

MARITIME IMPACT

ISSUE 01-16

THE MAGAZINE
FOR CUSTOMERS AND
BUSINESS PARTNERS

MODERN CLASS

KEEPING THE PROMISE



CYBERSECURITY

Thinking ahead:
protecting marine assets
from cyberthreats

DRONES

Cutting-edge technology:
drone inspections reduce
survey times and costs

DNV GL RULES

Double first: meet the
vessels constructed to
the new rule set

TAKE A MODERN APPROACH TO SHIPBUILDING

THE NEW DNV GL RULES

To meet the challenges of the modern maritime industry, DNV GL has created a new set of rules that are efficient and adaptable to your needs today and tomorrow.

Our new rules are the result of extensive industry involvement. They feature new approaches, including an enhanced method for determining dynamic wave loads, and are supported by powerful calculation tools.

Providing the ideal basis for a timely and cost-efficient new-building process, the DNV GL rules are ready for the future and create a new benchmark for the maritime industry.

Learn more at
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The DNV GL rules advantages

- Efficient
- Future-ready
- Consistent
- Transparent
- Modern
- Adaptable

Calculation tools -
free of charge in 2016



Knut Ørbeck-Nilssen
CEO of DNV GL - Maritime

It was with great pleasure that I read that this year's Posidonia trade fair was on course to be the biggest yet, especially in the light of today's unfavourable market conditions. This is a testament to the resilience of our industry, but in particular to the strength of the Greek maritime cluster, which remains among the most influential in the world.

The Greek cluster has always been of special importance to DNV GL. Our relationships stretch back over 100 years. At the heart of this is a tradition of close cooperation, based on our strong presence in the region.

Many of our customers are at home in Greece and so are we - which is why we are making Greece our "third home market". We have implemented a set of measures that will enhance services to the Greek shipping community, boost response times and strengthen the responsibilities and capabilities in the region.

Posidonia is not only a trade fair, but has an important conference programme. Smart shipping and the rise of complexity in the maritime world look to be some of the key issues.

At DNV GL, using data in a smarter way is one of our core strategies for the future. It forms the basis of our customer-centric strategy - part of what makes us not only the world's leading classification society but the most modern.

For us being the most modern classification society means taking the lead in implementing state-of-the-art rules, digital solutions, and transforming our processes through the deployment of new technologies. One of these is the use of drones, which has the potential to transform the way surveys are carried out on board vessels in our class. In this issue we show how using drones to visually check the condition of structural components can reduce survey times, cut costs and improve safety.

New technologies and complex systems, in addition to their benefits, can also pose new risks. This is why we are working with our customers to develop cybersecurity management plans to enhance the security of their IT systems. In this issue we examine one such project undertaken with Tsakos Columbia Shipmanagement.

I hope to see many of you at Posidonia, where we will be sharing insights into these topics and many more at our booth. Because even in these tough times, we must continue moving forward, working cooperatively and innovatively to ensure that the maritime industry continues on its path to becoming safer, smarter and greener.

A stylized, handwritten signature in black ink, appearing to read 'Knut Ørbeck-Nilssen'. The signature is fluid and extends across the width of the text area.

Knut Ørbeck-Nilssen

WIDE, WIDER, RAMFORM

In the unlikely event of bumping into this vessel while it's in operation, it would be very difficult to get out of the way - with a 70-metre-broad stern the DNV GL-classed seismic acquisition vessel *Ramform Tethys* is the widest ship in the world.



Image courtesy of PGS

Ramform Tethys is one of four Ramform Titan class vessels owned by Norwegian seismic company PGS, and was delivered at Mitsubishi Heavy Industries shipyard in Nagasaki in March 2016. "Her shape is unique and gives the vessel more stability in rough operational environments," explains Norbert Kray, DNV GL's Area Manager in Japan.

With an engine power of 26,400 kW, a stern equipped with 24 streamer reels and optimized equipment handling processes on the back deck, *Ramform Tethys* has an unrivalled level of flexibility and redun-

dancy for high-capacity configurations and sets a new industry standard for marine seismic acquisition vessels. "Productivity, safety, stability and reliability are the key benefits of these vessels. Their ability to tow many streamers gives high data quality with dense cross-line sampling and cost-efficient acquisition with wide tows," says Per Arild Reksnes, Executive Vice President Operations at PGS. *Ramform Tethys* typically tows a network of several hundred thousand recording sensors over an area greater than twelve square kilometres, which is equivalent to almost 1,700 football pitches.



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Knut Ørbeck-Nilssen,
CEO of DNV GL - Maritime

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IN BRIEF



China sets up its own emission control areas

While the International Maritime Organization (IMO) is currently discussing whether to implement the 0.5 per cent global sulphur cap in 2020 or 2025, China has released emission regulations of its own.

Ships, including ocean-going vessels, which operate in areas near the Pearl River Delta, Yangtze River Delta and the Bohai Sea will be obliged to use fuel containing less than 0.5 per cent sulphur from 1 January 2019. Eleven Chinese ports within the designated areas have been allowed to apply the same requirement to ships at berth since 1 January 2016. From 1 January 2017, the requirement will become mandatory for all ports within the designated emission control areas (ECAs). At the end of 2019 the Chinese government will assess the situation

and consider whether it is necessary to reduce the sulphur limit to 0.1 per cent. It should be noted that this regulation is not linked to MARPOL's ECA requirements; strictly speaking it is a Chinese unilateral regulation. The practical implication of this is that the IMO's ECA regulation provides no formal guidance as to how the Chinese authorities will implement or enforce their own requirements.



DNV GL has published an updated guideline on low-sulphur operations at: www.dnvgl.com/maritime/low-sulphur-operation.html



DNV GL launches LNG intelligence portal

The LNGi portal aims to bring stakeholders from across the liquefied natural gas (LNG) industry together to share market intelligence and promote LNG as a ship fuel.

LNGi allows subscribers to determine the availability of LNG fuel for specific trade routes

and newbuilding projects while providing information about current market developments along with status updates on other alternative fuels and emissions reduction technologies across all vessel segments.

An interactive map highlights existing and

planned LNG bunkering infrastructure. The portal also publishes news on alternative fuels and emission control solutions. All information on LNGi is reviewed by the Society of Gas as Marine Fuel (SGMF). Major stakeholders have already signed up to LNGi.

Gerd-Michael Würsig,
Business
Director LNG-
fuelled ships
at DNV GL -
Maritime.



World's first FLNG production unit to be classed by DNV GL

A floating liquefied natural gas production facility (FLNG), which is expected to be the world's first in operation, has been named at a ceremony held by PETRONAS and its strategic partners Daewoo Shipbuilding, Marine Engineering (DSME) and Technip at DSME shipyard in Okpo, South Korea.

PFLNG SATU is the first FLNG ordered by Malaysia's state-owned oil company PETRONAS. Following delivery the unit will be deployed in the Kanowit gas field off-



Naming ceremony of *PFLNG SATU* at DSME shipyard in South Korea.

shore Sarawak in Malaysia where it is expected to produce up to 1.2 million tonnes of LNG every year. *PFLNG SATU* is 365 metres long and 60 metres wide, with an LNG tank capacity of 177,000 m³

spread across eight tanks in dual-row configuration. The unit will be classed by DNV GL with the notation + OI Ship-shaped LNG Production and Storage Unit, POSMOOR, HELDK, COMF-V(2).

Editorial design awards for MARITIME IMPACT

MARITIME IMPACT has been presented with two Awards of Excellence at the renowned International Creative Media Awards (icma).

The MARITIME IMPACT 01/15 cover "Pushing Limits", displaying a close-up view of a bulbous bow, was honoured for its outstanding concept and design. In the same issue, the Facts & Figures double-page spread about ship sizes ("Giants of the Seas") received an award in the category Visual Storytelling. In the previous year, DNV GL's magazine for customers and business partners had also won two icma awards.

Organized by the International Editorial-Design and Research Forum, icma aims to promote information exchange in the field of corporate media, design, books and magazines on an international level. The award was launched in 2010 and saw an outstanding number of submissions at its sixth event at the end of last year. 411 publications from 17 countries took part and



The editorial team of MARITIME IMPACT receiving the icma certificates (from left to right): Andreas Bodmann, Nikos Späth (both DNV GL Maritime Communications), Peter Lindemann, Oliver Lohrengel (both printprojekt), Nina Chemaitis, Alexandra Jane Oliver and Simon Adams (all DNV GL Maritime Communications).

received prizes in 22 categories, amongst others B2B magazines, annual reports, infographics, online & crossmedia, and iPad apps. MARITIME IMPACT was launched in 2014 and is produced by DNV GL Maritime Communications and the Hamburg-based editorial agency printprojekt.



About 1,500 seafarers take part in training courses at the Maria Tsakos TCM Academy every year.

TAKING THE LEAD IN CYBERSECURITY



Sokratis Dimakopoulos, Deputy Managing Director of Tsakos Columbia Shipmanagement, explains the initiatives his company has taken to enhance cybersecurity, operational efficiency and personnel competence.

With a surge of cyberattacks across all industries, protecting shipping companies and their assets has become essential to ensuring safe operations. Recently published guidelines on marine cybersecurity by the round table of international shipping associations call upon shipping companies to enhance the security of their IT systems by developing cybersecurity management plans for their organizations and fleets. Several companies have already started to act on this with support from DNV GL - one of them is Tsakos Columbia Shipmanagement (TCM).

"We wanted to assure our charterers and customers that our systems would be adequately protected from cyberrisks by implementing the highest standards of cybersecurity on board our vessels and on shore. DNV GL's proactive attitude, its clear vision and commitment to the highest standards will assist us in achieving this," says Sokratis Dimakopoulos, Deputy Managing Director of TCM. Over the past five months, TCM has been working with DNV GL to create an information security management system

which will assist in assessing cybervulnerabilities and implementing the necessary measures for mitigating risks and responding to potential system breaches.

"The results are based on a thorough risk and gap analysis and will be verified through penetration testing carried out by the DNV GL Group company Marine Cybernetics," explains Nikolaos Kakalis, Head of the

"We wanted to assure our charterers and customers that our systems would be adequately protected from cyberrisks by implementing the highest standards of cybersecurity on board our vessels and on shore."

Sokratis Dimakopoulos, Deputy Managing Director, Tsakos Columbia Shipmanagement



DNV GL - Maritime R&D and Advisory unit in Greece. DNV GL is the first classification society to implement this kind of cybersecurity service in practice.

In addition to developing a robust information security management system, TCM has reinforced its IT department, developed in-house solutions for performance management and will be one of the first shipping companies in the world to apply for certification to the ISO 27001 standard. To be awarded this certification, companies need to demonstrate a process-driven approach for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving their information security management system.

Training for 1,500 seafarers per year

TCM manages a fleet with a total of more than six million dwt, which primarily consists of tankers. In 2013, the company added two DNV GL-classed dynamic positioning DP2 shuttle tankers and a third will be delivered in 2017. "Equipped with state-of the art, technically advanced systems with sophisticated automation capabilities, these vessels require personnel with specialized skills and advanced training. We decided early on to invest in developing an in-house pool of skilled DP officers and crew to ensure safe and reliable operations," says Dimakopoulos.

"Our Maritime Training Centre, the Maria Tsakos TCM Academy, has a DP bridge simulator and is currently acquiring accreditation for DP training and certification under an internationally recognized scheme," he adds. Established in 2013, the academy has been expanding rapidly, both in terms of technology and its curriculum." About 1,500 seafarers take part in TCM training courses every year and have access to a Class A bridge simulator, ECDIS simulators, cargo handling workstations, engine room simulators and a DP bridge simulator. "We consider our human resources as the key success parameter for our company. As such we are allocating significant resources to professional development projects to ensure that we attract, train and retain competent personnel," says Dimakopoulos.

Optimizing internal processes and fleet organization are also at the top of the agenda at TCM. "We have reorganized our fleet groups based on their trading areas in order to facilitate best practice sharing and enhance in-house experience for dealing with operational challenges particular to a region," states Dimakopoulos. In addition, TCM has been cooperating with DNV GL to improve the energy efficiency of cargo discharge and cargo heating operations as well as optimizing its dry-dock operations.



Virtual bridge.
Sokratis Dimakopoulos
inside the Class A
bridge simulator.

