DNV·GL

TANKER UPDATE

2017

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BWM Convention

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Cover photo: momentscatcher – Fotolia

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DEAR READER,

A large number of new tankers are hitting the water this year, which obviously will contribute negatively to an already turbulent tanker market. At the same time we are experiencing newbuilding prices at extremely low levels, in fact so low that many owners now are tempted to invest. The new assets will comply with the requirements for ballast water and NO_x, which could be an advantage in an increasingly competitive landscape. Furthermore, and based on the 0.50% sulphur cap in 2020, we are observing increased interest amongst owners in alternative fuels, even though scrubbers seems like a cost effective solution on paper. Whether newbuild or not, the entire fleet will have to cope with a complex regulatory environment, from the EU's carbon dioxide (CO_2) monitoring, reporting and verification (MRV) scheme to the 2020 sulphur cap and ballast water treatment (BWT).

For compliance with ballast water requirements, DNV GL has recently launched a Ballast Water Management Plan Generator app that you might find useful. Unfortunately there are no silver bullets in the choice of best ballast water treatment system, but as our client DNV GL is dedicated to supporting you in making the best choices according to the current operational profile. But no matter which system is chosen, it is clear that what used to be a simple ad hoc operation is now a complex process which needs careful planning. DNV GL is helping customers navigate the process of ballast water operations.

Another complicating issue are the upcoming retroactive changes to the IBC code coming into force on 1 July 2020. As certain products which are currently deemed to be non-toxic will be reclassified as toxic, some modifications may be needed in order to carry the same cargoes as before. DNV GL can assist you in identifying the caps for your ships, in order to be prepared for the upcoming regulatory changes.

Innovation is all around us, especially in the digital realm, from electronic certificates, machine learning tools and drone surveys to the launch of a new industry data platform. DNV GL embraces digitalization as a means to enhance class services and improve communication with customers. But nothing can replace personal contact. In March the International Technical Tanker Forum (ITTF) was relaunched after a six-year pause to provide a platform for sharing best practices and other information related to tanker operation, and to speak with a common voice when approaching other industry stakeholders. DNV GL communicates on all channels to keep you, our customers, abreast of new developments.

Enjoy reading!

TANKER UPDATE

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TOO LOW TO SAY NO

A prolonged period of weak contracting activity has forced shipyards to drop their newbuilding prices to levels not seen in decades. Crude oil tanker owners have decided to take advantage of the situation, despite the weakening earnings sentiment in their segment.

The collapse of oil prices back in 2014 was undoubtedly great news for oil tankers. After years of stagnation, seaborne crude oil trade started to grow by over four per cent per annum.

An increased demand for transport considerably improved ship earnings, which resulted in a wave of newbuilding contracts, as is normal in the shipping world. Almost three years later those ships are now being delivered in rather alarming quantities. Despite moderately optimistic oil consumption forecasts in terms of tonnes, seaborne trade is not expected to increase substantially in 2017 so a gradual softening of freight rates seems inevitable. High tonnage supply coinciding with weakening demand is a typical shift of the cycle which normally results in reduced contracting of the new tonnage. This time around however, we seem to be observing an entirely different behaviour.

2 May 2014
USD 108.73

Tempting prices

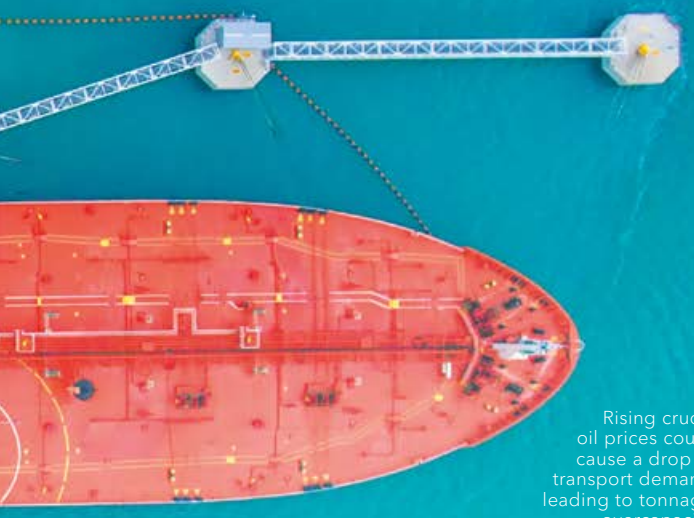
One may say that after almost no ordering in 2016, any new contract placed in the shipyard may look like an improvement,

OIL PRICE DEVELOPMENT

The 2014 oil price slump gave a boost to seaborne crude oil trade. The resulting strong demand for transportation encouraged owners to order new tankers. Rapidly increasing deliveries of new tonnage started to put pressure on tanker earnings. Despite a growing risk of overcapacity, historically low newbuilding prices tempt owners to place orders for new ships.

but the current pace of ordering is more than unusual. According to IHS Markit data as many as 20 ships were ordered in the VLCC segment alone during the first four months of the year. Compared to only three such contracts placed during the whole of 2016, an increase of activity is more than visible.

At the same time, there were 47 VLCCs and 26 Suezmaxes delivered last year and another 52 and 65 are expected to hit the water in 2017, allowing the fleet to grow by six per cent and eight per cent respectively. Even with continued strong imports to China and India and increased tonnage demand for US exports, such pace of expansion offers no slack for the earnings, which will continue to soften. Since this is a well-known conclusion, why are so many new contracts being announced nowadays?



Rising crude oil prices could cause a drop in transport demand, leading to tonnage overcapacity.

Photos: DNV GL, MAGNIFIER - Fotolia

The answer is simple – they are cheap! With 80 million US dollars for a VLCC and 53 million US-dollars for a Suezmax, you need to travel some 25 years back in time to see similar prices (including inflation in the equation). One simply does not say no to such bargains; a theory well supported by the current level of contracting.

Shipyards are in a tough negotiation spot and their exhausted order books leave them no choice but to accept what owners are prepared to offer. The newbuild price for a VLCC currently represents what owners had to pay for a five-year-old ship just 16 months ago! It means that the ships contracted now will have a considerable competitive advantage in terms of their break-even rates, compared to their peers contracted earlier.

In addition, the upcoming environmental regulations introduce additional costs for shipowners. Be it ballast water treatment systems or, for example, scrubbers the cost is substantial and hard to justify, particularly when the differential between second-hand and scrap prices is narrow. In consequence, we may see some ships sold for scrapping earlier than previously assumed. By the year 2020, some 100 VLCCs and 80 Suezmax tankers will be over 20 years old, which means that now would be the time to think about replacing them.

The cycle continues

Low oil prices also have consequences for trade patterns, particularly in and outside the US. Due to increased shale oil production, we observe lower imports across the Atlantic, particularly from West Africa. Those barrels, however are being re-routed to the Far East, which offers higher fleet utilization due to increased distances. In addition, ever since the US lifted the crude oil export ban, we have seen increased exports of American crude, often bound for Far East importers. In such trades it is possible to use Aframaxes and partially laden Suezmaxes going via the Panama Canal, however the best economies of scale can be achieved by using VLCCs going around the Cape of Good Hope. The problem is that it is impossible to load American crude on a VLCC due to lack of infrastructure. For the time being it is done via ship-to-ship operations, however it is reasonable to assume that in future there will be terminals big enough to accept VLCCs.

There are quite a few legitimate reasons for the current levels of contracting. However, the super-low newbuilding prices should be treated as an enabler for all other assumptions. There is of course a growing concern that the opportunistic contracting will result in a prolonged period of depressed earnings. It is indeed a concern, especially in light of possible further oil production cuts from the OPEC countries, which may reduce the amount of seaborne crude in the future. But then again, would anyone argue that this is the first time the market has dealt with oversupply? **JW**

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12 May 2017
USD 50.92

EXCEEDING STANDARDS: RUSSIA'S NEW LNG-FUELLED TANKERS

Russia's largest shipping company, the state-owned Sovcomflot, has just placed an order for four LNG-fuelled Aframax tankers plus options for delivery in 2018 and 2019. This sets a new standard for shipping, especially in the environmentally sensitive regions such as the Arctic where the SCF fleet operates.

At a time of attractive newbuilding prices, this order is a strategic step towards ensuring compliance with the upcoming environmental regulations. Aframax-size tankers are the workhorses of the trade and the preferred ship type for Russia's oil exports. "We remain positive about the long-term prospects of Aframax tankers in general and our own fleet in particular. Our ships operate in more challenging climatic and navigational conditions than most other vessels," explains Igor Tonkovidov, Executive Vice-President and Chief Engineer at Sovcomflot (SCF). Eco-friendly vessels with ice class give the company a distinct competitive advantage, he adds.

