them on a scale of 1:200. Now I build them 1:1."

**Mikael Krafft**, President Star Clippers



**Mikael Krafft** lives his lifelong passion for tall ships.

Some of her special features include a large open deck space, a spa with direct ocean access from a diving platform, and a three-level dining area.

"It's difficult to get this kind of ship built," Krafft explains. "This is a very small order for the bigger yards and they price it high, so we have to seek out the more accommodating yards." Star Clippers itself will design and build the rig though. "We have the experience, and we know what we want. The shipyards don't want to get involved," he assures.

With no advanced technology to assist in the actual sailing, the Star Clippers fleet is true to the pure concept. That doesn't prevent a little innovation from creeping in though. "We needed a better way to furl square sails, so we solved the problem in a garage in Holland, using long yards and a bunch of fans." The new vessel uses a hydraulic system to furl the sails into the yards. In calm seas this only takes approximately two minutes.

#### A passion for the beauty

Mikael Krafft is thrilled to say he has managed to stay true to his passion for traditional sailing ships and still turn a profit. "We don't do this for economic reasons. We do it because we think it's a lot of fun to build these kinds of ships, and I love it," he says.

Leaders must be passionate about their business, Krafft believes, whatever it is. "It has a profound influence on our staff and the customers. Sailing brings people together," Mikael says. "After two days everybody knows everybody. You don't get that on a ship with three or four thousand people. On my ships, everyone talks to everyone."

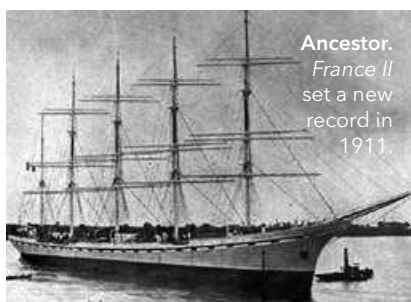
So is it true that Star Clippers puts their guests to work? "We do if they want us to but we don't insist, of course. Most of our American guests either own or have owned their own boat, so they want to be involved. Some stand watch and climb the rigging or go out in the bowsprit net to watch the dolphins and whales at sunset. The main thing for them is that we are really sailing the way they did 100 or 150 years ago." For Mikael Krafft, that is what it is all about. ■ **KG/AJO**

#### DNV GL Expert

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**Ancestor.**  
*France II*  
set a new  
record in  
1911.

#### FACTS ABOUT THE STAR CLIPPERS NEWBUILD BASED ON FRANCE II

Length overall with bowsprit: 162.22 m	Depth to main deck: 12.40 m	Main propulsion: sails
Length on water line: 130.83 m	Depth to clipper bulkhead deck: 9.70 m	Diesel-electric system with four caterpillar generators
Breadth moulded: 18.50 m	Displacement: 8,440 t	Crew: 140 persons
Draught: 6.40 m	Air draught (measured from water line): 64 m	Rigging: five-masted barque

# EVERY SECOND COUNTS

On the evening of 3 January 2015, *Höegh Osaka*, a 16,886 dwt pure car and truck carrier (PCTC) with a cargo capacity of 5,400 car equivalent units (CEU), experienced a severe list when it left Southampton port. The vessel was subsequently grounded on Bramble Bank in the Solent. The master informed the relevant local authorities and arranged for the rescue of the crew. Höegh Autoliners' Emergency Response team assembled at the company's headquarters in Oslo and worked with Wallem, the ship manager, to verify the safety of the crew. Höegh also moved

quickly to reach an agreement with Svitzer, a leading salvage company, to secure the vessel. One of their first calls was to DNV GL's ERS team.

## ERS team on duty

The four-person DNV GL ERS team was activated at 23.46 p.m. and gathered in the ERS Situation Room at DNV GL's headquarters. Equipped with banks of computers, monitors and drawing boards, the room serves as a crisis management centre where the experienced team members perform calculations to

Photo: Geni, CC BY-SA 4.0, 3.0, 2.5, 2.0, 1.0 / Wikimedia Commons

The grounding of the *Höegh Osaka* on Bramble Bank in the Solent.



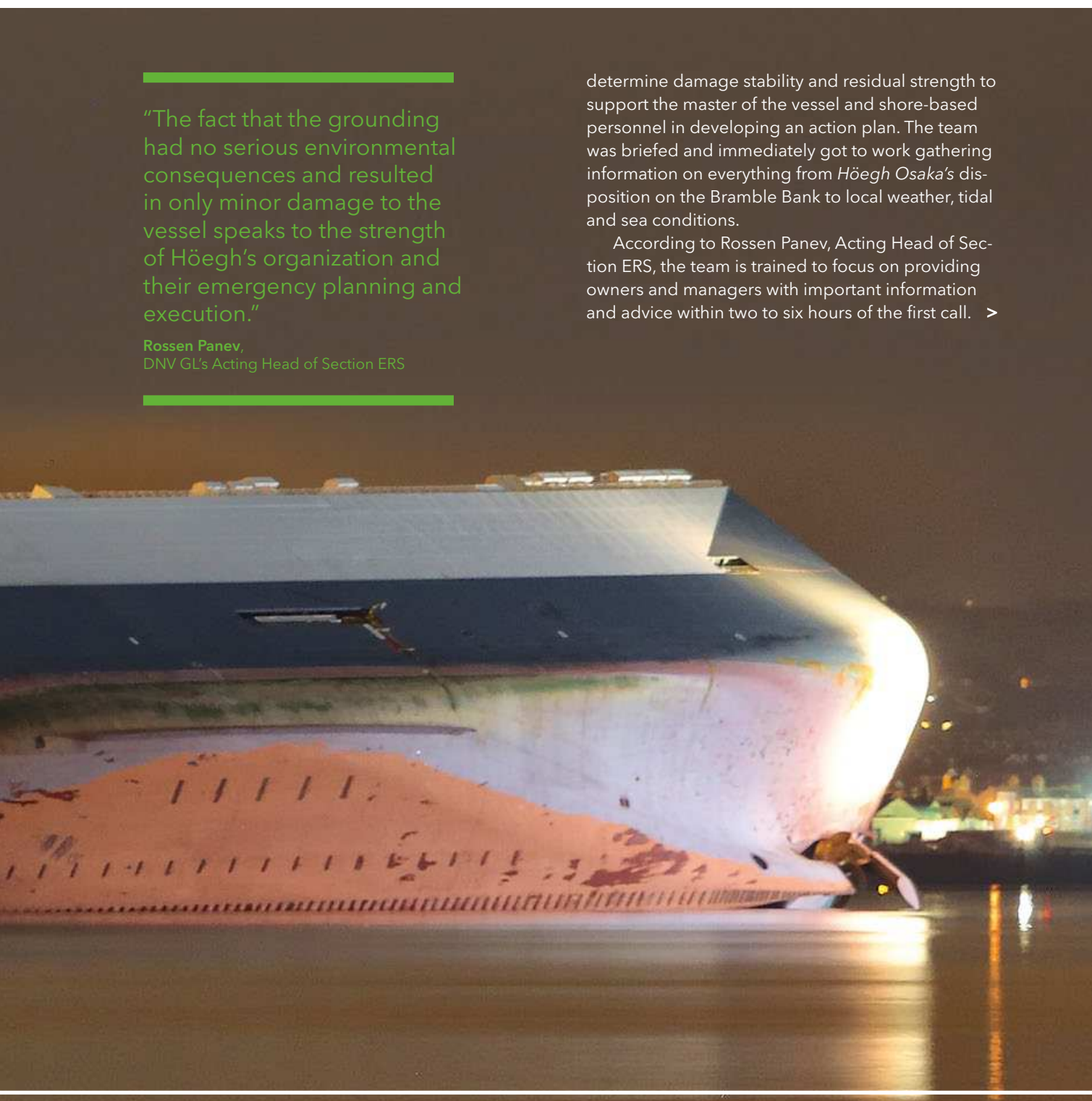
While accidents at sea have declined over the past decade and shipping remains the safest form of transport, accidents do happen. And when they do, a growing number of owners turn to the DNV GL Emergency Response Service (ERS) to obtain immediate support during the first critical hours.