FOCUS ON SKILL DEVELOPMENT

Sokratis Dimakopoulos graduated as a Chemical Engineer and holds a Master of Science degree. After his studies he joined the Hellenic Coast Guard as a Technical Officer and went on to work at the IMO as well as leading shipping companies in Greece before joining Tsakos Columbia Shipmanagement as the Deputy Managing Director in 2014.

Furthermore, DNV GL advisory experts have supported TCM in improving energy management and competence management. Later this year, TCM will work with DNV GL and several other shipping companies on an environmental benchmarking project.

Dimakopoulos is committed to reinforcing TCM's position as a leading management company, and he is confident that Greek shipping as a whole will maintain and even enhance its leading position in the industry. "The ultimate challenge for Greek companies is to maintain the seamanship and the traditional maritime values of our people. Without these elements the sustainability of our industry could be at risk." ■ AJO

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Even commercially available drones can be used to pre-inspect the nooks and crannies of large interior spaces.

DRONING IN THE DEEP

Using drones to visually check the condition of remote structural components has the potential to significantly reduce survey times and staging costs while at the same time improving safety for surveyors.

It's a simple idea – and not even a particularly new one: a remotely controlled flying vehicle that can get to places and see things that a person cannot. But the number of different uses for unmanned aerial vehicles (UAV) or, as we commonly know them, drones, is growing every day. From surveillance and military applications to racing, delivery, construction, and even just good old fashioned fun, drones have gone from rarity to ubiquity in the blink of an eye.

The inspection of ship tanks and holds can be a costly, time-consuming and potentially dangerous operation. The condition of the coating, corrosion, damage, piping, access points, equipment and safety systems all have to be assessed on a regular basis. And because of the sheer size of today's ships, getting a surveyor to where he or she needs to be to make those observations can take some doing. Staging, rafting and climbing are all used to help surveyors narrow the distance between eyeball and object – but what if the surveyor's eye could float? Or even fly?

"We have been looking at ways to help our customers by accelerating the survey process inside

ship tanks," says Cezary Galinski, Manager of the DNV GL - Maritime classification flying squad based in Gdansk. "Camera-equipped drones are now much more widely available and affordable, and by using them for a first screening we can identify areas that require closer inspection quickly and without extensive staging, which can be both costly and time-consuming."

Great for hard-to-reach areas

The first tests of this new system took place at the Remontova shipyard in Gdansk, Poland, and were carried out by the DNV GL - Maritime flying squad team based there. "We have been on board four different ship types a number of times. We have tested the drone in the cargo tanks and holds on a large oil tanker, a LPG carrier and a bulk carrier," says Galinski.

A modified DJI Phantom 3 camera-equipped drone was used to visually evaluate structural components through video streaming to a tablet. One surveyor operated the drone while a second one checked the video feed in real time. The stream was also recorded for review and documentation purposes. Equipped with powerful headlights, the >

> drone was able to produce a video of sufficient quality for initial inspection. In the event any damage is detected, a traditional close-up survey may still be required.

Surprisingly good video quality

"We used a modified off-the-shelf drone for our tests," explains Galinski. "Because there are currently no drones commercially available that are formally certified as explosion-proof, we performed a risk assessment. Of course, before the drone operation started, we also ensured that the cargo tank was gas-free and certified for safe entry." The camera was one of the strongest aspects of this general-purpose drone.

"It was a 4K camera and the quality of the video was very good, even better than we had expected. We were able to obtain a level of detail equivalent to that of the human eye from a distance of 1.5 metres as per DNV GL/IACS requirements. We did have to add additional lights, however, which reduce battery life," he explains. The survey team was equipped with a battery pack of six or seven charged batteries. In the cold December weather they had to land the drone every 15 minutes or so to exchange the batteries.

The tests were very successful, with a 20x30x15-metre tank taking roughly two to three hours for a complete close-up survey. And while a detailed cost assessment has not yet been conducted, early indications are that using a drone to inspect tanks could result in significant savings.

"Our next step is to work with a more advanced, tailor-made drone," says Galinski. "We are in the process of working with a supplier to build a custom drone for use in future tests. There are some practical issues, such as needing a drone that can fit through a standard-sized manhole on board a ship, some of which can be as small as 600 x 400 millimetres, and one that can be easily packed for transport and deployed by a single surveyor."

The next development stages

Improved endurance is also on the wish list, along with an even better camera, higher-quality lighting and enhanced flight stability through the use of ultrasonic and laser-based devices.

One of the challenges is to have a drone which is able to maintain a stable position without any input from the operator inside the tank. Drones are guided by GPS systems and equipped with magnetic



A DNV GL surveyor operates the drone during a test inside a ship tank.





The detail provided by conventional drone-mounted cameras is in line with DNV GL requirements. Future designs will deliver even higher resolution.

compasses and gyroscopes, but GPS does not work inside a cargo tank. "We have been testing other solutions such as barometric sensors, but they did not work as well as we hoped because the drone creates a draught as it approaches the deckhead, which means the pressure isn't stable and the drone thinks it is lower than it actually is," says Galinski.

Visions of future technologies

The end game is to have a drone that is fully autonomous. "DNV GL has 3D models of many of its ships, so a 3D model could be loaded into a drone's memory. The drone would then orientate itself inside the tank and follow a predefined route, stopping at points of interest inside the compartment to take a photo or video. The operator could use the camera and lights to document findings while the autopilot takes care of the flight. The final stage would be to have a device that has its own scanning capabilities. You would be able to drop it into an unknown space and it would scan it, create a 3D map and then proceed to carry out the survey independently. But we are still a fair way away from this," Galinski explains.

DNV GL is also looking into utilizing drones and other devices for inspecting mobile offshore units (MOUs), both for topside and external structures and for internal tank inspections. Another ongoing project is to establish a certification service for external drone operators to qualify for inspection work on classed MOUs. In future, the drone could be one of several systems used by DNV GL surveyors to deliver

the same quality of services to their customers in an even more timely and cost-effective fashion. For Galinski, these first tests have only scratched the surface of the potential of drones as surveying tools: "We have also been experimenting with 3D glasses, providing total immersion in a virtual reality world." ■ SA

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The team that conducted the drone tests (f.l.t.r.): Piotr Brygiert, Vegar Rype, Tomasz Oledzki, Cezary Galinski.



Supporting
the implementation
of new technologies,
the new DNV GL rule
set embraces the
next generation of
shipbuilding.

A RULE SET OPEN TO THE FUTURE

Years of hard work, an unprecedented effort to gather input from customers and partners across the maritime industry, and the experience of two highly respected classification societies are bearing fruit.

Two classification societies. 301 years of combined expertise. More than 20,000 pages. 2,000 detailed comments from 800 stakeholders. 27 joint development projects involving contributions from many leading shipyards in the world: these numbers tell a unique story of how two classification societies managed to merge their "DNA" into one for the first time in history. This was a huge undertaking and an important milestone for the organization.

The rules are now in force and are actively applied by the industry (see info box). But DNV GL does not stop there. "Building upon our history of competence and a fleet of almost 13,000 vessels, we have consistently applied our experience in the development of our rules in order to make them future-proof and enhance the performance of our customers,"

says Geir Dugstad, Technical Director Maritime at DNV GL. "Our clear ambition has been to develop the preferred industry standard, which also means offering the widest range of class notations in the industry," he adds.



Future-readiness involves flexibility

Alongside 38 ship type-specific notations, the new rule set features 72 additional notations, and the number is growing. These notations ensure that vessels are designed and equipped for their intended operation while supporting the use of latest technology and enabling shipowners and managers to stay compliant.

As the regulatory and technology outlook can be quite complex and sometimes unclear, "Ready" notations for gas or scrubber technology, for example, can help prepare vessels in the new- ➤



NEW DNV GL RULES NOW ACTIVELY APPLIED IN THE INDUSTRY

Following an extensive hearing process, the DNV GL rules were published in October 2015 and came into force in January 2016. Around 800 stakeholders provided more than 2,000 comments which resulted in over 700 rule modifications.

These new rules are thus the first that can truly claim to have been developed in close cooperation with the industry. And this collaboration continues: 27 joint development projects focusing on the new DNV GL are already under way.

The first contract signed for new-builds according to the combined DNV GL rules were Finnish ESL Shipping's two dual-fuelled bulk carriers, which will also be the first large LNG-fuelled bulkers globally (see page 20). Designed by Deltamarin and constructed by Sinotrans & CSC Qingshan Shipyard in China, they are due for delivery in early 2018. The vessels will be built to the new DNV GL rules for general dry cargo ships with DNV GL Ice Class and will have type C LNG tanks of approximately 400 m³. They

can bunker at several terminals within the Baltic region.

Additional ships built to the new rule set will be commissioned in the near future. They will receive a class notation starting with the main character 1A, which was previously 1A1 for DNV and 100A5 for GL.

DNV GL has also introduced a new load line mark, sometimes termed the Plimsoll mark due to its origin, with the letters "VL". Linking back to the history of the merged company, "VL" stands for "Veritas" and "Lloyd".

A new seal has also been introduced.



“Building upon our history of competence and a fleet of almost 13,000 vessels, we have consistently applied our experience in the development of our rules in order to make them future-proof and enhance the performance of our customers.”

Geir Dugstad, Technical Director Maritime at DNV GL

> building stage for potential future installation of the respective technology.

Sustainable approach on regulations

While DNV GL has recently updated its Gas Ready notation for the use of gas as ship fuel, a wholly new class notation, Scrubber Ready, was launched in spring 2016 (see page 30). “There is no doubt that stricter emission regulations for sulphur oxides are here to stay,” says Knut Ørbeck-Nilssen, CEO at DNV GL - Maritime. “Our new Scrubber Ready class notation gives shipowners the flexibility to minimize their initial investment when ordering a newbuild, and the confidence that their vessels are on track for compliance with upcoming emission regulations.”

The new notation not only identifies the general type and category of scrubber system that can be installed on the given vessel. It also details the level of scrubber readiness, with the minimum scope attesting that the space is available and the future installation arrangement meets class and statutory requirements. This can be expanded to more extensive preparations, through to a complete review of the scrubber documentation according to the main class rules, including certification and installation of piping and subsystems.

Another good example of how the new rule set offers greater flexibility to shipowners are the revised class notations for water-lubricated tail shafts, TMON (closed-loop water) and TMON (open-loop water). DNV GL is the first classification society to use a condition monitoring-based survey process which eliminates the requirement for tail shaft withdrawal surveys at predetermined intervals.

A monitoring system, which is primarily based on a remote sensor that measures stern tube bearing wear each time the propeller shaft stops turning, allows the crew to keep track of the condition of the bearings. This means they can optimally plan main-

tenance, avoiding unnecessary tail shaft withdrawals while having a system in place to identify any indication of beginning deterioration. The TMON notations can be assigned to both newbuilds and ships in service.

Fit for new technology and designs

An important aspect of the new DNV GL rules is also to ensure that they cater for the application of modern technology. Battery and hybrid technology, for example, enable the vessel's engine to run at more favourable loads and thus reduce fuel consumption and therefore emissions to air. Further benefits include an improved response time in safety-critical operations, an extended engine lifetime, less maintenance and less noise and vibrations. The DNV GL rules cover the use of batteries as part of a vessel's propulsion energy in either hybrid battery solutions or “pure” battery-driven vessels. The rules also stipulate requirements for the use of batteries as a power source for dynamic positioning systems.

Another example of the future-readiness of the rule set is the new Class Guidance for Wave Load Analysis. It describes a procedure for establishing wave loads for ships with unusual and innovative hull forms. It also includes procedures for consideration of particular wave environments or marine operations at a given sea state. This makes the rules adaptable for possible future changes to the wave environment which could be induced by climate change. ■ NIS

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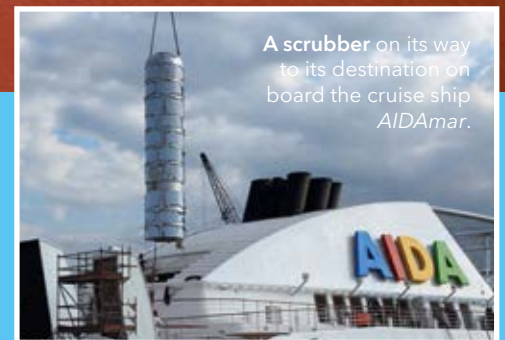
The new load line mark is composed of the letters V for "Veritas" and L for "Lloyd".