The newbuilding order is consistent with SCF's long-term strategy of continuous investments in fleet renewal to make sure charterers always have access to a modern, safe and reliable fleet. As a natural consequence of the geographical location of Russia's offshore oil fields, SCF considers its operational expertise in ice-bound and harsh maritime environments a key competitive advantage. With a fleet of 75 vessels ranging from ICE-1C to Arc7 and Icebreaker ICE-15 class, SCF is the world's largest owner and operator of ice-class vessels. In addition to tankers SCF also operates a growing fleet of specialized ships serving offshore oil and gas projects.

Ships operating in the harsh conditions of northern Eurasia must be exceptionally reliable to avoid endangering their crews and the environment.

The new Aframax vessels will primarily be deployed in trades between the Baltic Sea and northern Europe, transporting crude oil and petroleum products. They will feature Ice Class 1A hulls enabling year-round oil exports from the Russian Baltic ports. Since they are not specifically intended for operation in polar waters, the Polar Code requirements do not apply. Built in accordance with the additional BWM (T) class notation, the vessels will be properly equipped to comply with the International Convention for the Control and Management of Ships Ballast Water and Sediments, 2004 (BWM Convention).

LNG makes headway

The new Aframax ships will be equipped with low-pressure X-DF dual-fuel engines meeting Tier III requirements in all operational modes. The first four units will be LNG-fuelled or LNG-ready and capable of running either on LNG or on standard marine fuels. As the first LNG-powered Aframax crude oil tankers on the market, they will receive the Clean (Design, Tier III) class notation. When not running on LNG fuel, selective catalytic reduction (SCR) technology on board will ensure compliance with the Tier III regulations governing NO_x emissions.

Regarding LNG bunkering, SCF works closely with its cooperation partner Shell. Committed to LNG as a transport fuel, Shell will refuel the vessels from a specialized LNG bunker vessel in Rotterdam as well as other supply points in the Baltic. "The availability of LNG bunkering opportunities is still a primary concern for shipowners and a reason why many dismiss the LNG option without further investigation," says Jan Kvålsvold, Director Market and Business Development at DNV GL – Maritime, explaining the current market situation. "Furthermore, implementing LNG propulsion technology is a time-consuming effort with many details to be sorted out on top of all the other decisions that must be made in a design and contracting process. However, with the new LNG bunker request feature available on DNV GL's LNGi platform, shipowners are now able to inform LNG suppliers about their potential interest in bunkering LNG at specific locations so they can quickly understand whether LNG is an option they should pursue further. Making a request takes less than half an hour."

Svet, a VLCC completed in October 2013, is one SCF's young fleet of 124 tankers.

SCF expects the international LNG bunkering infrastructure to develop quickly as more LNG-fuelled vessels enter into service. The company also plans to expand its presence in the Gulf of Mexico where the LNG bunkering market is developing rapidly. "We see LNG as an important alternative fuel with a strong future, not least given its compelling features as an energy source for ships," Tonkovidov points out. "Our charterers increasingly expect to see their shipping requirements fulfilled with a minimal adverse impact on the environment. We have chosen to use innovative technical solutions to make sure that the next generation of Aframax tankers exceeds applicable emission legislation, rather than simply complying with it. Our mission is to set the standard for shipping, especially in environmentally sensitive regions such as the Arctic, where our fleet operates."

Investing in people and safety

"The philosophy of Safety Comes First is of the highest importance to our company and an integral part of our mission," Igor Tonkovidov says. Promoting a culture of continuous improvements, and investing heavily in its fleet and people, Sovcomflot has declared "Zero Accidents" a corporate goal. With an average vessel age of just 9.3 years, the SCF fleet is young and operates on a detailed programme of planned maintenance, including regular dry-dockings. This is the only way these ships can perform reliably in the harsh operating conditions of the north without damaging the sensitive natural environment.

Modern technology comes with its own challenges, and seamless interoperability of advanced on-board systems is a key concern today. Wherever possible SCF seeks to evaluate the compatibility of new technical systems prior to installation. Once in operation, these system environments are constantly monitored to make sure they fulfil their intended purpose effectively. But even more important than hardware are the people in charge of it, and SCF knows that continuous investments in personnel training and development are key to successful integration of new technical systems. Owning and operating one of the most advanced fleets in the industry, the company recognizes the importance of the human-technology interface for trouble-free performance of technical systems.

Sovcomflot has chosen both DNV GL and the Russian Register as classification societies for its dual-class vessels. Igor Tonkovidov explains the rationale behind this strategy: "The international reputation of DNV GL, combined with the specialist experience of the Russian Register regarding vessels operating in harsh environments were the decisive factors for this decision." **AK**

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Photos: DNV GL, PAO Sovcomflot – www.sovcomflot.ru

DNV GL'S DIGITAL JOURNEY

From electronic certificates, machine learning tools and drone surveys to the launch of a new industry data platform, DNV GL is embracing digitalization to enhance class services and improve communication with customers.

Shipping has undergone a remarkable transformation over the past few decades. Advances in technology, new materials and new insights into the design, construction and operation of vessels mean that they are more complex, more efficient and larger than ever before. While the use of ship-to-shore data and greater digitalization is improving operations and performance, reducing maintenance and operational costs, as well as enhancing safety. DNV GL has been at the heart of this transformation for more than 150 years.

"For us, digitalization is not an end in itself, we see it as another means to fulfil our main purpose: ensuring safe operations at sea and protecting life, property and the environment," says Knut Ørbeck-Nilssen, CEO of DNV GL – Maritime. "The role of class in ensuring the integrity of the vessel and safety of the crew will continue, but the way surveys are conducted may change significantly. Furthermore, digitalization enables us to become more efficient and improve our level of service," he adds.

Single access point to all digital services

When our customers interact with classification, they want this to be as simple and efficient as possible. To help, we launched My DNV GL. This is a single access point for all of our digital services, with many applications designed to support our customers in areas such as port state control inspections (see info box – PSC Planner), cybersecurity preparedness and regulatory compliance. To provide worldwide access to class documentation,

ELECTRONIC CERTIFICATES

Starting in September 2017, DNV GL will introduce electronic certificates for the class and statutory regimes. Accessible from anywhere in the world, electronic certificates bring many advantages to both DNV GL and its customers. By eliminating paper handling, they reduce the administrative burden on all stakeholders. A validation solution ensures that electronic certificates are just as safe as paper. In addition, electronic certificates are easy and convenient to share.

Compiling them in My DNV GL provides a comprehensive overview of key ship data that cannot get lost and is just a few clicks away. For DNV GL, electronic certificates help make processes more efficient, and they provide experts with easy access to certificates when they need to check up on something, be it during a survey or at a customer meeting. Electronic certificates will be rolled out gradually and will be implemented with a vessel's next annual survey.

Digitalization is enhancing our understanding of maritime operations, improving efficiency and helping to reduce costs.

"For us at DNV GL, digitalization is not an end in itself, we see it as another means to fulfil our main purpose: ensuring safe operations at sea and protecting life, property and the environment."

Knut Ørbeck-Nilssen, CEO of DNV GL – Maritime

SMART SURVEY BOOKING

The Smart Survey Booking tool will be launched towards the end of the year. It simplifies survey booking, fitting inspections into the customers' schedule while saving time and costs. This is how it works:

- Customers are notified about the best time to order surveys and audits and notified shortly before the due date of the next survey.
- The tool proposes the scope of the survey and states how long a survey of this scope would take.
- A list of approved service suppliers in each port is provided, and helps operators to find out whether an in-water survey can be performed in a specific port.
- The tool offers up-front cost estimates including travel and overtime charges for survey combinations during any given port stays based on ETA (estimated time of arrival) and ETD (estimated time of departure).
- Based on automatically calculated cost estimates and the possible scope of the inspection in each port, customers can compare and benchmark various port-stay options.
- Once the date is set, the tool attaches relevant survey preparation notes to the booking confirmation to help the operator prepare for the inspection.

DNV GL customers will soon be able to use electronic certificates. This means their documentation never gets lost, is always up to date and is accessible from any device (see info box – Electronic Certificates).

"And with the introduction of our new simple survey booking tool towards the end of the year, we will also start using intelligent software agents to help customers find the best time and place to book a survey," adds Ørbeck-Nilssen (see info box – Simple Survey Booking). When customers have questions or run into a problem, they can get in touch with one of DNV GL's technical experts through the DATE service. "This service has been a great success and now, to make it even better, we have introduced a tool that uses machine learning to automatically match our customers with the right expert for their question," says Ørbeck- Nilssen. The tool has already analysed more than 200,000 requests and is continuing to learn (see info box – Machine Learning). "Soon, we expect it will be able to answer simple questions on its own," he adds.

Modern survey methods

One of the most important ways we work to keep shipping safe is by conducting annual surveys on all of the vessels in our class. So far this has meant a surveyor needs to crawl and climb to reach every remote corner inside a ship. But new technologies are changing even how DNV GL does this. Already, surveyors have used camera-equipped drones to visually inspect large cargo holds and tanks. Using a drone opens up a lot of new possibilities. "In the future, drones could eventually be piloted remotely or even autonomously, meaning the surveyors could work from their >

Photos: DNV GL, Dale/zinkevych - Fotolia

> desk thousands of miles away from the ship and inspect the vessel in virtual reality (VR)," says Ørbeck-Nilssen.