"The fact that the grounding had no serious environmental consequences and resulted in only minor damage to the vessel speaks to the strength of Höegh's organization and their emergency planning and execution."

Rossen Panev,  
DNV GL's Acting Head of Section ERS

determine damage stability and residual strength to support the master of the vessel and shore-based personnel in developing an action plan. The team was briefed and immediately got to work gathering information on everything from *Höegh Osaka's* disposition on the Bramble Bank to local weather, tidal and sea conditions.

According to Rossen Panev, Acting Head of Section ERS, the team is trained to focus on providing owners and managers with important information and advice within two to six hours of the first call. ➤





*Höegh Osaka* safely moored alongside in Southampton on 25 January 2015, after running aground in the Solent.

> “We often work against the clock so we must not waste time speculating what might have caused the event,” he says. “Our primary goal is to assess the situation and support the client as best we can to minimize potential risks to personnel, property and the environment.”

Panev says that the three most common accidents at sea are groundings, collisions and fire. “For a grounded vessel, our first priority is to see if we can safely get the vessel refloated on the next tide,” he says. “To do that, we need to collect information and come up with a good plan as fast as possible. The more time a vessel spends aground in a location with significant tidal differences, the greater the potential for hull damage and progressive flooding. This may eventually compromise the vessel’s strength, residual buoyancy and ability to float safely. This is why we always calculate ‘worst case’ scenarios and help ship-owners be prepared.”

#### Making an action plan

DNV GL has access to vessel drawings and computerized models of all of the 3,725 vessels registered with the ERS. This information is critical to performing load, stability and strength calculations. “Differ-

ent vessel types have different designs and carry different cargoes,” Panev explains. “By analysing a vessel’s damage condition we can identify critical stability and hull stress points and recommend cargo discharge or re-stowing and ballast water or fuel transfer to increase its odds of surviving a refloat.”

One issue for the ERS team in the case of the *Höegh Osaka* was recreating the loading pattern and condition of the ship. “Because the crew had been evacuated, we did not have any reliable information on the condition of the cargo on the decks or the precise location of vehicles or heavy machinery in the vessel, which made calculating the actual stability challenging,” he explains. “However, by cooperating closely with Wallem we got the master of a sister vessel of *Höegh Osaka* to advise us on common loading practices. Based on that information and other data

“Our goal is to support crews and shipowners to find the safest and most cost-efficient way to manage emergencies.”

**Kai Ahlers**, DNV GL’s Deputy Head of Section Emergency Response/Damage & Repair Management



Photos: goodluz – Fotolia, Höegh Autoliners, Nige Brown CC BY 2.0/  
Wikimedia Commons





"We would like to thank everyone who has been involved in this challenging rescue operation, with a special thanks to the Maritime & Coastguard Agency, the RNLI, DNV GL, Gard and Southampton's Port Authorities."

Ingar Skiaker, CEO Höegh Autoliners

from Wallem and the Southampton port captain, we were able to determine that the vessel would not capsize and could be refloated."

#### Proactive response

Meanwhile, Höegh liaised with the UK Secretary of State's Representative for Maritime Salvage and Intervention (SOSREP), local port authorities, the insurer (Gard) and other officials. The next day Höegh Autoliners' CEO Ingar Skiaker flew to Southampton to meet with the press. In a statement, Skiaker expressed his relief that no one was hurt. "The crew is currently being offered all possible support and assistance to help them cope with the ordeal they have been through," he said. "We would like to thank everyone who has been involved in this challenging rescue operation, with special thanks to the Mari-

time & Coastguard Agency, the RNLI, DNV GL, Gard and Southampton's port authorities."

For Panev, who has supported more than 85 emergencies in his eleven years with the ERS, Höegh's response to the event was exemplary. "My hat is off to Höegh for how they handled the situation," says Panev. "They were proactive, cooperative and did a great job in sharing information with all the stakeholders, including the public. Sometimes accidents cause more damage to a company's brand than to the cargo or tonnage. The fact that the grounding had no serious consequences and resulted in only minor damage to the vessel speaks to the strength of Höegh's organization and their emergency planning and execution."

As predicted by the ERS team, the *Höegh Osaka* was successfully refloated on 7 January and towed to safety. With the crisis over and Svitzer in charge of the salvage operation, the ERS team, which had worked around the clock for four days, was able to stand down.