SELECTED DNV GL CLASS NOTATIONS

The DNV GL rule set offers 38 ship type-specific notations and 72 additional notations. Some of the most recently introduced and updated class notations include:

- **New Scrubber Ready notation:** This class notation includes a set of rules to prepare the vessel for future scrubber installation. It accounts for parameters such as space, weight and overboard connections while helping to reduce off-hire time and retrofitting costs.
- **New Chem notation:** This notation reflects the upcoming IOSVC (International Offshore Support Vessel Chemical) code as anticipated by DNV GL, offering a new standard for the design of OSVs carrying bulk chemicals. It also creates the possibility of designing OSVs to function as chemical tankers with the ability to carry a range of cargoes.
- **Revised HOT notation:** This notation defines requirements for strengthening cargo tanks and hull structures of ships intended to carry liquid cargo at high temperatures.
- **Revised TMON notation:** This notation spells out rules for water-lubricated stern tube systems under condition monitoring. They account for the increased focus on environmental protection, enabling unlimited survey intervals.
- **Revised Gas Ready notation:** This notation now defines requirements for a maintenance plan on installed systems/equipment to meet the gas-ready intention and as such helps in ensuring these are kept in good order until time for use.
- **Battery (Power) notation:** This notation ensures that vessels using battery power are properly equipped for battery operations. It applies to



A scrubber on its way to its destination on board the cruise ship *AIDAmär*.

battery installations in battery-powered vessels, ships with redundant propulsion, or DP vessels where the batteries are included in the redundancy for dynamic positioning.

- **Ship-to-Ship Gas Bunkering notation:** This notation addresses safety concerns in this field, covers gas bunkering vessel design and additional requirements to support the development of gas-fuelled shipping and bunker operations in ports. The rules are flexible and include a variety of gas fuels as well as the configuration of bunker transfer systems.

DOUBLE DEBUT

The first DNV GL classification contract for an LNG-fuelled bulk carrier built to the new rule set has been signed – another milestone on the way to sustainable shipping.



The establishment of emission control areas (ECAs) in the Baltic Sea and the North Sea is driving technological advances towards low-emission shipping. In the Baltic Sea in particular, early initiatives to establish an LNG refuelling infrastructure have encouraged owners to embrace LNG as ship fuel. DNV GL recently signed the first classification contract for a large LNG-powered bulk carrier – and the first vessel ever to be built to the new DNV GL class rules.

The project comprises two sister vessels which have been developed by the Finnish ship design and engineering group Deltamarin for the Finnish owner ESL Shipping Ltd., the leading carrier of dry bulk cargoes in the Baltic Sea region. Both companies cooperated closely on the concept development

to make sure the ships meet the demanding trading requirements of the Baltic area.

Mastering difficult climate conditions

Deltamarin is using its proven B.Delta26LNG design with a highly optimized hull form as a basis for these extremely energy-efficient ships, which will be built at Sinotrans & CSC Qingshan Shipyard in China. They will begin operating in the Baltic Sea in early 2018, supplying raw material to heavy industry and power generating companies. The 25,600 dwt handysize bulkers will feature highly efficient cargo handling and cargo hold arrangements, enabling rapid loading and unloading. To ensure reliable year-round operation in the difficult climate conditions of the Baltic Sea, they

The LNG-powered bulk carrier designed by Deltamarin will operate in the Baltic Sea.



B.DELTA26LNG PARTICULARS

- Length overall: 160 m
- Breadth: 26 m
- Draught: 10 m
- Deadweight: 25,600 dwt
- Class: DNV GL
- Type C LNG tanks with 400 m³ capacity

will receive the additional class notation DNV GL Ice Class IA.

Equipped with dual-fuel main and auxiliary machinery and 400 m³ type C LNG tanks, these vessels will be able to bunker LNG at several terminals in the Baltic region and meet all current emission requirements. Their CO₂ emissions per cargo tonne transported will be reduced by over 50 per cent compared with present-generation vessels. The energy efficiency design index (EEDI) value will satisfy the International Maritime Organization (IMO) reference line requirements even in Phase 3 which will come into force in 2025.

The bulk carriers will be built to the new DNV GL rules for general dry cargo ships. "It is fitting that the

first vessels that will be constructed to the most forward-looking set of classification rules are themselves at the cutting edge of maritime innovation," says Knut Ørbeck-Nilssen, CEO of DNV GL - Maritime. "We have created these rules to be ready for the future and we have long pioneered the use of LNG as a ship fuel. To see these two come together in a double first for the industry is a remarkable moment."

Ship designers have to account for increasingly complex requirements, resulting from stricter regulations and the need for optimal efficiency, which makes close cooperation with class more important than ever. Applying the new rule set for the first time was a journey into the unknown for the designers at Deltamarin. Konstantinos Fakiolas, Sales Director >



Sealing the deal: Knut Ørbeck-Nilssen, CEO of DNV GL - Maritime (left), with Mikki Koskinen, Managing Director of ESL Shipping.

“We chose DNV GL because of our good experience from our last series of newbuilds and because we are convinced they have the required high level of knowledge of LNG systems and safety.”

Mikki Koskinen, Managing Director of ESL Shipping Ltd.

> Ship Design at Deltamarin, reports: “The new rules are easier to handle than the old ones, and accessing them has become easier as well.

Mikki Koskinen, Managing Director of ESL Shipping: “Our main trade in the Baltic Sea is very busy and demanding, not only due to winter ice conditions but also because of tight schedules and very short port calls. That is why we need a classification partner capable of delivering services promptly and effectively when required without affecting the schedules of vessels. We chose DNV GL because of our good experience from our last series of newbuilds and be-

cause we are convinced they have the required high level of knowledge of LNG systems and safety.”

Optimized for varying sea conditions

Konstantinos Fakiolas describes how Deltamarin approaches the project: “We first modified the B.Delta26LNG design to make the ship fit for its trading purpose, then optimized it further to reach the highest possible levels of IMO compliance and ensure her competitiveness throughout her lifetime. The cargo spaces have been specifically designed and arranged jointly with the owner to meet the re-

DELTAMARIN - PROVEN EXPERTISE IN SHIP DESIGN

During its 25-year history, Deltamarin has built a strong track record of accomplishing over 1,000 concepts in all major ship types and special offshore units and hundreds of vessels sailing

the seas. Deltamarin services include the full range of consulting, design and engineering as well as procurement, construction and installation. The group employs around 400

experts in its own and associated companies located in Europe and Asia. The subsidiary of AVIC International Maritime Holdings, part of the Chinese AVIC Group, is based in Turku, Finland.

quirements in terms of cargo flexibility, distribution and quantity. The proven hydrodynamic properties of the Delta Series have been maintained despite the necessary restrictive Ice Class features, and optimized further in terms of power requirement, engine economy and hull lines. Finding the perfect solution for operation in two different weather conditions - icy water and open water - and different sea states has been challenging, but I believe we have found it."

A trendsetting design

For ESL, LNG was the preferred fuel option for the ships, says Mikki Koskinen: "In short-sea trades LNG is presently the best available large-scale energy solution, both operationally and from the environmental point of view. For us and our customers, LNG is a very good choice and will definitely be part of our future plans, despite the slow development of the LNG supply infrastructure, the large space requirement on board and the relatively high additional investment required."

Koskinen believes the new LNG powered bulkers are more than just state-of-the-art additions to ESL's fleet. "The ship concept developed jointly by the experts from Deltamarin and ESL Shipping is a trendsetting design that brings the commodity transport segment into a new era of greener shipping. When completed these vessels will be among the most environment-friendly ships to sail in pollution-sensitive areas, such as the Baltic." Fakiolas still sees additional optimization potential in ship design by expanding the range of parameters considered in the endeavour. "Future bulk carriers need to be operationally optimized further throughout their trade envelopes, accounting for various draughts and speeds while at the same time improving dynamically related performance characteristics, such as course-keeping at various sea states and wave angles, manoeuvrability in ports, and cost-efficient lifetime operation.

The future ship must be designed 'fit-for-trades' instead of 'fit-for-cargoes'. Traditionally ship fuel



Ship designer Deltamarin's Sales Director Ship Design Konstantinos Fakiolas.

consumption has been optimized for only a few fixed operational points, and the improvement potential for these conditions is usually limited. New design tools and methods set a completely new baseline to fuel efficiency evaluation that corresponds to real-life operation." Fakiolas is sure other ship types could benefit from the design improvements achieved with Deltamarin's B.Delta26LNG type.

ESL's Mikki Koskinen agrees that his company's new bulk carriers set the right course for ship design in general: "Shipping needs to be much more environmentally conscious and we must work hard in order to reduce our carbon footprint and other emissions. LNG helps us in achieving our ambitious goal of cutting our CO₂ emissions in half. We believe the industry will follow, since sustainability and profitability in our business go perfectly hand in hand." ■ AK

DNV GL Expert

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Photos: DNV GL, Deltamarin, ESL Shipping

ESL SHIPPING - SUPPLYING COMMODITIES TO NORTHERN INDUSTRIES

Operating for more than 60 years, Helsinki-headquartered ESL Shipping is the leading carrier of dry bulk cargoes in the Baltic Sea region. The company's main clients are the steel, power

generation and chemical industries. Its present fleet consists of 14 vessel units, and in 2014 the cargo volume carried was 12.1 million tonnes. ESL Shipping ensures availability of raw materials

for industries and energy production throughout the year even in difficult climate conditions. Special services include loading, topping-off and lighting of large ocean carriers at sea.

NEW KID ON THE BLOCK

DNV GL has welcomed the world's first methanol-fuelled ocean-going vessel into class. The companies involved in its development explain what makes this technology safe, cost-effective and sustainable.

Photos: Hyundai Mipo Dockyard, Sjøfartsdirektoratet (Norwegian Maritime Authority)

The quest for low-emission ship propulsion concepts is driving the development of alternative solutions using a wider range of fuels. The latest entry into the fuel mix is methanol. The DNV GL-classed vessel *Lindanger*, launched at Hyundai Mipo Dockyard in South Korea, is the first of two 50,000 dwt, dual-fuel tankers worldwide. It brought together a whole consortium of companies eager to establish methanol as an alternative marine fuel.

"We are not only welcoming a new vessel but also a groundbreaking innovative technology to the shipping industry," said Rolf Westfal-Larsen, President and CEO of the Norwegian company Westfal-Larsen Management, which owns *Lindanger* and another methanol-fuelled tanker still on order. Both belong to a series of seven dual-fuel vessels which will be chartered to Waterfront Shipping. Waterfront is a wholly owned subsidiary of Methanex Corporation, the world's largest producer and supplier of methanol. Four of the vessels, including *Lindanger*, will be classed by DNV GL, and DNV GL has also carried out

a hazard identification study on the remaining three ships.

"This is the first time a dual-fuel engine with a low-flashpoint liquid (LFL) fuel system has been installed on an ocean-going vessel. It is a testament to the excellent cooperation between all the project partners that we have been able to complete this unique project and gain flag state approval," says Knut Ørbeck-Nilssen, CEO at DNV GL - Maritime.

Seamless fuel switch

The impetus to use methanol as a marine fuel came from Waterfront Shipping. "In 2012 we were looking to renew part of our fleet to meet growing market demand. So we invited Westfal Larsen, Mitsui OSK Lines and Marininvest to collaborate with us on taking the methanol dual-fuel concept to the next level," says Jone Hognestad, President at Waterfront Shipping. "It is exciting to be working with our partners to advance this new, clean technology. Investing in methanol-based >



Lindanger's naming ceremony at Hyundai Mipo Dockyard, South Korea.



**LINDANGER MAIN PARTICULARS**

Tanker for chemicals & oil products with LFL fuelled engine

- Length overall (LOA): 186 m
- Length between perpendiculars (LBP): 177 m
- Breadth: 32.2 m
- Depth: 19.1 m
- Draught: 12.85 m
 - Deadweight: 49,999 dwt
 - Speed: 15.8 knots
 - Main engine: Type: Hyundai-B&W 6G50ME-9.3 LGI (Tier II), Output: 10,320 kW @100 rpm

Lindanger during her final outfitting stages at the pier in Korea.



PROJECT SCOPE - SEVEN DUAL-FUEL VESSELS

Owners: Westfal-Larsen (2), Marininvest and Waterfront Shipping (2), Mitsui OSK Lines (MOL) (3).

Charterer/joint owner: Waterfront Shipping

Shipyards: Hyundai Mipo Dockyard (Korea) and Minaminippon Shipbuilding Co. (Japan).