For our customers, the successful delivery and regular inspections of a vessel as well as interactions with class are just one part of a bigger puzzle. The other big questions are: How does the design perform in daily operations? Is the engine achieving optimal fuel consumption? And are the safety systems reliable at sea?

Turning data into business intelligence

Today, advanced sensor technology and powerful satellite connections have opened up a new range of possibilities for understanding more about vessels and their operation. Everything on board, from the engines, the propeller and the safety systems to the containers themselves can be fitted with smart sensors to monitor performance and catch irregularities early on. This information can then be fed into the DNV GL performance management platform ECO Insight, which can check the quality of the data before analysing it. "This lets operators benchmark their vessels against the world fleet, turning their data into valuable business intelligence," says Ørbeck-Nilssen.

DNV GL can also take this data and combine it with information from inspections and a 3D model of the ship to build a "digital twin" – a digital copy of a real object, modelled to exactly represent its properties. DNV GL experts can use the digital twin to find the best design, see how the networks on board respond to cyberattacks, test measures to improve performance and identify when vital equipment needs maintenance or replacement – throughout the lifetime of the vessel. Ultimately, digital systems could end up controlling ships entirely – without the need for a human crew. An autonomous ship would use advanced navigation software and smart control systems to follow a course, avoid obstacles and safely deliver its cargo. Of course, if the industry is going to rely on these systems, they need to be as reliable and secure as possible. With software-in-the-loop testing and a digital twin, DNV GL can check and correct weaknesses in the system.

The broader view

These new digital solutions are not confined to the world of shipping. "It doesn't matter where you look in DNV GL, our customers are using data analytics to improve safety, gain efficiencies, reduce environmental impacts and evolve new business models," says Remi Eriksen, Group President & CEO at DNV GL. "On drill ships, we've seen how sensor data and advanced data analytics are helping our customers save millions of dollars in downtime. In the renewables industry, power cybernetics is helping to integrate variable wind and solar power safely into the grid, while machine learning helps oil and gas pipelines become safer by drawing insights from previously unconnected data sets," he explains.

A new industry data platform

All of these advances need many different project partners working together with accurate, reliable and secure data from multiple sources. And as decision-making and business models become more data-driven, trustworthy data becomes even more valuable. "Without trust in this data, truly cooperative projects cannot deliver the progress we hope for. At DNV GL, we have always been trusted with data, trusted to give an independent expert view and trusted to connect different industry players. That is why we have created a place for industry experts and data to come together

MACHINE LEARNING

DNV GL has introduced a new machine learning tool to the Direct Access to Technical Experts service (DATE). When customers have a query, this service connects them to one of more than 400 technical experts located at five support hubs worldwide. DATE was used more than 20,000 times in 2016, with over 97 per cent of requests being completed within the customer's deadline. Matching every request with the right expert as quickly as possible is essential. DNV GL's new machine learning tool searches for key words in a customer enquiry to create a profile for each request. Then it sends the request to an appropriate expert. After a piloting phase the machine learning tool went live for all DATE requests at the beginning of May 2017. It has viewed about 200,000 requests already and is learning continually. In the future, it could even answer simple questions on its own.

DNV GL surveyors perform a final check on one of the custom-built DNV GL drones, before using it to inspect a cargo tank.

Advanced technology is helping to modernize communication with class and is changing the way DNV GL conducts surveys.

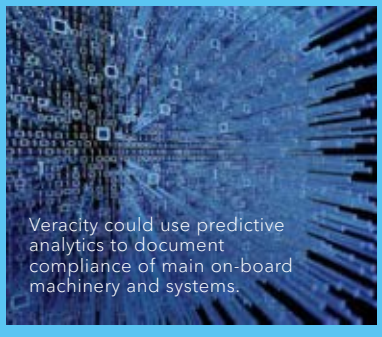
securely: our new, multi-sided industry data platform called Veracity," says Remi Eriksen.

Veracity is a meeting ground for co-innovation and co-creation between multiple industry stakeholders, playing a key role by assuring data quality, data security and access. It is an open platform for qualifying, unlocking and improving data from sensors and other sources. Customers stay in control in this secure environment, and can trust domain experts, algorithms and analytics to combine and transform their data into real value. And Veracity could be a key component of a class-concept built around sensor-based data: securing and assuring data for use in the condition assessment of the hull and critical components.

"The digital transformation cannot be realized with one solution or one service. It is a journey," says Knut Ørbeck-Nilssen. "By working together with us, customers can capitalize on these new opportunities – to make the world safer, smarter and greener."

VERACITY

The Veracity industry data platform is designed to help companies improve data quality and manage the ownership, security, sharing and use of data. One area where the maritime industry could benefit from the Veracity data platform in the future could be allowing DNV GL's maritime customers to document compliance of main on-board machinery and systems through predictive analytics, removing the need for calendar-based inspections. In one of DNV GL's first pilot projects a drilling operator embarked on a project to explore predictive analytics with a components vendor and an analytics services company. Working with DNV GL to see if this approach could gain class approval, an analysis of the data revealed severe quality issues that none of the partners were previously aware of. Once the data was quality-assured, machine learning algorithms could be applied to the data with success. A key learning from the project was that it demonstrated the need for continuous data management and quality assurance to reap the benefits of a data-driven approach.



Veracity could use predictive analytics to document compliance of main on-board machinery and systems.

PSC PLANNER

Launched in April 2017, the Port State Control (PSC) Planner is one of the most recent additions to the My DNV GL customer portal. Designed to help shipowners, managers and operators increase operational efficiency, the PSC Planner gives an overview of vessel or fleetwide PSC performance, which can then be benchmarked against the IACS-classed world fleet. The tool also assists the crew on board by highlighting specific areas to focus on when preparing for the next inspection.

Find out more at:
www.dnvgl.com/maritime/mydnvgl-service-overview/psc-planner.html

Photos: DNV GL, Devrimb-Thinkstock, donvictorio – Fotolia

SAVING COASTAL ECOSYSTEMS

With the Ballast Water Management Convention coming into force in September, shipowners and operators have little time left to ensure compliance. DNV GL provides comprehensive support.

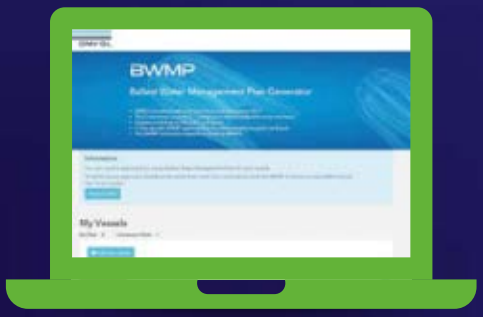
It has taken the International Convention for the Control and Management of Ships' Ballast Water and Sediments (in short, Ballast Water Management or BWM Convention) nearly 20 years to reach this point, but following the accession of Finland last autumn, the percentage of global shipping tonnage covered by ratifying nations finally crossed the required 35 per cent threshold. The BWM Convention, a crucial measure to protect marine ecosystems against invasive aquatic species, will take effect on 8 September 2017.

With only a few months to go, shipowners must take action as soon as possible to implement the convention. All affected vessels – which includes most ships travelling international waters and using ballast water – will be required to carry on board an approved Ballast Water Management Plan (BWMP) as well as the International BWM certificate ensuring compliance with the so-called D-1 standard, the first phase of the convention. If the flag state of a vessel has not ratified the BMW Convention as yet, a Statement of Compliance (SoC) should be issued and carried on board to avoid challenges of documenting compliance in foreign ports. Furthermore, all ballast water operations must be documented in a BWM record book. Since approval activities are expected to intensify as the deadline draws nearer, it is advisable to submit the BWMP for approval as soon as possible. Shipowners and operators should begin the process by identifying the affected vessels still lacking this documentation. Where required, they should order and perform the initial BWM survey in due time before 8 September. Most initial BWM surveys can be performed in conjunction with other surveys.

The D-1 standard relates to the first, transitional implementation phase of the convention, during which all ships not equipped with compliant ballast water treatment systems are required to exchange their ballast water in mid-ocean, at specified distances from the nearest shore, using one of several approved methods.

BW treatment systems

The next step for owners and operators will be to review the International Oil Pollution Prevention (IOPP) certificate renewal date for each particular vessel. The first IOPP renewal date after 8 September 2017 is the deadline for installation of a ballast water treatment system, the second



The customer portal *My DNV GL* provides access to the web application.