#### ERS: GOOD ADVICE WHEN YOU NEED IT

With over 3,700 vessels registered, the DNV GL Emergency Response Service (ERS) is the largest service of its kind in the industry, covering:

- Detailed and verified advice on how to improve a ship's or MOU's condition in a distressed situation, with a plan for the fastest return to operation.
- 24/7 access to damage stability and residual strength experts for immediate support to vessels in distress, from the incident up until the vessel is safely in repair or back in operation.
- Communication checks and realistic scenario exercises for effective and reliable crew training.
- Evaluation of an existing emergency response plan against reference best practices.
- Compliance with relevant international regulations and requirements.
- The DNV GL ERS is available for all ship types, offshore units and inland vessels, independent of class.

#### Busy year

It is unlikely they will be idle for long. Last year, the DNV GL ERS team supported owners on 33 different occasions, and this year the team has been activated on 13 occasions to date. In two separate grounding events in 2015 the advice provided by the ERS team enabled the vessels to be refloated by their own crews without significant damage to the ships or the environment. The bulk carrier *Adfines North*, owned by ABC Maritime, was refloated south of Lima (Peru) on 12 February, while the Geden Lines bulk carrier *Sharp* was refloated without salvage and with minimal assistance on 18 February.

The DNV GL ERS crisis centre works from both, the Høvik and Hamburg offices. "We manage cases for all vessel types from both locations," says Kai Ahlers, who is heading the Hamburg-based





The DNV GL ERS team was alerted immediately following the first explosion on board of the *MSC Flaminia* in July 2012.

> part of the ERS team. "We have been providing emergency response services since 1993 so we have plenty of experience managing issues related to the size and complexity of these vessels," Ahlers himself has been involved in more than 100 emergency cases since he joined the team in 2001.

He explains that for grounded containerships, the ERS team provides crews and shipowners with stability and strength calculations and recommendations for refloating the vessel. "In some cases it is necessary to discharge containers, but that requires detailed unloading plans to avoid additional damage and costly specialized equipment," he says.

One of the most complex and longest-running cases managed by the ERS team in Hamburg was *MSC Flaminia*. On 14 July 2012, the 6,750 TEU containership had caught fire in the Atlantic Ocean, more than 1,000 nautical miles away from the closest port of refuge. Due to the critical situation on board, the crew was evacuated. The DNV GL experts in Hamburg based their initial evaluations on loading data and rough information from photos. After fighting the fire successfully and obtaining more detailed on site information from Smit Salvage, the ERS team verified the calculations and prepared detailed recommendations on how to stabilize the vessel for towage to the appointed port of refuge. After arrival in Wilhelmshaven, Germany, the ERS experts assisted the shipowner with advice on the unloading procedures and the required loading condition details for safe transfer to a repair yard.

"In such cases we work closely with the on-site crews, shipowners and other stakeholders such as salvage companies and authorities to bring the ves-

sel safely to the closest port of refuge," Ahlers says. "We can't avoid emergencies, but with our knowledge, experience and fast response on permanent call we can certainly support decisions on how to minimize the impact of the incident on the ship, the crew and the environment."

#### Promoting preparedness

DNV GL also offers an Emergency Preparedness Service (EPS) developed to help clients improve emergency response plans and increase their ability to handle complex maritime emergencies. Last year DNV GL launched a special ERS ICE module for owners of vessels operating in harsh environments.

For both Panev and Ahlers, it is the technical and engineering competence and experience of DNV GL that makes the ERS organization such a valuable resource to the industry. "The mission of DNV GL is to safeguard life, property and the environment, so the entire organization is working hard towards the day when the ERS will no longer be necessary," says Panev. "Until that day we are standing by 24/7, always ready to serve." ■ AW

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# JACK-UP SAFETY

DNV GL has developed a new service for analysing the high energy collision response of jack-up structures hit by offshore service vessels.

The evolution of offshore service vessel (OSV) design and operation represents a new challenge for the design and safe operation of both new and existing jack-ups. To accurately assess potential damage and support customers in finding solutions to mitigate the results of such incidents, DNV GL utilizes non-linear finite element (FE) analysis and a tailor-made tool to determine post-collision strength.

"Offshore service vessels operating in the North Sea have grown considerably over the last 20 years, with the typical sizes increasing from 5,000 to up to 8,000 tonnes of displacement. Some special ships even have a displacement in the region of 10,000 tonnes," explains Eivind Steen, Group Leader Structures at DNV GL. "By using state-of-the-art non-linear FE analysis we are able to perform damage assessments that represent the operational conditions defined by our customers."

The design of OSVs has also changed from traditional shapes to bulbous bows and other types of modern bow. The collision response of these units differs from the traditional OSV design specified by existing standards. In combination with the extra displacement, this has changed the game for safe OSV operation alongside jack-up rigs. In recent incidents, collision energies have been found to be significantly

higher than the values of up to 14 megajoules (MJ) assumed by current design standards. Following reported collisions on the Norwegian continental shelf, DNV GL increased the collision energy requirements in its Verification for Compliance with Norwegian Shelf Regulation (DNV-OSS-201) to 35 MJ, in agreement with the Petroleum Safety Authority (PSA).

## Ongoing investigation

To examine how DNV GL can further support customers in improving the safety of their operations and achieving compliance with the regulation, DNV GL experts from the Maritime Advisory division have been assessing the response of jack-up structures to collisions with modern OSVs. The study, which is part of current DNV GL research and development initiatives, is specified as an ongoing investigation into jack-up safety. "The first results show that detailed FE analysis could be of great help in documenting how the structure of an installation responds to a collision with a current-design OSV," says Eivind Steen.

Customers can receive DNV GL support during the jack-up design phase and when reassessing existing units – including quick and simple calculations through screening analysis, or more advanced studies for the most critical scenarios requiring a detailed evaluation of the response. Apart from providing owners and operators with credible documentation, such analyses also deliver realistic damage assessments and help customers prepare their installations for current and future operational challenges.