Engine design: MAN Diesel & Turbo. The power plants were built by Hyundai-B&W.

DNV GL will class the four ships owned by Westfal-Larsen and Waterfront/Marininvest, and has carried out a hazard identification study on the remaining three MOL vessels.

“We are not only welcoming a new vessel but also a groundbreaking innovative technology to the shipping industry.”

Rolf Westfal-Larsen, President and CEO
Westfal-Larsen Management

> marine fuel is an important step in the right direction and reinforces our commitment to sustainable proven technology that provides environmental benefits and meets emission regulations,” he adds.

The engine required to operate the vessels with methanol as a ship fuel is based on the first-of-its kind MAN B&W ME-LGI two-stroke dual-fuel engine. The 6G50ME-9.3 ME-LGI dual-fuel, two-stroke engine enables *Lindanger* to run on methanol, heavy fuel oil (HFO), marine diesel oil (MDO) or marine gas oil (MGO). “We developed these two-stroke engines in response to interest from the shipping world to operate on alternatives to heavy fuel oil and meet increasingly stringent emission regulations. To hedge the risk of fuel price volatility, the vessels can switch between fuels seamlessly, and operate cost-effectively,” states Ole Grøne, Senior Vice President, Head of Marketing and Sales, at MAN Diesel & Turbo. “When running on methanol the engines have the same or even a slightly better efficiency record compared to conventional heavy fuel-burning engines,” he adds.

“Methanol will reduce sulphur emissions (SO_x) by about 95 per cent and nitrogen oxide emissions (NO_x) by about 30 per cent compared to conventional marine diesel oil, and therefore could become one of the popular alternative marine fuels in the future. We are so privileged to become the first shipyard in the world to deliver a methanol-fuelled vessel,” adds Man Choon Kim, Vice President, Contract Management Department, Hyundai Mipo Dockyard.

Ensuring safe operation

The shipping industry has a long history of handling methanol safely. As is the case for all marine fuels, the risks associated with methanol include toxicity and flammability. The properties and toxicity of methanol are well understood, and safety features that minimize risk to the crew, such as double-walled piping, are technically simple to implement and support the safe use of methanol as a marine fuel.

DNV GL was one of the class societies that verified the engine concept: “The classes have played a very important role in supporting the development of these engines. They have been involved from the design stage, through HAZOP, testing and sea trials through to notation for using methanol as a marine fuel,” says Hognestad from Waterfront Shipping. The DNV GL-classed vessels have been assigned the additional notation LFL FUELLED to demonstrate compliance with the DNV GL rules for low-flashpoint liquid fuels (LFL). DNV GL was the first classification society to publish rules covering LFL marine fuels in July 2013, to ensure that the arrangement and installation of these systems have an equivalent integrity level in terms of safety and availability as a conventional system.



Lowering the gigantic dual-fuel engine designed by MAN Diesel & Turbo into the hull is high-precision work.

using conventional bunkering and storage solutions without having to make extensive modifications. Sulphur-free and with lower particulate and nitrogen oxide emissions, methanol is also a promising option for vessels operating in emission control areas (ECAs) and for meeting both current and future regulations covering sulphur emissions.

As one of the top five chemical commodities shipped around the world, methanol is available globally through existing infrastructure. "This makes it a more feasible fuel option in remote areas, as the infrastructure required to make it available is far less costly than for comparable fuels," explains Ben Iosefa, Methanex Vice President, Global Market Development and Stakeholder Relations.

The cost to build new and convert existing vessels to run on methanol is significantly less than for other alternative fuels. "The technology significantly reduces emissions while giving shipowners a viable, efficient and convenient fuel alternative," says Waterfront's Jone Hognestad. "With this investment in sustainable marine technology, we have demonstrated and verified the potential for methanol to move the shipping industry forward." ■ **KG/SA**

When the ME-LGI engine operates on methanol, it uses HFO, MDO, or MGO as a pilot fuel, significantly reducing CO₂, NO_x and SO_x emissions while eliminating methanol slip.

Clean, cost-effective and globally available

According to Methanex, by the end of 2016 there will be eight large vessels in commercial operation capable of running on methanol, and interest from the industry is growing. Methanol is produced from natural gas or renewable sources, such as biomass, recycled CO₂, or agricultural and timber waste. Its energy content is roughly half that of standard heavy fuel oil, but as it is a liquid, methanol can be handled

Photos: Sjøfartsdirektoratet (Norwegian Maritime Authority), Methanex, Waterfront Shipping

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Unlike other alternative fuels, methanol can be bunkered using conventional equipment with only minor modifications.





DATE – WHENEVER, WHEREVER

DNV GL's DATE service gives customers direct access to technical experts based in five centres around the world. The global team shares their most common cases and explains how the 24/7 support works.

Established as part of DNV GL's efforts to enhance safety, reduce downtime and optimize performance, Direct Access to Technical Experts (DATE) offers a straightforward and effective way of providing support to customers during their daily operations. Just over a year ago, DATE became a global, 24/7 service, with support hubs in Hamburg, Oslo, Piraeus, Houston and Singapore.

"Our team consists of highly skilled experts, located in all major time zones. We provide 24/7 support to our customers and therefore have global capability to handle more than 4,000 questions or cases a month," says Jan Solum, Head of Technical Helpdesk Americas. "Our unique set-up allows us to address urgent requests within just a few hours," he adds.

A former master mariner, Solum was instrumental in setting up the DATE support hub in Houston last year. DATE provides customers with direct access to the more than 400 technical experts, who also support DNV GL surveyors in the field and supplement the work of the Key Account Managers as a primary point of contact for customers. Over 90 per cent of requests are usually answered within one working

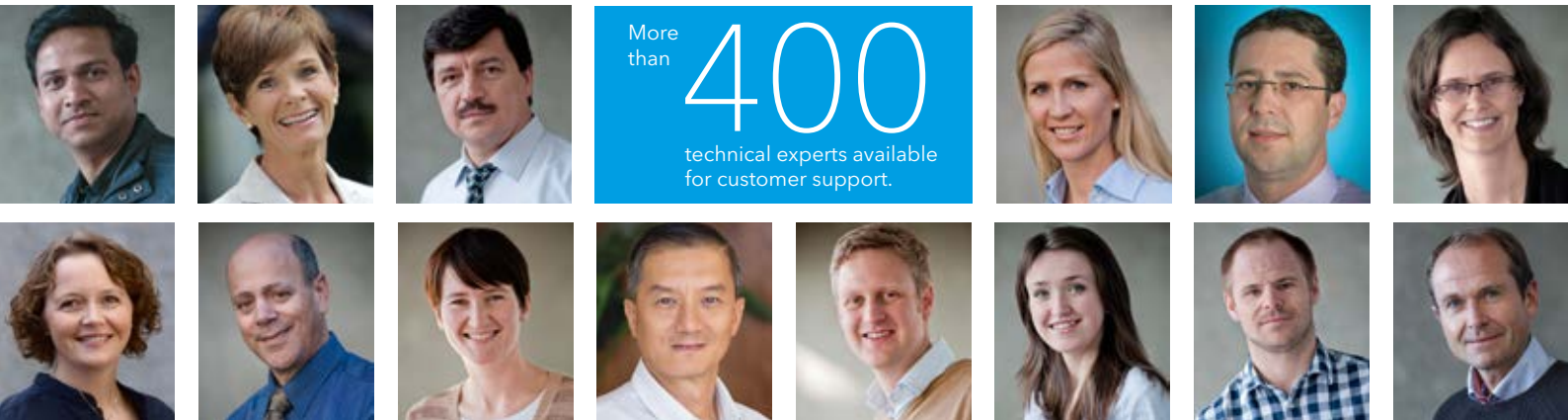
day and all offices cooperate as a single point of contact. "It was important for us to ensure that every case handler in the DATE system has access to all open cases. This way, a case can start at one hub and be completed by another one, and we can provide customers with a more efficient service," explains Solum.

Smooth handovers

Bijan Sedaghati, Head of Technical Helpdesk Asia, reports: "Since the beginning of the year our technical helpdesk in Singapore has handled 1,850 cases, most of which are SOLAS-related enquiries." To guarantee rapid processing, the Asian helpdesk takes over from Houston and discusses the status of unhandled cases, then hands over to Europe if appropriate. "Being in the same time zone as the customer allows us to interact more directly and support them locally," adds Sedaghati.

DNV GL's DATE team in Greece handled approximately 500 cases during the first quarter of this year. Most are related to class systematics, SOLAS and MARPOL and include clarifications of survey scope and requirements, postponements, interpretations of rules, international conventions and upcoming IMO





requirements,” explains Stefanos Tsiopanas, Head of the Technical Helpdesk Greece.

DATE can be accessed through a local DNV GL contact or directly via the customer portal “My DNV GL”. “Depending on the urgency of the case, our response time can vary from 24 hours for regular enquiries to just a few hours for particularly critical fleet-in-service cases,” says Torkel Skeie, DATE Process Manager in Oslo. The highest number of urgent cases is handled in Houston, because the office supports Europe after hours. An advanced in-house software tool ensures smooth handover processes between hubs, giving experts access to all open cases around the globe.

“Our unique set-up allows us to address urgent requests within just a few hours.”

Jan Solum, Head of Technical Helpdesk Americas

DATE - how it works

Cases are submitted using an online form to ensure that large numbers of technical questions and sensitive issues can be addressed properly. “Receiving all questions in writing means we can route requests to the right expert instantly through an automated process. The system is very efficient and we are able to respond within the requested time window more than 90 per cent of the time. The DATE system allows us to handle more than one case at the same time,” says Tijmen Klamer, Head of Section, Class Systematics, PSC and Fleet Monitoring at DNV GL - Maritime.

Customers receive an automatic e-mail notification when their case is being processed, and they can track the status of their enquiry using “My DNV GL”. The advice they receive from DATE can be shared with all relevant parties within their companies. “If a case is urgent we ask the customer to provide a phone number so we can discuss the details personally and help find the best solution quickly,” explains Klamer. Key Account Managers in

the regions are always copied in on DATE cases, so that they can provide local support and follow up with the customers.

“Our experiences with DATE have been very positive. Both internal and external customers are happy to be able to reach experts directly and rely on the fact that they will receive

an answer within a fixed time frame,” says Stefanos Tsiopanas. Continually developing their own expertise is also a very important part of the DATE team’s role at DNV GL. Tsiopanas explains: “We have established a number of practice networks, where experts from the different hubs share operational experiences and best practices, raise potential issues and improve the alignment between the different regions. This will ensure that we can continually improve our service and offer the best possible support to our customers, whatever the issue and wherever they are.” ■ NC/AJO

Photos: DNV GL



Access personalised services from DNV GL at my.dnvgl.com



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FINDING THE RIGHT FIT

Exhaust gas cleaning systems are a key technology for ensuring compliance with emissions regulations. DNV GL experts explain when it makes sense to invest in scrubbers, what type of system to choose, and how to avoid common operational problems.

With stricter sulphur (SO_x) and nitrous oxide (NO_x) limits in emission control areas (ECAs) in Europe and the Americas, and new control areas being established in ports in China, international organizations are slowly closing in on pollution from ships. By the time the global 0.5 per cent sulphur cap is introduced in 2020 or 2025, up to 70,000 ships may be affected by the regulation according to IMO estimates. A growing number of shipowners are beginning to weigh their options for ensuring compliance. They face a choice of switching from heavy fuel oil (HFO) to marine gas oil (MGO), burning ultra-low-sulphur HFO, retrofitting vessels to use alternative fuels such as LNG or installing scrubber systems which allow them to continue operating on regular HFO.

More than 310 scrubber projects

“So far, most operators have opted for the fuel switch from HFO to MGO, but our experience has shown that this is not the best option for every ship type,” says Markus Osterkamp, DNV GL Deputy Head of Section Environmental Certification. Out of the current total of more than 310 confirmed scrubber projects (see diagram page 31), more than half are or will be installed on cruise ships, passenger ferries or ro-ro ships, and a much smaller percentage on general cargo vessels, bulk carriers, tankers and gas carriers. Most of the current projects are being implemented with support from DNV GL.