MY DNV GL APP: BWMP

The app

- The application will help users to generate a Ballast Water Management Plan and hand it in for approval

Features

- Easy-to-use step-by-step template that helps with pre-filled technical information of the particular vessel to generate the Ballast Water Management Plan
- Smooth 1-click transition of plan to approval with discounted pricing

Benefits

- Saves time and effort on customer and DNV GL side
- All relevant vessel data is stored and accessible via *My DNV GL*
- Avoids the need for iterative clarifications

phase of the convention, which stipulates the actual treatment of ballast water according to the so-called D-2 standard. The effectiveness of the treatment system is assessed by the maximum permissible number of viable organisms remaining in the treated ballast water: ten viable organisms larger than 50 µm per cubic metre, and ten viable organisms 10 to 50 µm in size per millilitre. The BWM Convention also specifies certain indicator microbes as well as broad safety requirements. All relevant ships should be in compliance with the D-2 standard by the end of 2022.

Ships in service still lacking a type-approved ballast water treatment system (BWTS) must be retrofitted by the IOPP renewal date as indicated. There are various treatment technologies available, all of which have their pros and cons. The choice should depend on the characteristics of the given fleet, and the documents relating to the retrofit should be forwarded to class for plan approval as early as possible. According to the D-2 standard, ships must carry on board the type approval certificate for the BW treatment system as issued by the responsible administration, approved technical documentation and an operation manual as well as the International BWM certificate issued after the initial survey to confirm compliance with the D-2 standard.

The spread of invasive species through ballast water is causing enormous damage to biodiversity.

Newbuilds with keels laid down after 8 September 2017 will be required to be delivered with a BW treatment system installed. Newbuilding projects begun before that date should be retrofitted accordingly.

USCG performance requirements

After much anticipation the announcement at the end of 2016 that the first ballast water treatment systems had been approved by the U.S. Coast Guard (USCG). Alfa Laval, Optimarin and OceanSaver became the first suppliers in the world to be awarded USCG type approval and DNV GL is proud that it had worked with all three of these successful applicants. In the first quarter of 2017, DNV GL submitted two further applications to the U.S. Coast Guard, for manufacturers Sunrui and Ecochlor.

The USCG officially appointed DNV GL as an Independent Laboratory (IL) to perform type approval testing of ballast water treatment systems in 2013. "DNV GL and its associated sub-laboratories DHI Denmark, NIVA, Golden Bear Facility and DHI Singapore have been deep into the details of USCG testing for three years and have gained substantial experience in what is practical and possible to achieve compliance with the regulation." There are now five "Independent Laboratory" accreditations for BWTS. Out of 45 BWTS manufacturers who have signed a letter of intent for having their systems approved by the USCG, DNV GL is currently handling 25, making it the largest independent provider of laboratory services by far," says Martin Olofsson, Senior Principal Engineer, Environmental Protection DNV GL – Maritime Approval of Ship Systems and Components.

Ballast water management is among the top environmental issues addressed by new regulations.

Which treatment system is the best option for a particular vessel depends on a number of factors: What ship type is it? Does the vessel have to operate in fresh or brackish water? Does it operate in cold waters or in temperate conditions? Will the system have to work in high-turbidity conditions, meaning water that contains a lot of clay, algae or silt? All these questions are very important for making the right choice.

When installing a BWTS on a tanker the dangerous zones must be taken into consideration. On a tanker you cannot take ballast water back to the engine room. This indicates that a BWTS for a tanker must be installed in a separate ex-proof compartment on deck. Some tankers have "Framo" pumps inside the ballast tanks. This also implies that the BWTS most likely must be kept in a separate compartment on deck, because there is no pump room (with ballast pump). If a tanker is in OILREC mode, the BWTS has to be turned off if not ex-proofed.

The five ballast water treatment systems which either already hold or are soon expected to hold a USCG type approval certificate include UV systems, electrolytic systems and chemical injection systems. TANKER UPDATE takes a look at how these types of systems work, which operational profiles they can handle as well as their advantages and disadvantages (see next page).

As an interim solution the USCG Alternate Management System (AMS) is temporarily accepting type approvals to IMO standards for a period of five years after the installation on a particular vessel. Affected owners should visit the USCG environmental web pages from time to time for updated information before making a final decision regarding the type of BW treatment system to install.

DNV GL has been involved in ballast water treatment technology, testing and type approvals as well as the development of the BWM Convention itself for many years. As a Recognized >

> Organization for most flag states, DNV GL can approve BWM plans, perform surveys and issue international BWM certificates. DNV GL has published a Retrofitting Guide and a Regulatory News issue that give a concise overview of BWM requirements, and a Web-based application on *My DNV GL* helps owners accelerate the BWMP approval process. DNV GL stands ready to give comprehensive advice and support on all questions on the subject, including the best timing of surveys in view of the time frame for retrofits. ■ **AK**

More information on ballast water management is available at **dnvgl.com/bwm**

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SELECTED BWT SYSTEMS AT A GLANCE

Optimarin received USCG type approval for its filter/UV system in 2016.

UV SYSTEMS

- **How it works:** With a market share of 50 per cent, UV systems are the most popular option at present. They use a two-step process of filtration and ultraviolet (UV) irradiation to sterilize organisms and stop their reproduction.
- **Suitable for:** UV systems are suitable for any vessel in theory, but primarily for those which do not take in too much ballast water and have flow rates of up to around 1,000 m³ per hour.
- **Advantages/challenges:** UV systems are easy to install and retrofit, and have few safety concerns from a class point of view. They also operate independently of water salinity and temperature. However, they are dependent on water transmittance (UV-T) and work less well in turbid water. The U.S. Coast Guard's interpretation that any organisms released into US waters should be dead before leaving the vessel, rather than just made infertile, means that a type-approved filter+UV system becomes more sensitive to water turbidity and may require longer holding times to ensure mortality.

ELECTROLYTIC SYSTEMS

- **How it works:** Electrolytic treatment systems have a market share of around 35 per cent and therefore come second in the ranking of treatment systems. Many of these systems also use a filter as a pretreatment. By passing electric current through a small sidestream of seawater, they use the salt and the water molecules in a chemical reaction to generate sodium hypochlorite, a disinfectant, which is then reinjected into the ballast water to kill all organisms.
- **Suitable for:** Electrolytic treatment systems are more suited for larger vessels which have large ballast water volumes and high flow rates in the range of up to 8,000 m³ per hour.
- **Advantages/challenges:** As well as being able to handle large capacities, electrolysis-based systems are very efficient and the treatment of the water is done on the intake only (possible neutralization on discharge). This means they provide on-board disinfection and some systems even provide in-tank circulation treatment during the voyage, when treatment in the port is not feasible. One of the disadvantages is that the electrolytic reaction generates small amounts of hydrogen gas, a factor which needs to be accounted for in safety considerations. In addition, electrolytic systems are sensitive to low salinity and low temperatures, so salt or a heating system may have to be added where necessary. Finally, they are more complex to install, control and maintain compared to UV filter systems.

CHEMICAL INJECTION SYSTEMS

- **How it works:** These systems are often used in combination with filtration. A chemical solution is injected into the ballast water to ensure disinfection. The disinfectant may be liquid or granular and will sometimes require neutralization prior to discharge overboard. Some of the active substances which are commonly used include sodium hypochlorite, peracetic acid and chlorine dioxide.
- **Suitable for:** Chemical injection systems are deemed appropriate for most ballast flow capacities ranging up to 16,000 m³ per hour and are mostly used to treat ballast water on vessels with larger capacities and flow rates. The technology also makes it suitable for infrequent usage and is also good for disinfecting tanks that have been used without treating the ballast water during ballasting and deballasting in local waters.
- **Advantages/challenges:** Chemical injection systems generally have low power requirements because their only energy consumption comes from distributing the chemicals into the ballast water. With the dosing pump as their main component these systems require less space on board, making them easier to install than other technologies. However, the chemicals which are used, such as Peraclean or Purate, are trademarked, and supply might be limited to specific ports. In addition the chemicals must be stored on board in closed containers and may be hazardous. The use of chemicals requires implementation of strict safety provisions and crew training. Having to stock up chemicals regularly also generates additional operational costs compared to UV or electrolysis systems, which have electricity as their main cost item.

TANKER FORUM IS BACK TO BUSINESS

Uwe Körber of Columbia Shipmanagement was one of the initiators of the meeting.

After a six-year pause the International Technical Tanker Forum (ITTF) had an initial meeting in March this year with the aim to bring the ITTF back on track and develop new core principles for its work.

Uwe Körber from Columbia Shipmanagement, a former active member of the ITTF and one of the initiators of the re-establishment of the forum, welcomed all participants with a clear vision: "My dream is clearly to take the ITTF back to its former brilliance as one voice which is taken seriously within our industry."

In 2000, members of the tanker industry established the "Informal Technical Tanker Forum" as an independent platform for shipowners and ship managers to address and discuss market issues as well as legislation relevant to the tanker business in an informal setting. The last meeting had been held in November 2011 in Singapore. For various reasons such as the general drop in the maritime industry, members taking over new tasks and a lack of structure within the organization, no meetings had taken place since that time.