The new study is just one aspect of the DNV GL Maritime Advisory division's expanded competencies in the Mobile Offshore Unit market segment, particularly investigations of Accidental Limit State (ALS) and the resistance of self-elevating units to collision events. ■ GN

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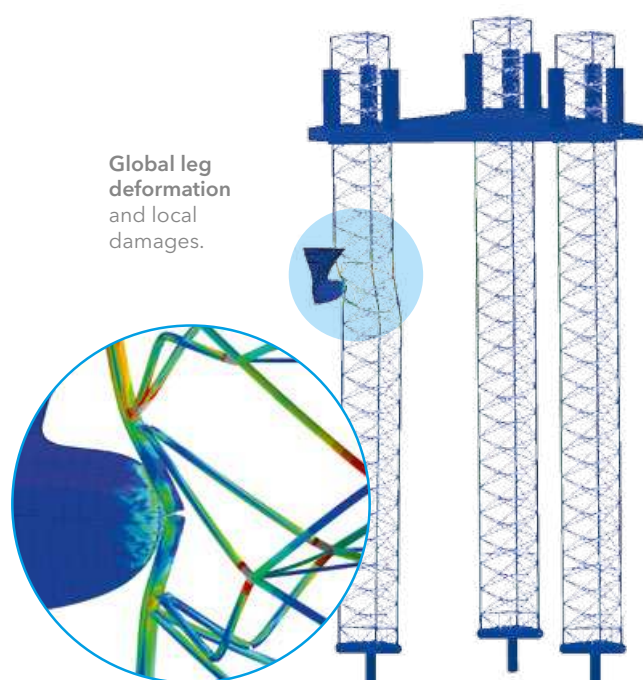
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Photos/Illustrations: DNV GL



# NEW DRIVE TO TRIM NEWBUILD COSTS

Korean shipyards support a project to promote standardization in engineering and construction of offshore oil and gas installations.

South Korean shipyards are market leaders in the construction of floating and fixed offshore oil and gas installations. They are world-class competitively, but even greater savings could result from addressing variations in owner, operator and regulatory requirements during engineering and construction for such projects. Less familiar specifications and processes result in "reworking, delays and misunderstandings in yards worldwide", observes Hans Petter Ellingsen, Group Leader of Offshore Risk Advisory, DNV GL.

Operators address this through on-site teams of up to 300 people, and sometimes move units from Asian yards for completion closer to the final destination or offshore.

## Overcoming complexity

DNV GL has initiated a joint industry project (JIP) to establish a new international industry standard for offshore oil and gas projects. The JIP is based on discussions between Hyundai Heavy Industries (HHI) and DNV GL. It is now being discussed with operators and other Korean fabricators, such as Samsung Heavy Industries (SHI) and Daewoo Shipbuilding and Marine Engineering Company (DSME), as well as the Korea Offshore and Shipbuilding Association and the Korea Marine Equipment Research Institute.

"We hope that it will lead to standardization that helps to reduce design periods and minimize design changes," says Jong Bong Park, Senior Executive Vice President (SEVP) and Chief Operating Officer of HHI's Offshore & Engineering Division. "Other potential benefits include reduced material costs resulting from decreased expenses for materials purchasing, manufacturing and testing. A shortening of materials purchasing lead-time would be expected as more could be held in stock. Surplus materials could be used in other construction projects."

"The complexity and range of standards, regulations and requirements create a big challenge for contractors," observes Dr Younsang Won, SEVP and

Head of Offshore Production Operations, SHI, and Chairman of DNV GL's Korea technical committee. "It takes much effort to clarify and implement these requirements, and there are sometimes omissions, inconsistencies and misinterpretations. This can generate a lot of changes and revisions, even when the design has already been frozen and fabrication or installation has started."

"Using international standards more widely in offshore oil and gas projects has potential to significantly reduce delays and the general cost level without compromising on quality and safety," Ellingsen stresses.





"Using international standards more widely has potential to significantly reduce delays and the general cost level without compromising on quality and safety."

Hans Petter Ellingsen, Group Leader of Offshore Risk Advisory, DNV GL

A maze of standards and requirements causes major headaches for shipbuilders.

### A maritime approach

The DNV GL study "Use of DNV GL Classified Units on Norwegian Continental Shelf: The Maritime Approach" published in May 2014 shows how maritime rules issued by classification societies and maritime flag authorities can save costs in offshore projects.

This "maritime approach", accepted for certain floating offshore units in Norway, has allowed hulls and/or marine systems to be governed by a maritime classification regime rather than the country's Petroleum Safety Authority (PSA) regulations. Maritime class rules exist for many types of floating units. Shelf-state legislation will normally accept use of a flag/class approach for areas of a maritime character.

"The approach has been shown to save cost through all phases of a newbuild project right through to operation. Designers, yards and suppliers work more efficiently when projects apply standards familiar to all players," Ellingsen explains. "One example of such standards is class rules. We would like to establish a standard for oil and gas projects that builds on the well-established approaches of classification. Industry estimates for potential cost savings on construction of installations range well into double-digit percentages. This approach is highly relevant in current market conditions."

Sung-Geun Lee, EVP, Chief Strategy Officer, DSME, agrees that applying maritime regulations to floating units simplifies engineering, procurement and construction procedures: "A maritime approach to standardization is welcome but should be implemented with caution," he advises. "Individual operators and companies have varying regulations, specifications and operating philosophies which may not be fully satisfied by maritime standards."

The risk is that a common standard developed on the basis of harsh environments, such as the North Sea, could end up raising the requirements for "more benign" seas, he adds. "We must also account for local content regulation in various regions."

That said, he hopes that the JIP will provide "the initiative for the standardization movement in the offshore industry". ■ HJL

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# FACING INVISIBLE THREATS

As ships and offshore structures increasingly depend on programmable control systems, there is an urgent need for protection against cyberthreats. DNV GL has developed strategies for strengthening maritime cybersecurity.



Software-driven systems have conquered ships and offshore installations, and while individual on-board systems were kept isolated in the past, the general trend towards integrated control networks has caught on in the maritime industry as elsewhere. What is more, external connections allow advanced systems to transfer operational data to shore or perform software updates. "Ships and offshore structures are becoming more connected," said Tor E. Svensen, CEO of DNV GL - Maritime, speaking about cybersecurity at this year's CMA Shipping event in

Stamford, Connecticut. "For example, it has become common practice to interlink bridge systems with machinery and safety systems."

## Complex systems are vulnerable

System interconnections and online transactions harbour new challenges and security risks, however. Not only can the increasing complexity of on-board networks compromise system integrity; but all programmable components, including machinery, navigation, and communication systems, could fall victim





to cyberattacks. "This is a weak spot," Svensen notes. "There are many ways something can go wrong with systems or software, whether caused by technical malfunction or human error. Cyberattacks exploiting existing vulnerabilities pose an additional risk. This applies to all industries, of course."