“Scrubber technology is a very popular solution for cruise ship and ferry operators because many of their vessels have a fixed trade route so they can



Photo courtesy of Yara Marine Technologies AS / ©Meyer Werft



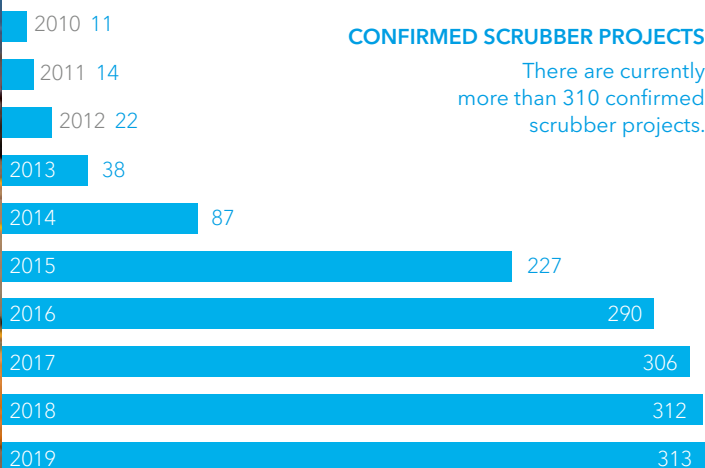
Scrubbers ready for installation on board *Norwegian Escape* at Meyer Werft. These are the biggest inline scrubbers worldwide.

plan for future operation in ECAs. They also have a higher fuel consumption than comparable cargo ships, as they need to produce additional electricity for hotel loads," adds Océane King, Head of Section Maritime Advisory Division Miami at DNV GL. In these cases, scrubbers could lead to fuel savings of approximately 45 per cent compared to switching from HFO to MGO in ECAs at current fuel prices¹⁾.

The right choice for each vessel

Océane King specializes in cruise ship projects, which includes advising customers on scrubber technology. The best scrubber type for a given ship depends on the operational profile and the routes of the vessel, she says. For example, open-loop systems use seawater to neutralize the sulphuric acid formed during the exhaust gas cleaning process. The resulting waste water must meet MARPOL requirements before being discharged. "Seawater is a natural alkaline, so this works well in most cases. However, if a vessel occasionally sails through waters with a slightly more acidic pH-level, such as rivers or brackish waters, we would advise the customer to choose a hybrid solution. Another drawback of open-loop-only systems is that several ports in Europe and the port of New Haven in the United States now prohibit the release of open-loop water. In addition, some cruise companies have a zero-discharge internal policy close to ports," King explains. Hybrid >

¹⁾IFO380: USD/metric tonne 172.50, April 2016





A scrubber being hoisted onto a cruise vessel owned by Royal Caribbean Cruises.

> solutions can switch from open to closed mode, eliminating the risk of compliance violations. Closed-loop systems use fresh water mixed with chemicals such as caustic soda to boost the alkalinity of the wash water, which is then recirculated through the system and partially purged.

Currently, hybrid scrubbers are the most popular solution, followed by open-loop systems. Closed-loop scrubbers are installed on ships sailing mainly in fresh water or low-alkalinity areas such as the Great Lakes in the United States. Most cruise ship operators originally opted for open-loop scrubbers because they offer lower system complexity. However, a number of owners in the cruise segment have chosen hybrid systems recently. Overall, more than

100 cruise ships have, or are in the process of installing scrubbers - more than 80 of these being retrofits. "The main challenge owners face in this scenario is to choose a system that adds the least possible weight to the vessel and has the smallest space requirement while still performing at optimum capacity and complying with both the exhaust quality and wash water regulations," explains Océane King.

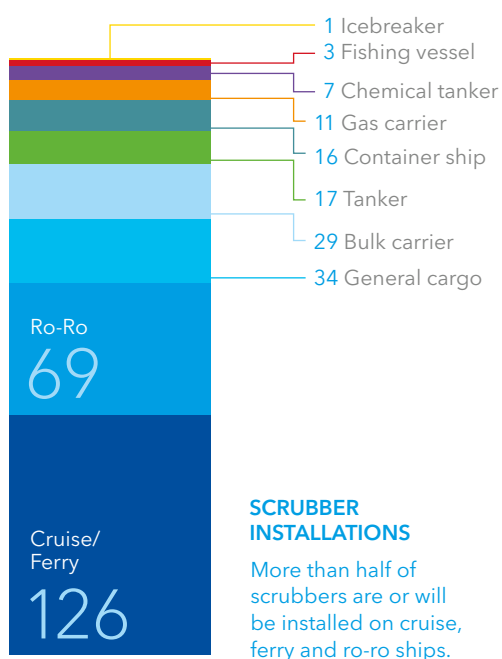
The number of scrubber towers needed can differ, depending on the exhaust gas flow created on the regular itinerary. DNV GL supports customers in choosing an exhaust gas cleaning system that fits their vessels' requirements. In the next step, the DNV GL Technology Qualification Process (TQP) helps identify and mitigate any potential design risks,

“Looking into the future, we expect scrubbers to get smaller as manufacturers try to make them a more viable solution for vessels with little capacity for additional equipment on board.”

Océane King, Head of Section Maritime Advisory Miami at DNV GL

such as corrosion, soot on deck or increased back-pressure to the engine. Back-pressure is caused by exhaust impedence and can restrict engine performance. “In the case of ships with a limited back-pressure margin, the installation of exhaust fans can alleviate the problem while ensuring that the exhaust air exits the boundary layer of the ship and does not linger around the funnel,” Océane King explains.

DNV GL has performed partial or full TQPs for six of the largest scrubber suppliers. Before and during the installation phase, DNV GL uses its risk assessment expertise to identify risks that could compromise the safety, schedule, costs or performance of the system and its installation. Follow-up actions are identified to ensure the risks are successfully mitigated. By combining all of these measures, the DNV GL EasyRisk software provides a platform which makes it easier to monitor statistics and trends of the total and detailed risk exposure within a project.



DNV GL is also the only class society to offer hardware-in-the-loop testing on scrubber automation systems through its Marine Cybernetics team. These tests are carried out in a virtual environment, enabling experts to check whether a scrubber control system is robust enough to withstand the expected stresses. By the time an automation system goes into operation at sea, its performance has been fully verified down to the individual line of software code. In addition, DNV GL works with scrubber system manufacturers to certify their products, and the DNV GL class notation Scrubber Ready (read more on page 16) helps shipowners make room for potential installation of a scrubber in a newly designed vessel at a later date.

Future trends

“Looking into the future, we expect scrubbers to get smaller as manufacturers try to make them a more viable solution for vessels with little capacity for additional equipment on board,” Océane King explains. As the industry gains more experience with the installation of scrubbers, most cruise operators have turned to installing scrubber technology for use during operation at sea in order to avoid downtime for extended dry docking. “At the moment, passenger and ro-ro vessels stand to benefit the most from this technology, as the potential fuel savings are significant and the return on investment is very good in these sectors.” ■ AJO

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A GIANT STEP FORWARD

With 227,000 GT and a length easily surpassing the Eiffel Tower, *Harmony of the Seas* is the largest cruise ship ever to set sail and sets new efficiency standards for the industry.

Stepping onto the *Harmony of the Seas* is like entering another world. The scale is the first thing that hits you as you crane your neck to the sky to take in a vessel that towers 20 decks high, and, at a length of 361 metres, seemingly touches the horizon. Beginning what turns out to be a lengthy voyage through the ship you pass through seven themed neighbourhoods: uptown "Central Park", with its 12,000 trees and plants; "Royal Promenade", home to a lively bar scene, where, if you so desire, robotic bartenders will shake up the cocktail of your choice; "Boardwalk", replete with arcades and carousels; the fitness neighbourhood "Vitality Spa and Fitness"; "Entertainment Place" featuring a Las Vegas-style casino; the "Youth Zone" for the kids; and, last but far from least, the "Pool and Sports Zone". Here you'll be able to rock climb, zip line and surf on FlowRiders. With a drop of over 33 metres, cascading out the rear section of the vessel, *Harmony of the Seas* also offers passengers a ride on the world's tallest waterslide at sea.

A class apart

After first setting sail in May, the vessel has embarked on a season of European cruises before moving to Fort Lauderdale for Caribbean voyages beginning in November. Her 227,000 GT and 2,100 crew will cater for some 5,497 guests - and what they don't see is just as impressive as what they do.

Royal Caribbean International (RCI) has been working on the construction of the vessel with the STX France shipyard in Saint-Nazaire for the last two years. DNV GL has been on site for the duration >



Photos: Royal Caribbean International, Icon by Freepik from www.flaticon.com

Length
361 metres

37 metres longer than the Eiffel Tower's height, this stately lady is the largest ship of her type yet.

Width
66.4 metres



HARMONY OF THE SEAS

- Flag: Bahamas
- Maiden voyage: 29 May 2016
- Shipyard: STX France, Saint-Nazaire
- Tonnage: 227,000 GT (sister ships *Oasis of the Seas* and *Allure of the Seas*, formerly the largest cruise ships in the world, are 225,282 GT)
- Length: 361 metres
- Width: 66.4 metres
- Draught: 9.1 metres
- Cruising speed: 22 knots
- Guests: 5,497 at double occupancy (6,780 max)
- Crew: 2,100
- Decks: 20 (16 of which are open to passengers)
- Neighbourhoods: 7



Passengers
5,497
guests at double occupancy



Tonnage
227,000
gross tons



Harmony of the Seas leaves the STX shipyard in St. Nazaire, France, for her first sea trial in March 2016.

> of the build, undertaking tests, inspections and verification processes to ensure the vessel is built to plan and is fully compliant with all necessary rules and regulations. According to Arto Nieminen, DNV GL Project Manager at the yard, it has been both a demanding and extremely rewarding process. "This is a huge ship that creates huge challenges," Nieminen states. "There's so much of everything and, as regulations become increasingly complex - with new considerations such as 'safe return to port' and emission control areas (ECAs) - so does our work." That said the sense of teamwork between the owner, the yard and DNV GL has really helped the process. "We understand each other's businesses and concerns and work together as one to find the solutions that achieve the desired results. This has made what could have been a daunting build run smoothly," Nieminen adds.

Harmony of the Seas is the seventh RCI build Nieminen has worked on, giving him a keen understanding of a client that likes to advance and evolve, continually with each new vessel. This is evident, he says, in the huge array of environmental innovations showcased within this latest one-billion-dollar-plus build. "RCI isn't just focused on the experience above the waves, it is also concerned about responsible vessel performance down below, and reducing

emissions to air and sea," Nieminen explains. "*Harmony of the Seas* will set new standards for the industry."

Innovating for a better environment

Petteri Keso, *Harmony of the Seas* Project Director at Royal Caribbean Cruises, explains what exactly this means: "This will be our most energy-efficient and environmentally friendly vessel ever," he proclaims,



DNV GL project team (f.l.t.r.): Niki Tsaprazi, Theocharis Keventzidis, Jan Mester, Guy Richard, Bruno Sanyas, Michal Bagniewski, Elliot Thompson, Jorge Dahl, Arto Nieminen, Hans Kahrs and Aleksi Luukkonen.

“DNV GL understand us and we rely on them to ensure everything is done to the highest standard. It’s been a very enjoyable voyage with them.”

Petteri Keso,
Project Director
Harmony of the Seas,
Royal Caribbean Cruises



A crew member on board *Harmony of the Seas* checks the engines during the ship's first sea trial.

“some 20 per cent more fuel-efficient than her sister ships, *Oasis of the Seas* and *Allure of the Seas*. We build ships with the planet in mind, utilizing the latest designs and technology to optimize performance and minimize our carbon footprint. This makes good environmental sense and - if you consider the increasing awareness of our customers with regard to green issues - excellent business sense as well.”

Further innovations supporting these high standards include the exhaust gas treatment plant from Wärtsilä, three highly efficient ABB Azipod propulsion units (producing 20 megawatts each) and a steam turbine that generates electricity from recovered waste heat. LED and fluorescent lighting systems throughout the ship reduce power consumption and heat radiation, thereby minimizing the strain on the air conditioning system.

One of the main highlights of the design is the hull. “We are constantly upgrading the hull designs of our ships to help them perform more efficiently, and the *Harmony of the Seas* sees that evolution take a further step. This hull, optimized for real-life operating and speed profiles, particularly at the bow, reduces drag and enhances efficiency,” Keso explains. An advanced anti-fouling coating prevents potentially invasive marine species from attaching themselves.

“The hull also features the same air lubrication system we introduced on *Quantum of the Seas* in 2014. This

ingenious innovation creates tiny air bubbles that stick to the bottom of the hull and reduce friction - so that it practically sails on a cushion of air. Again, this pays real dividends in terms of efficiency,” Keso adds.