> "My dream is clearly to take the ITTF back to its former brilliance as one voice. "
>
> **Uwe Körber,** Marine Director at Columbia Shipmanagement

Six years later the need for an international forum representing the tanker industry in the maritime world is as evident as ever. Decision-makers from tanker companies whose daily business relates to the design, construction, supply and operation of tankers have returned to the table. During their first meeting in Dubai they agreed to rename the ITTF "International Technical Tanker Forum".

A platform for networking and sharing information

Catrine Vestereng, Global Segment Director for Tankers at DNV GL – Maritime, will serve as secretary of the forum. Welcoming the initiative, she pointed out: "Renaming the ITTF from 'Informal' to 'International' Technical Tanker Forum will help us underline our global presence and the wish to run the forum in a more structured way. It is important to exchange ideas and experiences continuously to bring the international tanker business forward and strengthen its position in the maritime industry. Therefore we agreed to hold meetings biannually at major maritime hubs like Oslo, Hamburg, Dubai, Singapore and Athens. Our local DNV GL offices will be hosting the events and nominate a local representative for the forum." The first initiative taken in Dubai was to develop, discuss and approve a draft guideline for the ITTF which spells out its main objectives: to provide a platform for networking, share best-practices and other information related to tanker operation, benchmark performance to identify areas for improvement as well as discuss and speak with a common voice when approaching other stakeholders in the maritime industry.

After defining the formal role of the ITTF, current market issues and possible future scenarios were discussed. For regulatory topics such as the EU MRV regulation, the global sulphur cap and ballast water management, the main concerns are ways to avoid double reporting, finding the best way to comply and discussing the impact on shipowners.

New technologies are also on the agenda. The use of drones for surveys and deliveries was viewed as a positive development. Furthermore, the members shared their experiences with the use of environmentally acceptable lubricants, various stern tube seals and alternative repair methods in case of leakage.

The next meeting, scheduled for week 39 in September 2017, will take place in Singapore or Athens. During that meeting a permanent chairman will be nominated. ■ JS

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PARTICIPATING COMPANIES IN THE FIRST MEETING

- ADNATCO
- Bahri Ship Management
- Central Ship Management
- Columbia Shipmanagement (D)
- Emarat Maritime
- E-Ships
- Euronav NV
- GEM
- Noah Shipmanagement
- SCF Management
- Thome Ship Management

You are welcome to attend the Tanker Forum's next meeting. Please contact Catrine Vestereng to receive your invitation.

Photos: DNV GL

BIG IS BEAUTIFUL

Four years ago *Bow Pioneer* made headlines as the world's biggest chemical tanker ever to enter service. TANKER UPDATE takes a look at how the design concept has been faring amid changing markets.

When *Bow Pioneer* was commissioned by Odfjell in 2013, building a chemical tanker of these enormous dimensions – 228 metres in length, 37 metres wide, and with a 14-metre draught – was considered by many as a daring step. But Odfjell, planning for the longer term, ordered the vessel in anticipation of the growing demand for liquid chemicals from new and emerging economies in Asia, most notably China and India. And since size always promises benefits of scale, a key consideration in a highly competitive industry, Odfjell wanted to be able to offer economy of scale to its large-volume-moving customers.

Solid know-how

As one of the world's top operators in the chemical business, Odfjell is an expert in transporting "anything liquid", as the company motto says. With a fleet of about 74 specialized ships of all sizes, both owned and chartered, and a total capacity of around 2.2 million dwt, Odfjell has solid experience in worldwide operations and is present on all main trades between the US, Europe, Asia, the Middle East and South America. The size of the fleet gives the company the flexibility to choose just the right vessel for a given voyage or shipment, whether customers want to transport as little as 100 to 150 tonnes or as much as 50,000 tonnes of cargo. Odfjell ships carry everything from organic and inorganic chemicals to vegetable oils and petroleum products. Other business lines include gas carriers as well as operation of tank terminals in key ports around the world, an ideal match for the tanker business.

Bow Pioneer is a good example of Odfjell's maxim of offering utmost flexibility: the vessel is capable of carrying 86,000 cubic metres of Type 2 chemicals and other liquids in 31 separate, inorganic zinc silicate-coated cargo tanks. Setting new standards in terms of fuel efficiency and versatility, the ship encouraged several other operators to order larger chemical tankers as well. Fuel consumption per tonne mile, the main benefit of her size, translates to reduced transport costs for commodity chemicals, especially since a larger vessel does not require a larger crew, as Odfjell CEO Kristian Mørch points out: "The number of crew is about the same whether it's a 20,000 tonner or an 81,000 tonner."

Expecting growing demand

While the liquid chemicals segment grew 2.6 per cent in 2016, this outcome fell short of the expected 3.5 per cent. Seaborne trade typically follows the general growth trend of the global economy, and experts are predicting a somewhat more dynamic development for the current year as well as 2018. The OECD projects a global GDP growth of 3.3 per cent for 2017 and expects a modest pick-up to around 3.6 per cent in 2018. "Both the US and the Middle East areas are instrumental for further growth in our segment," says Mørch. "But what matters most is stable economies in consumer regions, while our biggest threats are geopolitics and obviously, risks inherent in the global economy."

As the demand for commodity chemicals rises, so does the profitability of *Bow Pioneer* and her classmates. In particular, world demand for methanol is expected to increase substantially, especially from China. Methanol is used as a feedstock for the

BOW PIONEER MAIN PARTICULARS

- Length overall: 227.9 m
- Breadth: 37.0 m
- Depth: 19.0 m
- Design draught: 13.2 m
- Main engine power: 10,870 kW
- Design deadweight: 75,000 dwt
- Cargo capacity: 86,280 m^3
- Cargo tanks: 31
- Service speed: 14 knots

"Both the US and the Middle East areas are instrumental for further growth in our segment. But what matters most is stable economies in consumer regions."

Kristian Mørch, CEO Odfjell SE

manufacture of other chemicals, such as biodiesel fuel, formaldehyde, polypropylene and many synthetic products. It is also gaining importance as an ingredient of low-emission vehicle and ship fuels. Methanol and other commodities transported by product tankers are mostly produced in the Middle East, where major new refinery capacities are currently being added, and in the United States, where shale gas is expected to boost methanol production. All this means that the demand for ship sea transport is likely to increase. Apart from China, Japan and India are also expected to import significantly more of these commodities in future.

Challenges are manageable

But size can also bring challenges, such as higher port fees, the need for extra tugboats, or berthing and unberthing operations being restricted to daylight hours only. While designed to fit the new locks of the Panama Canal, the vessel nevertheless still has to undergo a few minor modifications to meet requirements unknown at the time she was built before being able to pass, and charter parties need to be updated to clarify coverage of canal costs. Furthermore, a ship carrying multiple products must deal with additional scheduling and tank cleaning tasks, and the product supply chain has to be managed carefully because loading and discharge ports change frequently. And since the number of ships the size of *Bow Pioneer* is still limited, some ports lack the right infrastructure to handle them. "The vast majority of chemical vessels are limited in size by the former Panama Canal restrictions," says Odfjell CEO Mørch. "This limits incentives for terminals to invest in their existing infrastructure. However, we see that many new terminals are being built to a larger scale to fit the size of *Bow Pioneer*."

As a tank terminal operator, Odfjell can influence this development, and its own tank terminal operations offer opportunities to develop new markets. Further tank terminal projects are currently under development on Fujian and in Changxing Island, China. So all these matters can be dealt with without compromising the benefits of size and fuel efficiency. And *Bow Pioneer* is well equipped to comply with upcoming environmental regulations as well, with a certified ballast water treatment system installed and a monitoring plan and emission reporting system in preparation. **AK**

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EXTENDED PANAMA CANAL – DNV GL HELPS PREPARING FOR TRANSIT

DNV GL is receiving an increasing number of requests regarding the modification requirements for vessels with a length of more than 294.13 metres or breadth of more than 32.31 metres intending to transit the Panama Canal through the new extended locks. More than 50 per cent of the requests currently come from tanker operators. Operators interested in rerouting their services need to take several factors into consideration before booking a slot for an existing post-Panamax ship. One of the biggest adjustments concerns the mooring equipment. All chocks and bollards which are used for the towing operation need to withstand a safe working load of 90 tonnes, since the tugboats manoeuvre the vessel with greater force than the locomotives would. DNV GL can assist in preparing for the transit. The installation of towing and mooring equipment is regulated by DNV GL rules: **www.dnvgl.com/rules**

Photos: DNV GL, Odfjell

SAFE, FLEXIBLE, EFFICIENT

Shuttle tankers are an alternative to subsea pipelines Typically for large water depths. For harsh weather operation the use of shuttle tankers is a necessity. DNV GL has incorporated the latest findings related to their design, operation and safety in an updated shuttle tanker paper.

A shuttle tanker leaving the rig after completion of loading operations.