Statistics show that most cyberattacks target the energy sector. For example, the Norwegian National Security Authority has received reports of more than 50 cybersecurity incidents in the Norwegian oil and gas sector. The maritime industry is not immune ➤

Illustrations: Marine Cybernetics

#### CURRENT STANDARDS

DNV GL has identified 35 standards pertaining to cybersecurity in the energy, oil and gas and maritime sectors. Much of the original development has come from the US energy sector.

- **ISO 27001/2:** addresses general information security; also relevant for ship and industrial facility systems; well established as a management system and policy guideline at the organizational level.
- **ISA/IEC 62443:** currently under development; addresses industrial automation and control systems. Testing laboratories offering certification to the standard are expected to emerge eventually.
- **ENISA** (European Network and Information Security Agency) issued the "Analysis of Cyber Security Aspects in the Maritime Sector" in 2011.
- **The Norwegian Oil and Gas Association** published "Recommended Guidelines for Information Security Baseline Requirements for Process Control, Safety and Support ICT Systems".
- **DNV GL** offers testing against its own Enhanced System Verification Rules or Integrated Software Dependent Systems (ISDS) standard.

**Integration testing** examines the behaviour of a software application or module in conjunction with other software.



> to these threats: the recent manipulations of AIS, ECDIS and GPS data have demonstrated that ships are equally vulnerable.

### Identifying blind spots

Why are automation and control systems vulnerable? Typically, external network connections are used for remote debugging and maintenance. Commercial off-the-shelf products use commercial operating systems, which might not be regularly patched and use unsecured communication protocols. Additionally, security policies and procedures are often inadequate, partly due to a lack of awareness and suitable training.

"In the end, it doesn't matter what causes systems to fail," Svensen says. "We need to have the right procedures and technology in place in order to minimize the risks and deal with the consequences."

#### USCG: CYBERSECURITY STRATEGY ROLLED OUT

"The maritime industry is rather late in the game of addressing cybersecurity," says Blaine Collins, DNV GL Vice President, Group Government and Public Affairs in the US. "But cyberattacks on the consumer end, on financial institutions or even entertainment companies such as Sony have attracted a lot of attention. In the US, in general, cybersecurity has become a major concern."

In a recent report, the Government Accountability Office (GAO) also recommended that the USCG assess cyber-related risks and use the assessment to give maritime security guidance. Accordingly, the USCG has set cyber security as one of four focus areas for 2015. "We expect the USCG Cybersecurity Strategy to be rolled out sometime soon," says Collins.

In response to the increasingly complex technology in the offshore sector, DNV GL began to formulate procedures for software development and integration, then moved into testing of control systems and is now addressing vulnerability to external threats.

In 2014, DNV GL acquired Marine Cybernetics, an offshoot of the Norwegian University of Science and Technology at Trondheim which has been developing hardware-in-the-loop (HIL) testing methods to assess control systems and their robustness (refer to illustration on the right). "Control systems provide millions of options, but in a sea trial you can only test a few procedures," Svensen explains.

While the primary customers for the HIL testing programme have been drilling rig operators who specify it in contracts for new rigs, new customers have emerged in the offshore support and subsea construction vessel segments.

The main concern for merchant ships is to ensure that system integration avoids conflicts between systems, and to test the software thoroughly. Furthermore, care must be taken to minimize system exposure to cyberthreats when performing software upgrades via the Internet.

"Networked systems are the future," Svensen adds, "but we must integrate appropriate safeguards that do not rely on the crew to function properly."

### Supporting the US Coast Guard

Its long-standing experience in addressing risks related to integrated information systems has enabled DNV GL to provide consultancy services to organizations such as the US Coast Guard (USCG) on building a regulatory framework and implementing maritime cybersecurity standards. "DNV GL is well positioned to contribute to regulations and establish rules, class notations, recommended practices and guidelines," Svensen underlines.





### WHAT IS HARDWARE-IN-THE-LOOP (HIL) TESTING?

"HIL tests examine the functionality and robustness of control system software, making sure that software is functioning correctly," explains Jan-Tore Ervik, VP Sales and Marketing US of DNV GL's independent business unit Marine Cybernetics. "We use in-house CyberSea technology and in-

dependent testers to ensure unbiased results. We have tested more than 300 systems on 150 vessels, encompassing a total of 60,000 test cases and 10,000 findings."

Testing often includes integration between different systems.

HIL tests help verify that control system software is resistant to failure, whether caused by technical fault, human error or cybercriminals.

**HIL testing** uses a simulated system environment to verify the functional reliability of a device.



Today, DNV GL offers information security and consulting services to customers in the energy, maritime and oil and gas sectors, building on established risk-based approaches and taking requirements from relevant own, national and international standards (see info box on page 49).

### Software to directly address cyberthreats

DNV GL introduced its own Integrated Software Dependent Systems (ISDS) standard in 2009. Originally developed and optimized for the offshore industry, ISDS helps to ensure that a vessel's integrated and stand-alone control systems perform reliably and safely. Unlike other class notations, ISDS requirements address the development process rather than the finished product.

Other DNV GL services such as cybersecurity audits or "health checks" take things to the next level. DNV GL's independent business unit Marine Cybernetics offers a combination of hardware-in-the-Loop (HIL) and cybersecurity tests to address typical threats such as network storms and penetrations,

password attacks, disconnections and communication failures.

### Moving forward

There is already much that can be done to improve protection against cyberattacks. Nevertheless, all industry stakeholders should share more information on cyberevents so as to learn and progress. To mitigate risks, Svensen recommends frequent cybersecurity self-assessments as well as third-party assessments, audits, testing and verification for asset owners and operators.

"Once you have taken care of software integrity, installed data protection and assessed the risks with HIL testing or ISDS, you are in a good position to take the next step in improving cybersecurity," he says. ■ AMO

### DNV GL Expert

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# A GLIMPSE AT THE FUTURE OF SHIPPING

The 14th International Conference on Computer Applications and Information Technology in the Maritime Industries (COMPIT) has taken the lead in bringing together software developers and users for the advancement of shipbuilding and shipping technology.