Preferred partners

On the subject of paying dividends, Keso says RCI sees huge benefits in working with established partners like DNV GL: “Cruise ships demand specialist expertise and real dedication - each one is unique and, as they grow in scale and functionality, increasingly complex. You therefore need partnerships you can trust - that’s why we choose DNV GL.” He adds: “They have been involved with the vessel from the very beginning, from providing advisory and verification services to testing and inspections, right through to helping us undertake the final sea trials, which are in process now. They understand us and we rely on them to ensure everything is done to the highest standard. It has been a very enjoyable voyage with them.” ■ MF

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THE PERFECT NICHE

A shrinking number of newbuilding orders has created fierce competition between shipyards, putting many businesses under pressure. But in a small city on Croatia's Adriatic coast, a shipbuilder has undergone a remarkable transformation.

Moving from bulk carriers and tankers to building advanced high-tech vessels such as naval ships, superyachts, sailing vessels and LNG-fuelled container ships was the right choice for Brodosplit, says CEO Tomislav Debeljak: "Like all European yards we continue to face tough competition from Asia, but shifting our focus to highly specialized vessels with higher added value has given us a competitive advantage," he points out. His company has completed a radical three-year restructuring process. After Croatia joined the European Union (EU) in 2013, the yard was privatized and acquired by the DIV Group, one of Croatia's largest manufacturers in the metal industry. The new management optimized the yard's design, procurement and production processes and brought in new, highly skilled engineers. Today Brodosplit's in-house design team of 150 specialists offer full ship engineering capabilities, from concept development through to project and workshop documentation. Through a new partnership with AVEVA Marine formed in 2015, the company can offer engineering software solutions as well. Its order book of 23 newbuilds worth about 356.5 million euros is ample proof that these measures are paying off.

The five-masted sailing ship *Star Clipper*, one of the DNV GL-classed newbuilds, will be the world's largest sailing ship and the first of its kind to be built at Brodosplit. 162 metres long and 18.5 metres wide, she has a 74-metre air draught and a sail area of

6,350 square metres. She will accommodate 300 passengers and be operated by the Monacan company Star Clippers. Until she is ready for delivery in late 2017, Brodosplit Project Manager Captain Radovan Načinović still has a lot of work to do. "Our biggest challenge is that the vessel is modelled after *France II*, which was built in 1911 and didn't have an engine. We had to make sure we stayed as true to the original as possible while fitting in modern propulsion systems and equipment and complying with today's standards," he explains. "We did extensive testing to ensure our construction plans used the available space in the best possible way."

Ready for LNG

DNV GL also carried out a safe-return-to-port analysis. *Star Clipper* will be the first sailing ship built according to safe-return-to-port rules. This means that the vessel will be equipped with redundant safety systems and machinery such as power generators to ensure it can function as its own lifeboat.

At the opposite end of the shipyard, another project is underway that represents a first for Brodosplit: a series of LNG-fuelled container ships. The first of these 2,000 TEU vessels is scheduled for delivery in November 2017. With a deadweight of 24,000 dwt each, the DNV GL-classed vessels will be some 184 metres long and 27.5 metres wide and will reach speeds of up to 18 knots. Their two-stroke, dual-fuel (LNG/MGO)

Photos: Brodosplit



BRODOSPLIT SHIPYARD

Covering an area of 560,000 square metres, the yard can build ships larger than 160,000 dwt. It has three open slipways as well as one 60-by-26-metres enclosed slipway which is used for building megayachts and similar projects. The manufactur-

Building specialized and high-tech ships is a key differentiator for Brodosplit.

ing lines are equipped with several automated and robot stations, and the cutting capacity is estimated at 137 metres of cut per hour. The yard's next big investment will be a gantry crane with a lifting capacity of 500 tonnes.



engines are more efficient and run at lower rotational speeds than conventional engines, resulting in lower maintenance costs and a longer lifespan. They are made by Brodosplit's own diesel engine factory under license from MAN.

The special tanks needed for bunkering the liquefied natural gas are likewise manufactured by Brodosplit. The design accounts for future requirements of the International Code of Safety for Ships Using Gases or other Low-flashpoint Fuels (IGF Code). The yard expects these vessels to achieve an energy efficiency design index better than the IMO requirement for the year 2025.

The greatest challenge so far has been to find the best and lowest-risk solution for installing the on-board LNG tanks, piping, ventilation trunks and the LNG regasification system while minimizing the loss of cargo capacity. "DNV GL experts were



"DNV GL's long-standing expertise has made this a great partnership."

Tomislav Debeljak,
CEO of Brodosplit

involved from the design phase and worked very closely with Brodosplit to realize this project," says Ivo Siljic, Senior Lead Surveyor at DNV GL - Maritime, who shares his office in Split with two surveyor colleagues. "DNV GL's long-standing expertise has made this a great partnership and we look forward to continuing our collaboration in the future," adds Brodosplit's CEO Tomislav Debeljak.

He is certain LNG will play a major role in the shipping industry's efforts to reduce its environmental footprint. LNG-fuelled container ships are therefore a key focus area for his company, along with passenger ships and megayachts. "We are very proud of Brodosplit's achievements over the past few years. We have definitely found our niche." ■ NL

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PUMP UP THE VOLUME

Bigger container ships are more economical, but there are limits to what major ports can handle. DNV GL looks at how much more these vessels could grow in today's environment.

The Suez Canal is a key limiting factor for the size of future container ships.

The increase in the maximum length and beam of ultra-large container ships (ULCS) has been stalling for several years, but the interest in building bigger ships has not waned. A DNV GL study into the most efficient ways to increase ULCS capacity while accounting for structural robustness as well as port and waterway restrictions found that the most important limiting factor for the main particulars of next-generation ULCS is the Suez Canal.

The DNV GL study focused on two aspects: improving transport efficiency, i.e. optimizing the required propulsion power per TEU by increasing the length, beam and draught for a predefined operating profile and a range of homogeneous container weights while accounting for infrastructural limitations imposed by seaways and ports; and the structural feasibility of such designs.

Methodical approach

Using a proprietary methodology called "Concept Design Assessment", DNV GL analysed 21 variants of a possible future ULCS design, combining three different lengths (24, 26 and 28 bays), three beam widths (23, 24 and 25 rows), and three draught conditions (15, 16 and 17 metres respectively). All cases

assumed twelve container tiers in the hold and eleven tiers on deck, which is equivalent to a ship depth of about 33 metres.

For all possible variants, the study determined the nominal container intake, the deadweight at each draught condition, the lightship weight adjusted for the results of the structural feasibility study, and the required main engine power for a speed range from 12 to 21 knots. Finally, the results were normalized and the difference in percentage was calculated for all variants in relation to the selected reference case, a ship with 24 bays, 23 rows and a 16-metre draught.

The concept design assessment produced a number of findings which are of great interest to ULCS designers: increasing the draught improves transport efficiency of all variants for most homogeneous loading conditions. In general, a draught increase by one metre without altering the ship's length or beam results in a deadweight increase of around 20,000 dwt. It reduces the required average propulsion power per TEU by roughly six per cent for heavier containers but is slightly unfavourable for lighter boxes.

Widening the beam by one or two rows without changing the length improves transport efficiency as long as the homogeneous container weight remains

low. Adding one hold (two bays) to the length of a ship with a 23-row beam improves transport efficiency by about five per cent for all loading conditions, and increasing the beam additionally increases the capacity but does not improve transport efficiency. A vessel lengthened by two holds (totalling 28 bays lengthwise) and widened to 25 rows will offer a transport efficiency improvement of roughly eight to eleven per cent, depending on the average weight of the containers.

Port restrictions are another important factor to consider. While vessel dimensions are rarely restricted in Asia, many European ports have to limit the draught, length and width of ships – usually because they are located in tidal waters or many miles up a river. Several ports in northern Europe permit ship lengths up to 400 metres only, and in some cases impose limits on the beam and draught as well. Length restrictions might be relaxed in future to accommodate ULCS lengths of up to 430 metres, provided the vessels are specifically equipped for efficient manoeuvring. Nevertheless, with ULCS dimensions continuing to increase, some European ports will no longer be able to serve as final loading or first discharge ports. A key limiting factor for global container shipping is the Suez Canal which currently allows passage for ships with a 59-metre beam and a 17-metre draught.

Structural feasibility study

The structural analysis performed by DNV GL on all design variants focussed on the mid-ship section, it assumed a maximum plate thickness of 90 mm and a steel yield strength of 460 N/mm² (YP460) in the deck area, and 355 N/mm² (YP355) in the bottom area. Because of certain mathematical and physical relationships between bending moments and ship dimensions, adding one bay lengthwise has a much greater effect on steel weight than adding a row. Using high-yield steel in parts of the mid-ship area would reduce the weight but might pose other chal-

lenges which require further investigation. The study also found that increasing the scantling draught from today's 16 metres to 17 metres would not have a major effect on the structural properties.

The study shows that next-generation ULCS can be designed, built and operated without requiring major changes to current design concepts or structural arrangements. The next step would involve increasing the beam to 24 rows to expand the nominal capacity by roughly 1,000 TEU. The fuel costs per TEU will remain nearly the same. Increasing the maximum draught of such a 24-row ULCS from 16 to 17 metres will boost the deadweight capacity by about ten per cent and improve fuel efficiency.

An even higher nominal capacity could be achieved by lengthening the vessel by one cargo hold, or two bays, to raise the intake to approximately 23,300 TEU, thereby reducing the fuel costs per TEU by 4.5 per cent. These modifications could be implemented in today's operating environment, without facing restrictions from current port and seaway infrastructure.

What's next?

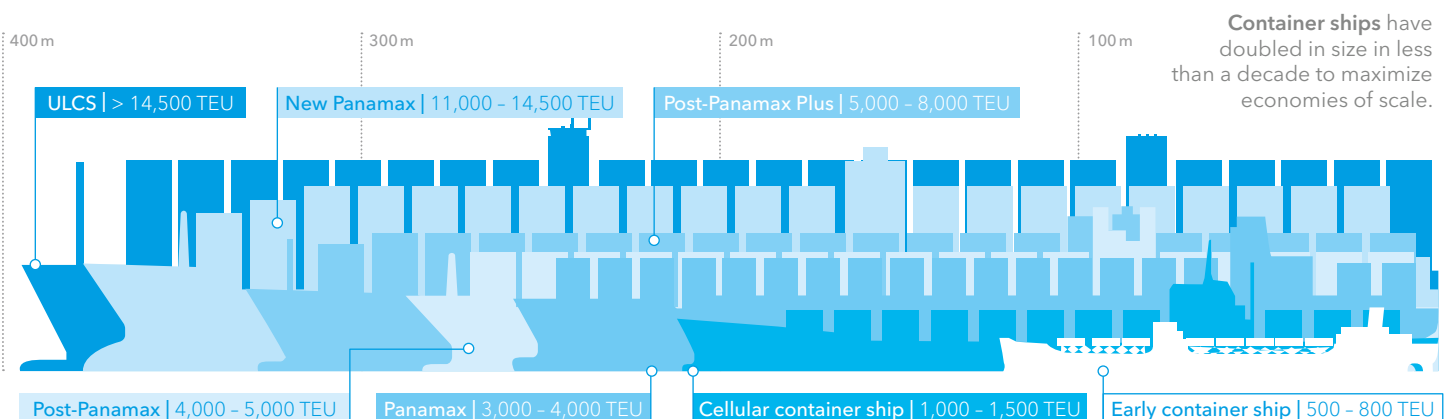
In theory, it would even be possible to construct a vessel 25 rows wide and 26 bays long and with a capacity of 26,300 TEU. However, such a ULCS would be unable to enter a number of major ports or pass through the current Suez Canal fully loaded. It would also require a new structural design concept involving "strength coaming" on top of the sheer strake. This makes it appear unlikely that such a vessel will be ordered any time soon, in spite of the promise of an additional 3.5 per cent reduction in fuel costs per TEU. ■AK

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PORTS OF THE FUTURE

Growing vessel sizes, stricter environmental regulations and the ambition to achieve higher turnover rates have already prompted many new developments in ports around the world. DNV GL has taken a look at some of the most advanced ports to see which technologies will shape the ports of the future.