Shuttle tankers transport crude oil from offshore oil fields to terminals where use of subsea pipelines are not feasible. Major deployment areas include the North Sea and the Brazilian offshore fields. The global fleet has been growing steadily for decades, comprising 88 ships by the end of 2016.

Two owners, Teekay Corporation and Knutsen NYK, account for 62 per cent of the fleet, and 64 per cent of all shuttle tankers are DNV GL-classed. Ship sizes vary between 95 and 155,000 dwt, where the larger sizes are typically operate in Brazil. Nine newbuilds are scheduled for delivery in 2017/2018, and one vessel on average is scrapped annually. 32 vessels are more than 16 years old and will require replacement in the near-to-medium term. Nearly 50 per cent of newbuilds have been built by Samsung Heavy Industries in South Korea.

Special features

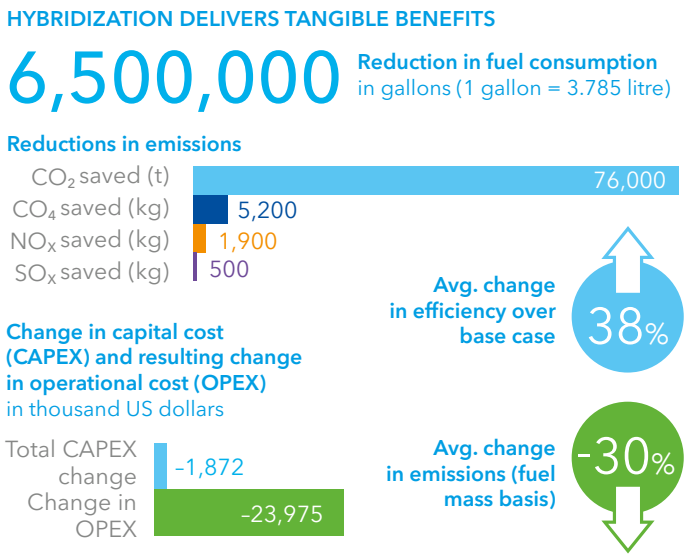
Shuttle tankers differ from "standard" crude oil tankers. To increase the regularity during loading operations and for the purpose of collision avoidance, they are equipped with dynamic positioning (DP) systems, which typically includes azimuth and tunnel thrusters both forward and aft. North Sea shuttles typically have a twin-screw propulsion system for redundancy and dynamic positioning purposes. In order to improve the position-keeping and manoeuvring capability in ballast condition, it is not uncommon that shuttle tankers have an increased ballast tank volume compared to standard crude oil tankers.

Vessels designed for operation in rough sea areas such as the North Sea feature a hull design with increased fatigue life. As shuttle tankers load offshore, they all have a bow loading arrangement. Some existing shuttle tankers were built with submerged turret loading (STL) systems required for serving specific North Sea oil fields. Shuttle tankers operating on the Norwegian Continental Shelf may need to comply with Norwegian regulations for emissions of non-methane volatile organic compounds (NMVOC) and install complex vapour recovery process systems for that purpose. Significant technological developments are ongoing with respect to utilizing the VOC as fuel for e.g. power generation purposes.

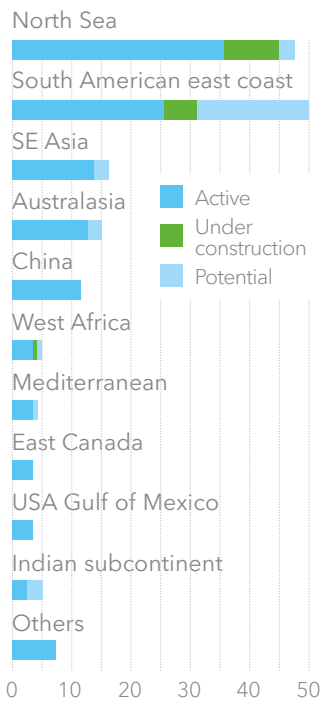
Recent North Sea shuttle tankers use electrically rather than steam-driven cargo pumps. The consequence is that they typically have larger auxiliary engines, smaller boilers and inert-gas generators as opposed to flue gas systems. North Sea shuttle tankers are typically provided with state-of-the-art nautical safety systems and bridge designs, and typically comply with enhanced fire safety and pollution prevention standards.

Loading

Shuttle tankers load directly from floating production/storage units or various types of offshore loading systems/buoys. Loading time may vary from 24 hours to more than one week, while the voyage



FIELDS OPERATED WITH SHUTTLE TANKERS
Number of fields



itself is typically short. Therefore the loading and discharging frequency is comparatively high, with up to 50 cycles a year per ship. Some shuttle tankers spend 25 to 50 per cent of their operating life in loading mode at the field.

The North Sea is a harsh environment where significant wave heights up to 5.5 metres, wave periods of 12 seconds, wind speeds up to 19.7 metres per second and current speed of 0.5 to 1 metres per second can occur. These operating conditions result in a very specific set of design specifications, especially for position-keeping. Although similar conditions may apply in certain offshore oil fields in Brazil, the weather conditions in Brazil are generally less harsh. Note however that current speed is generally higher in Brazil than in the North Sea.

State-of-the-art shuttle tankers are either equipped with a bow loading system (BLS) for loading from offshore loading systems/buoys, FPSOs or FSOs, or a submerged turret loading system (STL). STL loading is currently used at very few offshore installations, notwithstanding the fact that it allows loading in more severe weather conditions than BLS, supporting a significant wave height (H_s) of 16 metres.

Dynamic positioning

Dynamic positioning (DP) systems are an essential component in today's shuttle tanker technology and must be capable of maintaining the tanker in position in harsh weather conditions. Today most cargo owners specify that new shuttle tankers shall satisfy IMO dynamic positioning Class 2 requirements. New shuttle tankers operating in both the North Sea and Brazil appear to have adopted the DNV GL's class notation DYNPOS(AUTR) as the required minimum. Historically requirements have gradually become more stringent, a development that is likely to continue and may lead to frequent use of more advanced notations such as DYNPOS(E) and DYNPOS(ER). These notations ensure reliable and robust yet flexible DP systems which can be run in more cost-efficient modes with a smaller environmental footprint compared to traditional redundant DP systems. DNV GL has also issued rules for the use of batteries in hybrid DP systems to further support industry efforts to deliver efficient, eco-friendly and incident-free DP operations.

Battery power on shuttle tankers

In a recent joint industry project, four ship types with selected operational profiles were analysed to quantify the fuel, emissions and reliability benefits of using hybrid power for dynamic positioning, drilling, propulsion and backup power. The study found that hybrid power architectures are technically feasible, with a viable return on investment (ROI) and payback periods of zero engine hours for shuttle tankers and up to 7,700 for other ship types. In the case of the shuttle tanker selected for the study, using battery power increased efficiency by 38 per cent.

The result is a multifaceted value proposition: operational efficiency is improved by balancing diesel engine loads and avoiding wasteful idling periods; reducing engine running time also cuts CO_2 and other noxious emissions. Redundant engines may be dispensable if the battery system functions as a spinning reserve. Avoiding cycles of extreme engine loads reduces engine wear and maintenance costs and may allow maintenance cycles to be extended. What is more, the ability to close the tie switch between buses can greatly improve the hybrid value proposition.

Batteries can be optimized either for fuel efficiency or for backup power, depending on the given application. In hybrid DP operations, batteries can supply load for approximately one third of the operating time, reducing generator cycles and responding faster than a generator set. As for backup power applications, economic feasibility depends on the ratio of investment cost versus the desired duration of backup power availability. Furthermore, fire safety is a key concern for battery rooms, which must be designed with fully independent ventilation, cooling and fire suppression systems and a sophisticated, integrated control system.

As an indispensable element of the hydrocarbon value chain, shuttle tankers must keep up with the evolution of technology to satisfy today's and tomorrow's safety and environmental requirements, and DNV GL does its part to make sure they will. The updated DNV GL brochure "Shuttle Tankers" describes recent technological advances in detail. **CV/JS**

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The complete Shuttle Tanker paper covering topics such as cargo, loading, dynamic positioning, hull design, machinery, nautical and fire safety, helicopter decks as well as an overview of all relevant class notations can be downloaded at **www.dnvgl.com/publications**

Photos: DNV GL, Nightman1965 – Fotolia

NAVIGATING THE NORTH

While low oil prices have cooled interest in the Northern Sea Route, a deeper understanding of the risks and opportunities will make it easier for operators to head north when the time is right. An international study is taking a closer look at the North-East Passage.

Transporting goods from Asia to Europe normally takes around 20 to 25 days, if you travel from China to the UK. Most vessels leaving from the Far East travel through the Suez Canal to reach the European continent. For a long time this was their only option, but the global rise in temperatures has created an alternative: the North-East Passage. Instead of heading south, ships can now travel to Europe on the Northern Sea Route, which takes them along the coast of northern Russia into the Arctic Ocean and the Barents Sea.