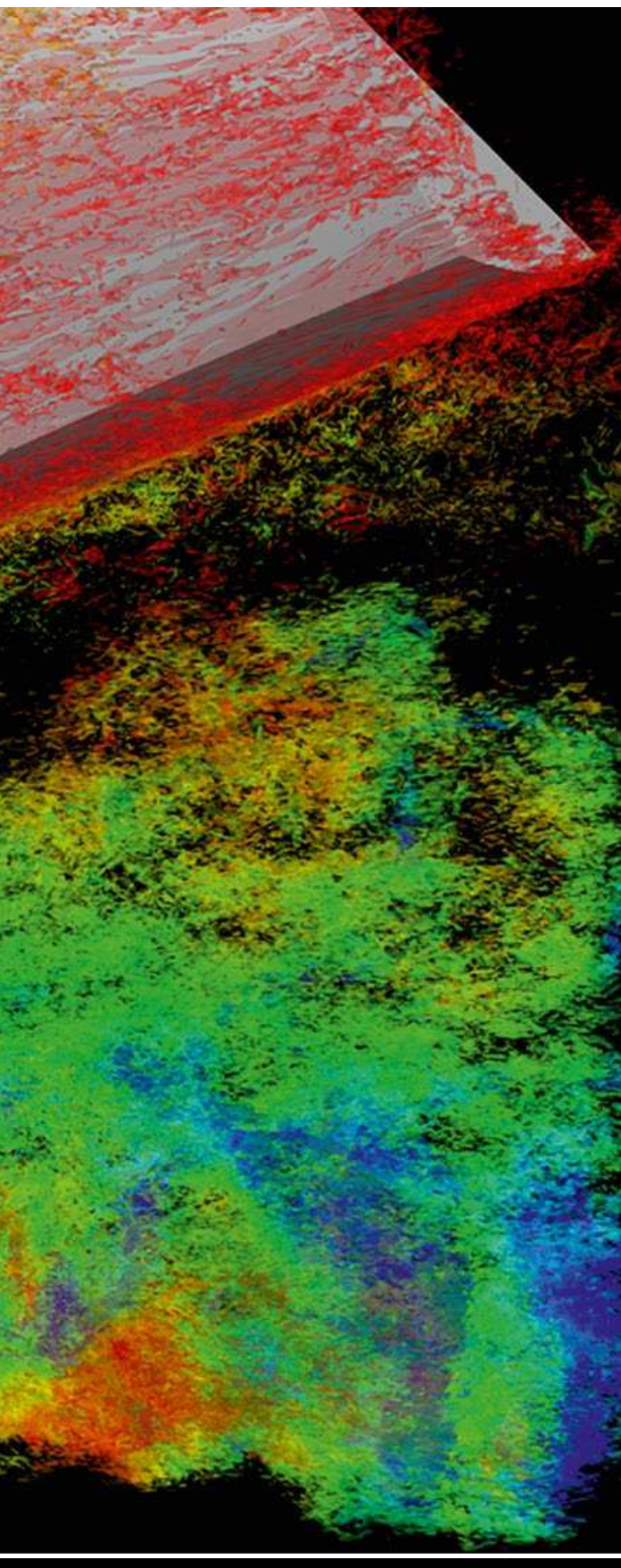


Photo: DNV GL; Illustration: Shipbuilding Research Centre of Japan

Covering many of the most important technical topics in shipping, the COMPIT conference has grown from strength to strength since it was held for the first time 15 years ago. COMPIT 2015, which took place in Ulrichshusen, Germany, saw 99 participants from 18 nations hold 49 presentations. The proceedings – COMPIT's "Big Red Book" – weighed in at nearly 600 pages, with papers covering everything from virtual ship design and augmented reality to voyage planning and insights from Big Data. Sponsor numbers have also grown steadily, with this year's list including many leading lights of the industry.

Each year COMPIT covers the major phases in the lifecycle of ships over three days. This year, day one addressed ship design with sessions titled "3D Hull Models", "Simulation-based Design", "Coupled Simulations" and "High-Performance Computing for CFD". Day two looked at ship lifecycle management and production with sessions on "Product Lifecycle Management", "IT for Ship Production & Ship Repair", "Virtual & Augmented Reality" and "Maritime Robotics", and day three examined ship operation with the topics of "Ship Routing", "Big Data & Performance insight", "Sea Traffic Management" and "Towards Unmanned Shipping".

#### Big Data grows in importance

More data has been created in the last four years than since the beginning of time. This information is created by machines and includes sources such as AIS data, machinery sensors and embedded chips. Big Data is high-volume, high-speed and high-variety data that is difficult to process using traditional tools. It may help us with business intelligence, predictive maintenance, streamlining traffic flows and other performance enhancements. Several sessions



**CFD calculations** enable simulation of vessel hydrodynamic performance faster and more accurately than ever before – here with Japan's massive K-computer.

**COMPIT participants** reading the "Big Red Book" covering the comprehensive conference proceedings on about 600 pages.

**Virtualization** has catapulted ship designers, builders and optimizers into a new era where concepts and models can be tested nearly without limitation.

**Experts debate** advanced IT applications for the lifecycle of ships and offshore structures at the 14th COMPIT.

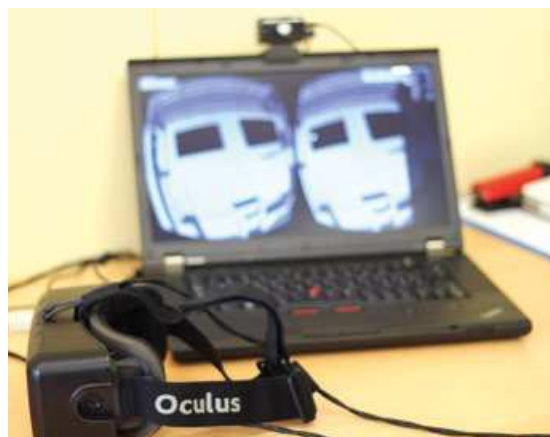
> touched in part or were completely focused on the topic. DNV GL expert Kay Dausend-schön's presentation "Big Data - Business Insight Building on AIS data" gave some concrete examples of how Big Data analyses can help ports and ship operators improve operational performance and gain business insight on competitors. In one striking case Dausendschön showed how analysis of irregular speed patterns using AIS data had identified annual bunkering costs two million dollars higher in one customer's 8,500 TEU vessel.