Ultra-large container ships

400 metres long, 60 metres wide: the world's largest container ships carry up to 20,000 TEU today. The trend towards XXL ships continues. It is technically feasible to build **24,000 TEU ships**. This means that some ports may have to adapt their infrastructure to the new dimensions: new container gantry cranes, hinterland connections and storage facilities are needed. **Shipping lanes must be dredged and widened**, crane systems enlarged. While in many ports expansion space is naturally limited, **new giga-ports are being built**, especially in Asian industrial centres.



Digitalization

Today, state-of-the-art ships generate a data volume of **20 GB per day**. Data traffic between the bridge and land-based offices is steadily increasing. The port of the future will also require a **smart IT infrastructure capable of transmitting relevant transport data** from all port stakeholders (terminals, logistics operators, government agencies, transport firms, etc.) in all directions. **The results** are a comprehensive traffic management system, efficient customs clearance processes and an **all-encompassing safety concept**.



Efficiency

Competition is driven by the ambition to continuously speed up **in-port processing**. Ships are not supposed to spend more than **36 hours at berth**. Crane systems must work more accurately and be prepared to handle special cargo, from small boxes through to bulky items. Port roads are expected to **allow container access from both sides**.

Automation

In future container ship loading and unloading will be handled by **fully automated systems**. Terminals for ultra-large container ships (ULCS) will be able to **move 6,000 containers per day**, equivalent to 11,000 TEU. Transport of goods from ships to trucks or trains will likewise be handled by **unmanned automated guided vehicles**.



Intermodal transport

Whether rail, road, inland waterways, pipelines or combinations thereof: goods and cargo are reaching consumers **more quickly, safely and cheaply** than ever. The existing traffic network is being expanded and modernized. **IT-based traffic information systems** and a port traffic management centre optimize container flows.

Thanks to this infrastructure, **it is possible to save thousands of empty container trips**.



Low emissions

Ports become **environmental zones**: in the port of Hamburg, **automated guided vehicles (AGVs) charge their batteries automatically** when green power peaks are available on the grid. Effective 2020, 80 per cent of container ships berthed in Californian ports will be required to use **shoreside electricity generated from LNG**. Around the world, terminals and warehouses are being upgraded to **enhance energy efficiency**. New waste water treatment plants conserve up to 90 per cent of the fresh water used for cleaning.



STAYING AHEAD OF THE GAME



Greek ship management company Thenamaris reflects on Greek shipping's role in driving innovation, how to explore efficiency improvements in daily operations and the company's plans for the future.

Minas Giaouzis wasn't really convinced that he wanted to go into the maritime industry when he started his studies in Athens in 1983, but soon after he fell in love with shipping. Today, he heads the Technical Management department at one of Greece's most innovative ship management companies, Thenamaris.

Speaking to MARITIME IMPACT in Thenamaris' headquarters in Athens, Giaouzis calls on the Greek shipping industry to proactively pursue innovative and sustainable technologies. "I am happy to see that Greek shipping has already changed dramatically over the past few years. The community has moved from a short-term profit-oriented approach to directing their investments towards the implementation of new designs, innovative ideas and the protection of the environment. We should be pioneers and drive new developments in ship design and daily vessel operations," he says.

Thenamaris has made a commitment to research and innovation and consistently renews its fleet. Currently, the company has 15 newbuilds on order, eleven of them are tankers. "The tanker market is relatively stable at the moment, which was another reason for us to go forward with the order, even in difficult times. The current

dry bulk market on the other hand does not allow us to order newbuilds," he explains. The average age of the Thenamaris fleet is 8.3 years.

Joint research projects

In cooperation with DNV GL, Thenamaris has also worked on optimizing cargo discharge operations on tankers. "We piloted the next generation of thermodynamic modelling services with Thenamaris, which help identify efficiency gaps and improve cargo discharge operations using the DNV GL COSSMOS tool," explains George Dimopoulos, DNV GL Principal Specialist in the Maritime R&D and Advisory unit in Greece.

"Thenamaris is a highly technology-oriented and knowledge-based company, therefore this cooperation was a perfect fit. We engaged with them early on in our development process for this tool and their staff provided excellent feedback that has been very valuable in helping us roll out this service globally," he adds. The DNV GL computer platform COSSMOS is used to model and simulate complex integrated ship machinery systems.

The results of the discharge optimization project show that there is significant potential for fuel savings on the discharging

Technical Manager

Minas Giaouzis graduated as a Naval Architect and Marine Engineer from the National Technical University of Athens. He joined Thenamaris in 1996.



process. "We were very happy with the cooperation and have decided to take this project into a second phase," adds Minas Giaouzis. DNV GL and Thenamaris will work together to develop further tools for optimizing cargo operations, addressing cargo heating as well as on-board decision support using DNV GL COSSMOS.

The list of other projects Thenamaris has underway to increase the safety, efficiency and cost-effectiveness of their operations is long and also includes feasibility studies on scrubbers and LNG as ship fuel as potential solutions for ensuring compliance with current emissions regulations and the upcoming global sulphur cap in 2020/2025.

Addressing market challenges

"LNG is an interesting option, but after studying it on an Aframax ship we concluded that the current market does not warrant investments in retrofitting or the installation of LNG technology on newbuilds. However, we are taking steps to ensure we are prepared for when this option is financially feasible," explains Giaouzis. Thenamaris is in discussion with the shipyard that is constructing the company's newbuilds to make provisions for dual-fuel or LNG engines. In the meantime their vessels will continue to use low-sulphur distillate fuel to achieve compliance in emission control areas.

One of the Technical Manager's greatest challenges is the Ballast Water Management Convention (BWMC). "The regulatory environment is unclear and there is no holistic view of the impact, positive or negative, from its application," Giaouzis says, explaining that the protection of the environment through ballast water treatment may have a negative impact

on air pollution because of the additional energy and chemicals required for running ballast water treatment systems. "Nobody has concluded what the best outcome would be in this case, so it's not surprising that owners are hesitant," he adds.

One of the challenges he is already addressing is crew competence. "The expansion of the worldwide fleet coupled with greater demands on performance has brought the industry into a position where there is a mismatch between the competence of seafarers and the expected result, and shipping companies have a responsibility to change this

by developing their people," he states. Thenamaris has implemented a training programme for its crews around the world and is currently setting up its own academy where the courses will provide hands-on, vessel-relevant training to personnel, such as handling electronically controlled engines and fully automated systems.

Giaouzis is very happy with the progress so far: "Our training programme and an additional staff initiative we have been running internally have already started bearing fruit in helping us to improve our daily operations on shore and at sea. This goes to show that the human element is always going to be essential in making sure that we can reap the benefits technology has to offer." ■ AJO

"We should be pioneers and drive new developments in ship design and daily vessel operations."

Minas Giaouzis,
Technical Manager at Thenamaris

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Photos: DNV GL, Thenamaris



GLOBAL PROVIDER OF CHARTERING SERVICES

Thenamaris (Ships Management) Inc., Athens, provides its global integrated ship management services exclusively on an agency basis. The fleet under management currently comprises 72 vessels, including crude oil tankers, product carriers,

bulk carriers, and container ships. Thenamaris LNG manages three 160,000 m³ LNG carriers. Thenamaris operates, maintains, crews and trades its principals' vessels worldwide. The company's portfolio is a combination of spot and time charters.

COMPIT 2016 - IT DRIVES INNOVATION

Modern shipbuilding and shipping benefit enormously from advances in information technology. COMPIT is an annual event where experts present new developments and concepts and explore new ways of engineering and running ships.

Every year the Conference on Computer and IT Applications in the Maritime Industries (COMPIT) looks at the leading edge of IT-driven innovation in shipping. Held this year in Lecce, Italy, the classical Italian stonework that greeted the participants outside was a stark contrast to the architecture of 21st century shipbuilding being discussed within.

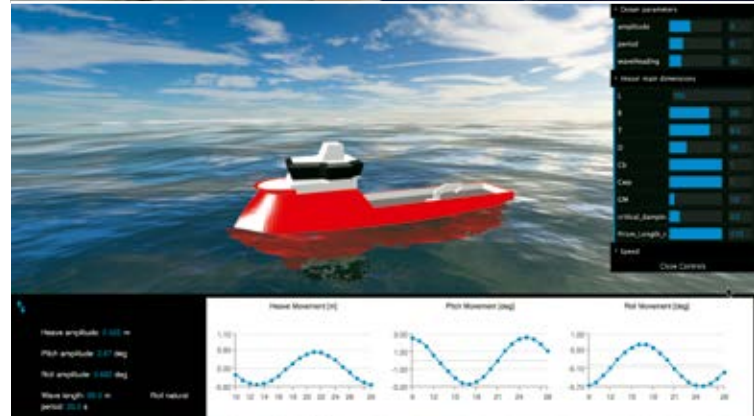
The list of COMPIT session topics from the past several years reads like a programme of emerging trends shaping the present and future of the maritime world. The themes dominating this year's conference were big data, and smart and connected.

Big data gets bigger - and bigger again

The key to big data is to turn it into meaningful small data, simple trends or even individual numbers that can be used to make good decisions. So far the applications we have seen fall largely into two categories: smarter maintenance schemes and smarter operation schemes. But some of today's pioneers are now presenting second-generation applications which combine multiple data sources with intelligent data fusion as well as integration with other maritime software.

In the big data sessions, Ørnulf Rødseth from Marintek looked at "Big Data in Shipping - Challenges and Opportunities". His paper gives examples of successful applications but also discusses the constraints of using big data in the shipping industry: low bandwidth, costly satellite communication links, data ownership issues, etc., along with the ability or inability of organizations to absorb and make use of collected information. Mary Etienne and Anthony

Professor Volker Bertram with Henrique M. Gaspar,
winner of the 2016 COMPIT award.



Augmented reality software by Matsuo Kohei helps workers locate components in ships and may soon assist welders as well.

Sayers (Dell) showed how the “The Internet of Things and Connected Ships” could be a game changer for the maritime industry, helping customers integrate operations, reduce production costs, improve safety, and effectively implement and manage large-scale change. Etienne and Sayers also presented a pragmatic approach to getting started today.

One notable feature of COMPIT is the loyalty of its attendees who often return to present updates on their work. A notable example this year was Matsuo Kohei from NMRI in Japan, who demonstrated an update to his very impressive augmented reality (AR) system for shipbuilding. In Kohei’s video of a pipe installation, a worker was able to locate a pipe for installation in a matter of minutes using AR. Kohei’s next project will explore AR-assisted welding.

A real winner for a virtual world

Henrique M. Gaspar won this year’s DNV GL COMPIT award for his paper “Open Source and Web Based Ship 3D Virtual Simulator”. The Brazilian CAD (computer-aided design) expert works at NTNU Ålesund.

“Professor Gaspar’s work merges innovative technologies and promotes open, transparent cooperation in the maritime industries,” says COMPIT organizer Volker Bertram. “His work is an interesting contribution to the development of the digital twin, combining state-of-the-art visualization technology with engineering simulation software to mimic ships in sea states.” A digital twin is a computer model that simulates not only the physical properties (geometry, steel thickness and quality, hull condition, etc.) of an object or machine, such as a ship, but also its performance characteristics, including its motion behaviour when manoeuvring, power consumption, strength, vibration and noise properties.

Professor Gaspar’s paper can be used to assess vessel motion performance in waves in a very intuitive way. It can also be used for a variety of other purposes, for example crew training and accident investigation. The system is based on open-source software and therefore open to the wider maritime public. It can be easily run on commercial off-the-shelf computers.

Volker Bertram, Senior Project Manager for Fluid Engineering at DNV GL, also contributed a paper in cooperation with Benoit Mallol and Alvaro Del Toro Lollens (NUMECA), called “Trends in CFD Illustrated



Exemplarily for Competitive Sailing Yachts”. The trends discussed in this paper include automated work processes, adaptive grid refinement, highly parallel computing and multidisciplinary analyses. Advanced computational fluid dynamics (CFD) technology has already led to the abandonment of model tests for America’s Cup yachts.