Arctic 2030

This route is currently open for about four and a half months per year and can cut travel time by up to twelve days, reducing a ship's fuel costs and, with it, its overall environmental footprint. But does this theory live up to the industry's expectations in practice? What efficiency gains can be realized? What are the risks involved? And what logistical challenges could operators face when their vessels navigate the Northern Sea Route?

To investigate this, DNV GL has teamed up with experts from across the northern hemisphere in the Arctic 2030 project, bringing together the Centre for High North Logistics, the University of Busan, South Korea, FSUE Atomflot, the Russian government-owned operator of the nuclear icebreaker fleet based in Murmansk, the Norwegian University of Science & Technology, the Norwegian Shipowners Association, and DNV GL. The goal of Arctic 2030 is to perform a comprehensive analysis of current commercial transport and logistics operations along the Northern Sea Route.

The study covers aspects such as potential efficiency gains, the cargo base, costs, infrastructure needs as well as security and

Climate change has opened up the North-East Passage for commercial shipping.

safety. "It aims to gather the data, performance indicators and scenarios needed to assess the feasibility and reliability of using this route in the future," says Morten Mejlænder-Larsen, Discipline Leader Arctic Operation & Technology at DNV GL – Maritime.

Safe Arctic operations

A remote and inhospitable environment combined with limited infrastructure makes safety an absolute priority in Arctic operations. "In many respects the dangers in the Arctic differ little from those in other sea regions: collision with a vessel or installation, fire and explosion hazards, structural failure, grounding, an accidental oil spill. But the consequences of any individual incident could be much more serious," explains Mejlænder-Larsen.

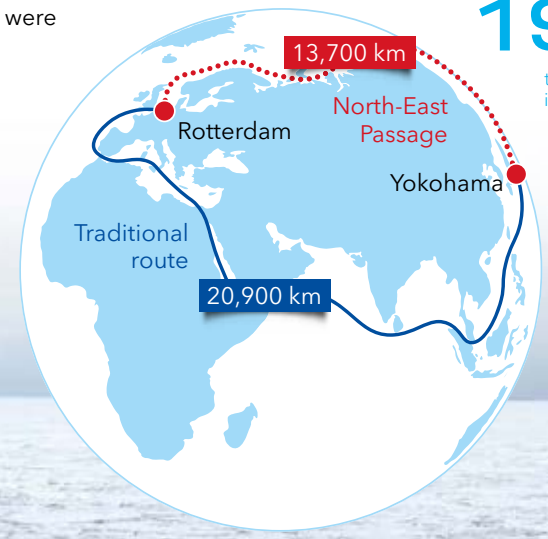
Adding regional hazards such as ice, topside icing, low temperatures, darkness and fog, this changes the risk equation. Many of these factors were considered in the development of the IMO Polar Code, a set of internationally agreed minimum standards for ice operation, which has been in force since January of this year.

Vessel-specific considerations

Most of the ship traffic takes place over the summer months and a vessel's risk profile varies >

"Our investigations found that infrastructure in the region is slowly improving, but future development will depend on the attractiveness of the area to potential investors."

Morten Mejlænder-Larsen, Discipline Leader Arctic Operation & Technology at DNV GL – Maritime



19 vessels

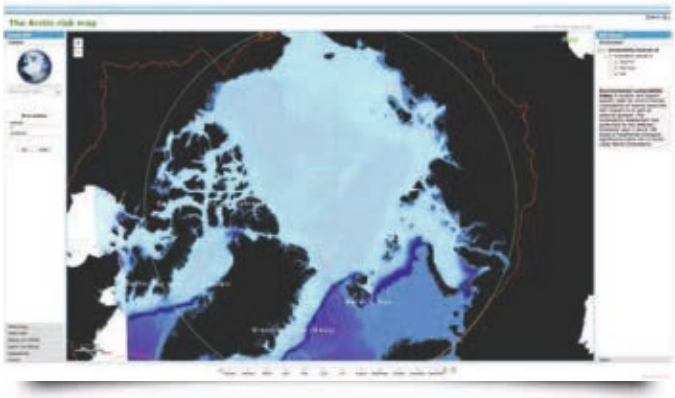
transited the Northern Sea Route in 2016, averaging

14,3 days

of transit time.

The duration of a trip from eastern Asian ports to northern Europe can be cut by up to twelve days.

Photos: ohmega1982 - Fotolia, GarrettL - iStockphoto



Arctic risk map. This interactive feature on the DNV GL website provides a dynamic overview of the ice cover, meteorology and ecology of the Arctic region as well as search and rescue information, oil and gas activities and shipping statistics.

> according to its type and mission. "Offshore support vessels tend to work in groups. If one gets into trouble, another can come to its aid, but on the flip side there is a heightened danger of collision or contact. Cargo ships in transit will be heavily dependent on icebreaker assistance. The elevated risk for tankers is reflected in the Polar Code's additional training requirements for officers on watch on board these two vessel types.

When assessing the feasibility of Arctic operations, the availability and cost of emergency response services during each leg of the voyage is one of the main considerations for all vessel types. "Operators need to be aware that some ports along the route are not open or equipped to handle international traffic," Mejlænder-Larsen explains. "Furthermore, the costs of a response are hard to predict and not always transparent." Since the Arctic is an environmentally sensitive region, it is also necessary to draw up effective plans and prepare resources for efficient clean-up in the event of an oil spill. This comes on top of making sure the vessel is fit for Arctic operation and its crew has the relevant skills and experience.

Ready for the challenge

"Our investigations found that infrastructure in the region is slowly improving, but future development will depend on the attractiveness of the area to potential investors. Recent activities have mostly been driven by the oil and gas industry, particularly the Yamal LNG project," says Mejlænder-Larsen.

Low oil prices and a drop in commodity prices have reduced the appeal of the route to international shippers. In 2015 the number of transits went down to 18 from a high of 71 in 2013, with tankers being the most common ship type to use this route.

"However, with the Polar Code rules for ice class vessel designs in place, as well as a growing body of experience and deeper understanding of the risk involved, it may only take a turn in the markets or a rebound in oil prices for that interest to be rekindled," says Mejlænder-Larsen. "If and when that happens, we at DNV GL will make sure our customers are well prepared for the challenge." **KT**

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The Arctic 2030 report will be available for download at **www.chnl.no** from June 2017.

For more insight about the IMO Polar Code and related services please visit **www.dnvgl.com/polar**

PREPARING TO CROSS THE NORTH-EAST PASSAGE

- **Certification:** Operators should check, whether their vessel has the necessary ice class certification. The requirements will vary, depending on the time of year and the conditions predicted by the Northern Sea Route Association.
- **Communications:** Vessels need to ensure that their vessels have communication equipment, adapted to the planned sailing route. GMDSS Sea Area A3 is acceptable for operations up to 70°N/S. GMDSS Sea Area A4 is required for operations above 70°N/S. Ships travelling through these polar regions must carry a DSC-equipped HF radiotelephone/telex. Non-GMDSS systems, such as Iridium, can be effective for voice and data communication in polar waters.
- **Operation:** Vessels travelling through the North-East Passage are required to have a Russian ice pilot on board during this part of their voyage. In addition, they need to be accompanied by a nuclear icebreaker along sections of the route where ice may be present. This area normally strechtes from the Kara Sea to the Bering Strait. A date and meeting point need to be arranged in advance and DNV GL recommends to arrive ahead of time. Operators need to be aware that they may have to adjust their schedule at short notice, depending on the availability of the icebreaker.
- **Safety:** Even during the summer months there is a risk of encountering drifting ice in the North-East Passage. This will have an impact on the vessel's speed. Finally, the availability of search and rescue teams is somewhat limited on the Northern Sea Route. It may not always be possible to gain access to the nearest port, as some are open to Russian vessels only.

Photos: DNV GL, GarretL – iStockphoto

A PAIR OF FRESH EYES

Helping tanker owners get vetting approval from oil companies requires detailed know-how and solid experience. DNV GL's CAP service has been further digitalized and provides interactive assessment and immediate advice.

Interactive assessment enables DNV GL to make a good service even better.

As the inventor of the original CAP (Condition Assessment Programme) service, DNV GL is consistently monitoring the ever-evolving requirements of tanker vetting to make sure DNV GL CAP is the best tool available to avoid good vessels being rejected by oil majors.

For more than 25 years DNV GL has helped owners get well-maintained older vessels accepted by oil companies by assessing, reporting and rating their most important safety-related features. The service is divided into two main parts, CAP Hull and CAP Machinery and Cargo Systems. In parallel to documenting the present condition of a vessel, the CAP service gives advice and guidance on how to further improve the ship's condition and rating. The CAP Machinery and Cargo Systems (CAP MC) service has been further digitalized by live analysis and live reporting of machinery.