#### Japan's strong presence

A growing reputation has helped COMPIT attract more and more participants from outside Europe - and this year was no exception. Notable in 2015 was the large number of attendees from Japan, who alongside COMPIT Award winner Dr Tatsuo Nishikawa had a big impact on the programme.

In the session covering ship routing, three of the five presentations were from Japanese participants. Toshiyuki Kano from NMRI, Chen Chen from Kobe University and Hideo Orihara from Japan Marine United Corporation impressed the audience with their presentations. In the "IT in Ship Production & Repair" session as well there was a great deal of interest in Tomoya Iwashita's presentation: "Heap-Model-Based Scheduling of Ship Building Lines for Tandem Construction of a Pair of Ships". The paper analyses scheduling at Oshima Shipbuilding and suggests a new method to optimize the construction process.

Since the turn of the century, the sharp end of computing power has been transformed by the rise of huge numbers of parallel computers with tens of thousands of processors and millions of individual cores. This new architecture has been especially valuable in allowing ship experts to run computational fluid dynamics (CFD) calculations to simulate vessel hydrodynamic performance more accurately than ever before, in less time. The transformative power was put to use in the service of the maritime industry



#### DNV GL PRESENTATIONS AT COMPIT

- Christian Cabos, Bernd Tietgen (DNV GL), Byeong-Seog Kang, Sungho Ha (Samsung Heavy Industries), Tapio Hulkkonen (NAPA) - "3D Ship Design from the Start - An Industry Case Study".
- Kay Dausendschön (DNV GL) - "Big Data - Business Insight Building on AIS data".
- Knut E. Knutsen, Steinar Låg, Gabriele Manno, Grunde Løvoll (DNV GL) - "Implementing a Hadoop Infrastructure for Next-Generation Collection of Ship Operational Data".
- Andreas Krapp (Jotun), Volker Bertram (DNV GL) - "Hull Performance Monitoring - Combining Big Data and Simulation".





The winner of the DNV GL COMPIT Award 2015 is Tatsuo Nishikawa (c.). He is presented with the award by Albrecth Grell (l.), Director of the Maritime Advisory division at DNV GL, and COMPIT organizer Volker Bertram, DNV GL – Maritime.

for the first time by the winner of the DNV GL COMPIT Award 2015, Dr Tatsuo Nishikawa from the Shipbuilding Research Centre of Japan in Tokyo.

#### Access to great computing power

Dr Nishikawa's paper "Fully Resolved Large Eddy Simulation of Double-Model KVLCC2 in Self-Propulsion Test Condition" presents numerical ship propulsion tests performed on Japan's K-computer, currently the fifth largest computer in the world, using 60 billion cells and 200,000 cores in parallel. This is some 10,000 times the number of cells and cores available to even the most powerful computing clusters currently used in industry applications.

"Dr Nishikawa's paper gives us a preview of what we can expect to see in CFD as we are able to access greater computing power over the coming years. It is like a look into the future as we go from teraflops to having petaflops, even exaflops of power at our disposal," said COMPIT organizer Volker Bertram from DNV GL. "Over the next 10 to 15 years, similar processing capabilities will enable the industry to benefit from Dr Nishikawa's pioneering work."

After three days of non-stop presentations, the COMPIT conference went out with a bang with

Giampiero Soncini's (SpecTec) presentation "Sense and Nonsense of No-crew, Low-crew Ships". Unapologetically forward-looking, Soncini made a strong case for a shipping industry without on-board crew. With some trains already totally automated, airplanes largely under automatic control and the Google car on the way, what was holding shipping back? Soncini looked at what could be gained by reducing on-board numbers even further and the legal, political and cultural hurdles as well as the technical developments that would need to be overcome to realize unmanned commercial shipping.

Even with the final dinner beckoning, there was a full house for Soncini's frank and provocative talk, which left everyone with much to mull over and discuss. A fitting caper to another successful conference that left everyone ready for next year's trip to Lecce and COMPIT 2016. ■ SIAD

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08. - 09.06.15

**Maritime Risk Management and Incident Investigation Course**  
Høvik, NO

08. - 11.06.15

**Approved HazMat Expert**  
Hamburg, DE

08. - 12.06.15

**ISRS Assessor Course**  
Rotterdam, NL

09.06.15

**Gas as Ship Fuel**  
Hamburg, DE

09.06.15

**Vessel General Permit**  
Madrid, ES

09. - 10.06.15

**Accident Investigation in Shipping - Analysis and Root Cause**  
Riga, LV

09. - 11.06.15

**Train the Trainer for Shipping Companies**  
Piraeus, GR

11. - 12.06.15

**Effective Leadership in a Maritime Environment**  
Mumbai, IN

11. - 12.06.15

**Offshore Vessel Management and Self Assessment (OVMSA) Workshop**  
Genoa, IT

16. - 17.06.15

**Designated Person Ashore (DPA) Training Course**  
Makati City, PH

16. - 17.06.15

**Machinery Course**  
Høvik, NO

16. - 17.06.15

**Management of Change - Risk Assessment**  
Istanbul, TR

16. - 18.06.15

**Company/Ship Security Officer (CSO/SSO) Training Course**  
Piraeus, GR

17. - 19.06.15

**HAZOP Leader Course**  
Antwerp, BE

18. - 19.06.15

**Electric Design**  
Busan, KR

19.06.15

**Hull Inspection using 3D Simulator (Bulk Carriers)**  
Genoa, IT

19.06.15

**Plans for Recovery of Persons (new SOLAS III/17-1)**  
Mumbai, IN

23.06.15

**Media Handling for Shipping Companies**  
Makati City, PH

23. - 25.06.15

**Hull Structure and Strength - Concept and Rules**  
Istanbul, TR

24.06.15

**Practical Marine Risk Assessment Course**  
Rotterdam, NL

24. - 26.06.15

**Internal Auditor of an Integrated Management System acc. to ISO 9001, ISO 14001 and OHSAS 18001 for Shipping Companies**  
Makati City, PH