Every year the three-day COMPIT conference covers the main phases in the life cycle of ships. This year, day one focused on “New Design Processes”, “Cloud-based CFD Simulation”, “Interdisciplinary Simulations” and “Hydrodynamic Optimization”. Day two addressed “Smart & Cooperative - Design & Production”, “Autonomous (Seeing) Systems”, “Smart & Cooperative Ship Operation” and “Virtual Reality”. Day three examined “Asset Management”, “Smart Energy Management” and “Big Data I & II”. Next year’s COMPIT will take place in Cardiff, Wales. ■ SA

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DNV GL PAPERS AND AUTHORS

- Dausendschön, Mestl (DNV GL):
Port ETA Prediction based on AIS Data
- Vindoy, Dalhaug (DNV GL):
High-level Vessel Characterization
- Mallol, Del Toro Lollens (NUMECA), Bertram (DNV GL): Trends in CFD Illustrated Exemplarily for Competitive Sailing Yachts

A guest contribution by Dr John Coustas

A STRONG ALLY AND TRUSTED PARTNER

For shipowners, the role of the classification society as an authoritative source of expertise and advice has never been more crucial than today. Dr John Coustas, President and CEO of Danaos Corporation, shares his thoughts on the relationship between owners and their class.

The shipping industry has seen tremendous change over the last several decades, and most stakeholders will agree that there was a time when shipping was a bit more straightforward than it is today. In fact, safety and environmental matters were taken a bit too lightly in the olden days, and it took a number of severe shipping accidents and oil spills to make the industry – including classification societies – realize that a serious effort was needed to turn things around and save its reputation.

A number of organizations and bodies went to work drafting regulations, standards, and inspection regimes. In particular, the IMO and the classification societies developed sets of requirements and rules encompassing all aspects of a ship's life cycle. Their work continues. As a matter of fact, today all the inspections, surveys and vetting regimes add up to a situation most shipowners find exasperating. Hull insurers and Protection and Indemnity (P&I) clubs, port authorities, MoUs and others all want to tell owners what is wrong with their ships. While safety and environmental protection are worthy intentions, owners often find themselves facing conflicting or unreasonable inspection results or situations where other interests might be influencing the decision of an inspector. What is more, new regulations and conventions are imposing ever tighter restrictions on the industry which sometimes seem unachievable.

The final say

In this difficult environment, classification societies have a crucial role to play. Shipowners need a single point of reference, a final arbiter on the technical condition of their ships. When an MoU or P&I body identifies a deficiency, the owner needs class to have the final say on when the deficiency has been

eliminated, not the individual surveyor or authority. Where this is not the case, the result is an unstable environment for the operation of ships and the shipping business in general.

So the industry has a strong interest in reinstating class as the authoritative source of truth regarding the condition of the vessel. This would also help keep the overall burden of inspections at a reasonable level. Class is definitely in a position to assume this ultimate responsibility. It has the knowledge of the individual ship, its technical status and history. By virtue of its own research, class has the required expertise and maintenance know-how to assess a ship, and the necessary infrastructure in the form of experienced surveyors who understand technical problems of all kinds. Furthermore, class is unbiased and not influenced by external interests, be they political, commercial or otherwise. Shipowners and their classification societies must form a united front towards third parties. On global issues such as IMO regulations, class is the shipowners' ally in advocating what is technically feasible. At times politicians, who cannot possibly all be shipbuilding experts, try to impose stipulations, targets and conditions on the industry that are technically unachievable.

Research and technology

Classification societies are hotbeds of maritime research and shipowning companies depend on this scientific work when designing next-generation ships and optimizing vessels in service. In the field of ship newbuilding, owners rely on their class for pre-contract consultation, design assistance including computer modelling, cooperation during the plan approval process, and experienced supervisors to make sure the ship will be up to specifications. Owners look

to their class for technologies which allow them to comply with new emission limits and ballast water restrictions, enable the use of alternative fuels and innovative propulsion systems, and pave the way towards utilizing advanced information technology to optimize processes, ship operation, cargo distribution, on-board system monitoring, system automation, fleet management and more.

As big data moves into focus, shipowners and operators are anxious to reap the benefits of this technology to better overcome daily operational challenges. While they have data from their own fleets, they need more general information to extract industry-wide insights and derive performance benchmarks. Classification societies can provide global statistics and real-time information, along with software and reliable algorithms to assist with big data analytics. The current enterprise IT landscape is marked by a multitude of proprietary systems which work fine as long as they are used within a single company. But big data means tapping global resources, which requires compatibility between data models and processing systems. Classification societies should work towards developing a common industry standard to integrate information from different sources. For example, when the requirement for monitoring, reporting and verification of CO₂ emissions (MRV) enters into force in 2018, the industry would benefit greatly from a standard allowing MRV data to be aggregated with other types of information.

A united front

Of course, the leading classification societies are well aware of the issues and challenges – from MRV and the IMO Tier III NO_x regulation to COP21 and

through to ballast water management and big data – and they are working towards finding sustainable solutions. Class has a great responsibility to stand up and tell policymakers what is feasible and where the limits of current technology are. At times political institutions try to push regulations which are actually counterproductive to the original cause. For example, if a container ship which normally takes three days from Spain to Germany is forced by regulations to slow down too much, then the cargo owners will resort to trucking instead. The environmental damage will be several orders of magnitude greater, defeating the purpose of the regulation. It would make much more sense to allow industry experts to take charge and eliminate all pockets of inefficiency rather than attempting to solve environmental problems through ill-advised blanket solutions.

Selecting a class

When choosing a classification society, shipowners value superior understanding of the individual ship and its history as well as thorough industry knowledge, leading research and development work in the field of ship technology, as well as comprehensive assistance in implementing class rules. Class should have the ability to respond to the needs and enquiries of shipowners in real time, cooperate with them closely to help them make efficient use of information resources, and of course, offer competitive fees.

Shipowners want their classification society to be an independent, trusted partner. Class should liaise with shipowners in the dialogue with authorities and supervisory bodies, and should be recognized as the only body empowered to opine on vessel rule compliance. In return, owners will make every effort to deflect any attempts to undermine class authority. ■



Photo: Danaos Corporation

“Class has a great responsibility to stand up and tell policymakers what is feasible and where the limits of current technology are.”

Dr John Coustas,
President and CEO of Danaos Corporation

Danaos Corporation, one of the largest independent owners of modern, large-size container ships, is headquartered in Piraeus, Greece. Dr John Coustas is its President, Chief Executive Officer and a member of the board of directors. He holds a degree in Marine Engineering and a PhD in Computer Controls and has over 30 years of experience in the shipping industry.



WHAT WILL SHAPE THE

DNV GL's Technology Outlook 2025 report is more about the probable than the possible and it suggests that digitalization will overturn today's business models and shape new modes of operation.

Every five years, DNV GL publishes the Technology Outlook to give customers and stakeholders a basis for discussion and insight into the technology landscape of the next decade. In shipping we can already see fundamental changes taking place, with many more in store. The vessel of the future is rapidly becoming a floating computer, echoing developments in the automotive industry, where today's family cars have more computing power than early space shuttles. Digitalization of information flows will spur automation and positively impact safety and environmental performance. Advances in satellite communications will allow for a massive increase in the volumes of data transferred at ever-lower costs.

Onshore, new cloud technologies, such as big data platforms and digital twin technologies will have a dramatic effect on how the industry manages information, and how vessels and their components are designed, built and tested. Ship systems and their digital twins, virtual replicas of vessels and their systems, could be designed with the support of cloud-based information management and multimodel simulation platforms. Over time, increasingly detailed virtual models will be continuously populated with information collected on board, accelerating the development of industrial big

data and smart analytics platforms. This will improve fuel economy, maintenance and performance.

As technologies become more robust, unmanned vessels could also become a reality. This requires automation and high reliability of the engine and other integrated systems. In addition, advanced navigation systems and sophisticated algorithms to maintain a vessel's course are prerequisites. Based on different levels of autonomy, we can imagine a completely autonomous ship that reports to shore-based operators only when human input is needed or if emergency situations arise.

Cyberphysical systems

"Our view is that the coming decade will be all about the implementation of technologies that are known to us. What's new is the combination of advanced technologies from previously separate domains," says Remi Eriksen, Group President and CEO of DNV GL. "It may be hard to believe we're on the cusp of a technology-led revolution at a time when the global economy is slowing down. But I believe we are entering a new 'renaissance' of industrial progress characterized by a massive and accelerated uptake of cyberphysical systems."



FUTURE OF SHIPPING

A cyberphysical system comprises physical components that can be monitored, controlled and optimized by smart sensors, advanced software and actuators. Modern ships are becoming highly automated and are increasingly dependent on software-based control systems. Advances are likely to be applied to machinery systems first and then move gradually to vessel navigation systems, which will increasingly rely on advanced software and sensors to alert the navigator of possible hazards and propose appropriate courses of action to maintain safety.

These developments will also lead to on-board systems being managed remotely. Crews will be reduced, and more decisions will be made from shore-based control centres.

Additive manufacturing - or 3D printing - is dramatically changing where and how things are made in other industries, and shipping will likely see an uptake of this technology too. Spare parts for ships, for instance, could be printed out at a port of convenience; conceivably from recycled material as circular economy models become pervasive.

More efficient supply chains

Digitalization will impact entire supply chains enabling them to be more efficiently organized around adaptable operations that leverage timely information on cargo, routes, and the operation and condition of assets. This will reduce lead times and fuel consumption by optimizing arrival times, while

also allowing better organization of cargo handling operations and onshore personnel.

Finally, there is little doubt that financial, regulatory and societal pressures will continue to be exerted to encourage shipping to lower its environmental impact. This will result in growing numbers of vessels being designed to offer superior energy efficiency through measures such as improved hydrodynamics, use of lightweight materials and advanced hybrid power generation systems. New, increasingly effective solutions to reduce water and air pollution will become available. Diversification of the fuel mix should also be expected, with an increasing share of distillate fuels as well as scrubbers for compliance with upcoming low-sulphur requirements. Alternative fuels such as LNG and vessel hybridization have the potential to play a more important role, and grid electricity could become standard for cold ironing in ports.

DNV GL's Technology Outlook 2025 makes predictions based on economic, geopolitical and demographic trends. It has three main focus areas: shipping, energy - including power as well as oil and gas - and life sciences. The report suggests that digitalization will feature heavily in the future of all of these focus areas. ■ PWR

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Further info including the course catalogue can be found at bit.ly/maritimediaploma

EVENTS & EXHIBITIONS



Please also visit: dnvgl.com/events for a constantly updated list of events, conferences and exhibitions.

14. - 16.06.16
CWC's LNG Fuels Summit
Amsterdam, NE

15. - 16.06.16
Pacific Rim LNG Summit 2016
Tokyo, JP

19. - 24.06.16
International Conference on Ocean, Offshore & Arctic Engineering (OMAE) 2016
Busan, KO

21. - 23.06.16
Electric and Hybrid Marine World Expo
Amsterdam, NE

27. - 29.06.16
7th Annual LNG Shipping Conference
London, UK

16. - 19.08.16
Nor-Fishing
Trondheim, NO

23. - 25.08.16
International Software Summit 2016 - Americas
Hershey, US

29.08 - 01.09.16
ONS
Stavanger, NO

06. - 09.09.16
SMM
Hamburg, DE

14. - 15.09.16
OSV Chartering Contract Management Seminar
London, UK



The 27th SMM Hamburg is being held from 6 to 9 September 2016. The leading international trade fair is offering the market a hall exclusively dedicated to "green propulsion".

26.09 - 27.09.16
Liquefaction of Bulk Cargoes Seminar
London, UK

04. - 06.10.16
Arctic Shipping Forum North America
Montreal, CA

04. - 06.10.16
International Marine Technician Symposium
Bergen, NO

04. - 07.10.16
Offshore Marintec Russia
St Petersburg, RU

15. - 19.10.16
Interferry Annual Conference
Manila, PH

24. - 26.10.16
Arctic Technology Conference 2016
St John's, CA

25. - 28.10.16
Shiptec China 2016
Dalian, CN

31.10. - 02.11.16
Seatrade Middle East Maritime 2016
Dubai, AE

14. - 16.11.16
EAGC - European Autumn Gas Conference 2016
The Hague, NL

14. - 17.11.16
Green Ship Technology North America Conference
Washington, US

16. - 18.11.16
7th Gas Fuelled Ships Conference
Hamburg, DE

28. - 30.11.16
6th International Maritime Conference on Design for Safety
Hamburg, DE

29.11- 01.12. 2016
Seawork Asia
Shanghai, CN

30.11. - 02.12.16
The International Workboat Show 2016
New Orleans, US

07. - 08.12.16
19th Annual Salvage & Wreck Removal Conference
London, UK

December 2016
Ballast Water Management Technology
London, UK

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DNV GL

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