24. - 26.06.15

**Hull Structure Course - Oil Tankers and Bulk carriers**  
Piraeus, GR

25.06.15

**Introduction to the Offshore Industry and Dynamic Positioning**  
Singapore, SG

25.06.15

**Navigational Audits**  
Hamburg, DE

25. - 26.06.15

**Accommodation Design Course**  
Busan, KR

30.06. - 02.07.15

**Planning and Managing a Drydocking for Superintendents**  
Madrid, ES

02.07.15

**Efficient Communication in a Maritime Environment**  
Piraeus, GR

07. - 08.07.15

**Energy Efficient Operation of Ships - Masterclass**  
Limassol, CY

08. - 09.07.15

**OHSAS 18001 for Shipping Companies**  
Rotterdam, NL

09. - 10.07.15

**LNG Essential and Liquefaction System**  
Busan, KR

14. - 21.07.15

**PSC - Interactive Workshop**  
Madrid, ES

16. - 17.07.15

**TMSA Workshop - Efficient Tanker Operation**  
Genoa, IT

02. - 06.08.15

**Superintendent Workshop - Managing day-to-day operations**  
Dubai, AE

12.08.15

**Ballast Water Management**  
Dubai, AE

20. - 21.08.15

**Internal Auditor ISM- ISPS-MLC for Shipping Companies**  
Singapore, SG



# EVENTS & EXHIBITIONS



Please visit: [dnvgl.com/events](http://dnvgl.com/events)  
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conferences and exhibitions.

15. - 17.06.15  
**International  
Conference on  
Computational Methods  
in Marine Engineering**  
Rome, IT

16. - 17.06.15  
**10th Annual Ship  
Recycling Conference**  
London, GB

24. - 25.06.15  
**OSV & Subsea  
Vessels Mexico**  
Mexico City, MX

14. - 15.07.15  
**LNG Fuelled  
Tugs & Barges  
Conference**  
New Orleans, USA

11. - 13.08.15  
**Marintec South  
America -  
12th Navalshore**  
Rio de Janeiro, BR

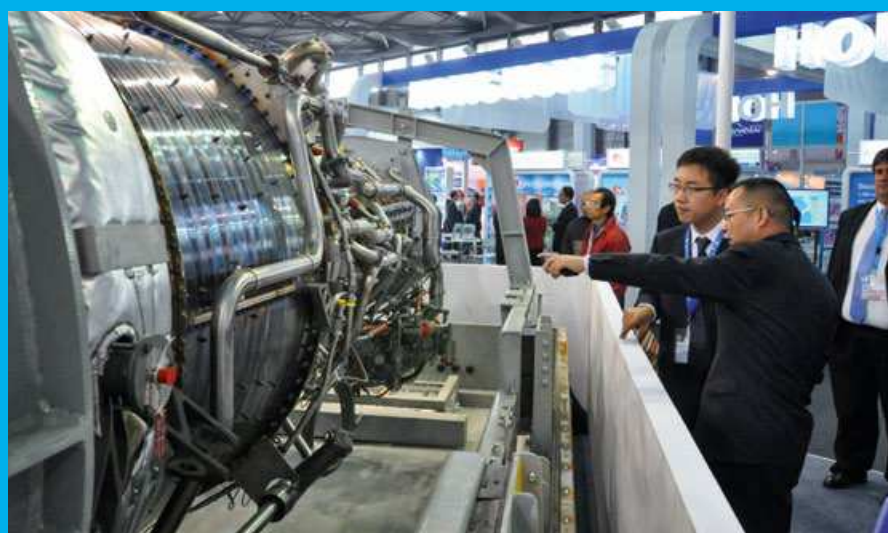
07. - 09.09.15  
**BALTEXPO  
International  
Maritime Exhibition**  
Gdansk, PL

08. - 11.09.15  
**SPE Offshore Europe**  
Aberdeen, GB

10. - 11.09.15  
**Global Liner Shipping  
Asia Conference**  
Singapore, SG

20. - 22.09.15  
**Intermodal  
Expo 2015**  
Fort Lauderdale, US

22. - 25.09.15  
**NEVA 2015**  
St Petersburg, RU



**Marintec China** is the largest and most authoritative maritime trade fair in Asia.

23. - 25.09.15  
**INMEX-SMM India**  
Mumbai, IN

23. - 26.09.15  
**Monaco Yacht Show**  
Monaco, MC

24. - 25.09.15  
**BWMTech,  
Ballast Water  
Management Technology**  
North America  
Conference  
Miami, US

28. - 29.09.15  
**LNG Fuel Forum**  
Stockholm, SE

03. - 07.10.15  
**Interferry Conference**  
Copenhagen, DK

05. - 07.10.15  
**Seatrade Offshore  
Marine & Workboats**  
Abu Dhabi, AE

06. - 07.10.15  
**Offshore Support  
Vessel Conference**  
Oslo, NO

06. - 08.10.15  
**PACIFIC 2015:  
International  
Maritime Exposition**  
Sydney, AU

20. - 23.10.15  
**Kormarine 2015**  
Busan, KR

27. - 30.10.15  
**Gastech**  
Singapore, SG

03. - 04.11.15  
**Arctic Shipping North  
America Forum 2015**  
Newfoundland, CA

03. - 06.11.15  
**EUROPORT - Exhibition  
for Maritime Technology**  
Rotterdam, NL

03. - 07.11.15  
**World Marine  
Conference,  
SNAME**  
Providence, US

04. - 07.11.15  
**Marine Indonesia**  
Jakarta, ID

06.11.15  
**Eisbeinessen**  
Hamburg, DE

17. - 19.11.15  
**Intermodal Europe**  
Hamburg, DE

01. - 03.12.15  
**International  
WorkBoat  
Show 2015**  
New Orleans, US

01. - 04.12.15  
**Marintec China 2015**  
Shanghai, CN

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## DNV GL

Driven by its purpose of safeguarding life, property and the environment, DNV GL enables organisations to advance the safety and sustainability of their business. DNV GL provides classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries.

It also provides certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, DNV GL empowers its customers' decisions and actions with trust and confidence. The company continuously invests in research and collaborative innovation to provide customers and society with operational and technological foresight. DNV GL, whose origins go back to 1864, operates globally in more than 100 countries with its 16,000 professionals dedicated to helping their customers make the world safer, smarter and greener.

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**100**  
Countries

**16,000**  
Employees

**400**  
Offices

**13,000**  
Ships and MOUs in class