Interactive reporting

Interactive reporting during the survey is a great way to further improve the service. Data is fed into a report generator while testing machinery. Performance analysis results and rating scores are continuously updated. Powerful diagnostic tools available during the survey ensure that the findings are explained and immediately discussed with the crew; on-shore support is hardly needed.

Based on engine performance measurements the DNV GL experts can recommend adjustments. Advanced electronic pressure indicators enable live measurements on the engine while it is being adjusted. This eases the adjustment process and gives accurate results.

Many shipowners use regular analogue P-max meters for performance measurements on auxiliary engines. These may work well on new engines but experience has shown they are not adequate for older engines. The combustion process may drift off due to wear and tear; eventually the measured pressure peak only reflects compression pressure, not the expected combustion pressure.

Even the most meticulous chief engineer may be unable to detect deviations with such equipment. Accelerated engine wear, increased fuel consumption and higher emissions to air may be the result.

DNV GL has found that many operators are very competent and dedicated with respect to condition monitoring of their engines. Nevertheless even the best operators can benefit from having a pair of fresh eyes take a good look at their maintenance procedures. Often DNV GL CAP experts reveal conditions that harbour fuel-saving potential. Frequently this is related to engine tuning and timing, but it may also be linked to engine operation and monitoring equipment as illustrated in the example below. **MB**

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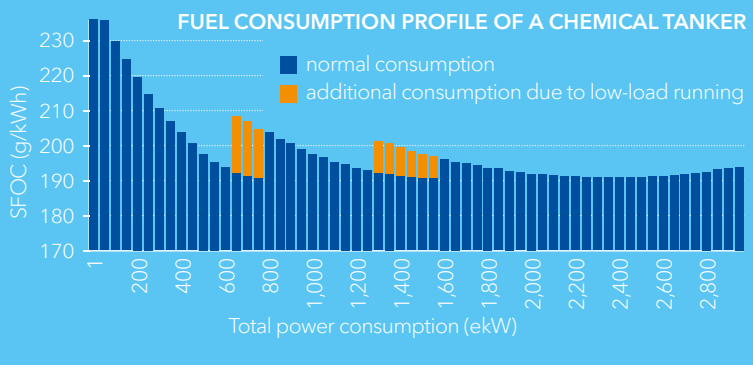
EXAMPLE: FUEL-SAVING POTENTIAL IDENTIFIED

In this case the vessel's engine load monitoring equipment indicated a load percentage for the auxiliary engines relative to the switchboard rating rather than relative to the engine or generator rating (which is more common). Although the Power Management System (PMS) indicated an 80 per cent load, the engines were actually running at a 65 per cent load only. Based on this finding the vessel could adjust the operational profile for parallel-running engines and save up to seven per cent of fuel at given loads. Further savings and reduced engine maintenance will follow with fewer running hours.



Photos: DNV GL

FIT FOR THE FUTURE

The amendments to the IBC Code are being finalized. The revised chapters will presumably come into effect on 1 July 2020. DNV GL is helping customers assess the impact of new requirements will have on their vessels to ensure timely compliance.

New requirements for bulk transport of chemicals are expected to be passed soon.

Closing the gap between the categorization of new versus existing IBC Code products is the purpose of the amendments to the code being discussed at IMO. The process involves reassessment of all existing products. The finalized new chapters 17 and 18 are expected to pass at PPR5 in early 2018 whereupon they will be submitted to MEPC and MSC for approval and adoption. Unless the time frame changes, the revised chapters will enter into force on 1 July 2020 and bulk transport of chemicals will be subject to the new carriage requirements from that date. This means that a new Certificate of Fitness including a new product list based on the new requirements has to be issued for each chemical tanker.

The IBC Code

Chapter 17 of the IBC Code lists each product and its carriage requirements, such as ship type, tank type, pollution category, ventilation, tank environmental control, electrical equipment, gauging, vapour detection, fire protection as well as additional specific requirements based on toxicity, heat sensitivity, water reactivity, risk of polymerization and other properties. Chapter 18 of the IBC Code specifies several products which are considered to be less hazardous and are therefore not subject to the IBC Code. Chapter 21, originally introduced in 2004, states the criteria for assigning carriage requirements pursuant to Chapter 17 based on physical properties, behaviour and toxicological data.

Background

The main reason for the current review is the fact that the relevant changes could not be incorporated into the 2004 Amendments to MARPOL Annex II and the IBC Code because of time constraints. The 2004 Amendments introduce the new pollution categories X, Y and Z and moved most of the Chapter 18 products to Chapter 17, requiring products such as vegetable oils to be carried on chemical tankers. At the time, only the ship types, tank types and pollution categories were reviewed based on the pollution aspects addressed by MARPOL Annex II for existing products. The safety criteria defined by the new Chapter 21 of the IBC Code and the corresponding Chapter 17 requirements were not discussed in 2004, which left a discrepancy between existing

products assessed prior to the 2004 Amendments and new products assessed thereafter. Since then, stricter carriage requirements have often been applied to new products than to comparable pre-2004 products.

To eliminate this discrepancy and close the gap, a full reassessment of Chapters 17 and 18 of the IBC Code was initiated to review the carriage requirements for each and every product, applying the assessment criteria specified in Chapter 21. At the beginning of this process the existing assessment criteria were questioned, especially those for tank and ship types. In some cases these criteria have resulted in disproportionately strict requirements for certain cargoes. It was decided to revise Chapter 21 and the assessment criteria before proceeding with the product assessments in Chapter 17 and 18.

The most important change to Chapter 21 was the introduction of the SVC/LC50 method, which allows the inhalation toxicity of products with very low vapour pressure or next to no vapour emission to be disregarded when determining the ship and tank types. The same principle may optionally be applied to other carriage requirements where inhalation toxicity is a factor. Other, minor adjustments were made to achieve a more realistic outcome when applying Chapter 21.

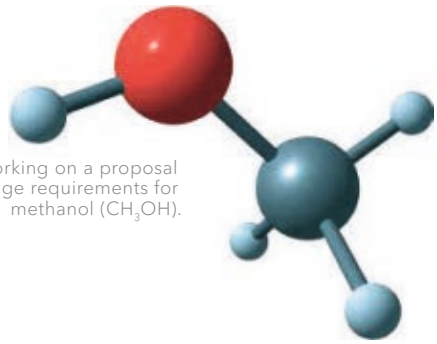
Ship and tank type

The most significant implication of the revisions is the required change of ship type or tank type for certain products. In particular, a change to Ship Type 1 and/or Tank Type 1G (independent tanks) could be challenging since the available tonnage is limited. A few products, including acetone cyanohydrin among others, will be upgraded to both Ship Type 1 and Tank Type 1G for which there is hardly any appropriate bulk tonnage in existence. There are also volume restrictions for Ship Type 1 and 2 cargoes (1,250 m^3/tank and 3,000 m^3/tank respectively). To ensure efficient utilization of tank capacity, it may be advisable to use multiple, smaller tanks for the affected products. Other products will be downgraded to Ship Type 3 so larger quantities can be carried in individual tanks.

Toxic products

Under the IBC Amendments, more than 200 products which are currently deemed to be non-toxic will be reclassified as toxic. This typically implies additional requirements for toxic vapour detection, cargo tank vent position, a higher pressure valve opening set point, cargo and vent piping systems, use of stern line arrangements, and the cargo tank location relative to fuel tanks. Compliance with most of these requirements can be achieved through minor modifications. However, cargo tanks located next to fuel oil tanks will no longer be admissible for these products.

There are already various products requiring toxic vapour detection where no such equipment is available, and the revised Chapter 17 will expand this list considerably. Flag state administrations may exempt some ships from this requirement by imposing other operational requirements on the crew and vessel instead, such as using breathing apparatus and protective gear when entering a tank that previously contained relevant cargo, or spaces directly adjacent to it.



The industry is working on a proposal to ease the carriage requirements for methanol (CH_3OH).

Methanol

One cargo product of particular interest has been methanol, or methyl alcohol as it is called in the IBC Code. Methanol, often carried in large volumes, is currently assigned to Ship Type 3, which allows unrestricted filling and is not affected by any toxicity-related requirements. Methanol was originally intended to receive stricter treatment under Chapter 21 but is now back to Ship Type 3 following submission of new product data and modifications to Chapter 21. However, toxicity-related requirements have been added. An initiative from the industry to further ease the carriage requirements for methanol in deviation from Chapter 21, backed by expert opinions and proper arguments, is expected.

Recommendations

Chemical tanker operators should be proactive and determine the impact of these amendments on their fleets in due time. Depending on charter parties and cargoes of interest, some modifications may be necessary.

As the revised carriage requirements are more or less clear by now and only minor adjustments are to be expected, DNV GL stands ready to assist customers in predicting the impact on any DNV GL-classed vessel that has received a Certificate of Fitness from DNV GL. This service comprises preparation of a GAP report indicating cargoes that may be lost or gained as well as the affected tanks. **KJ**

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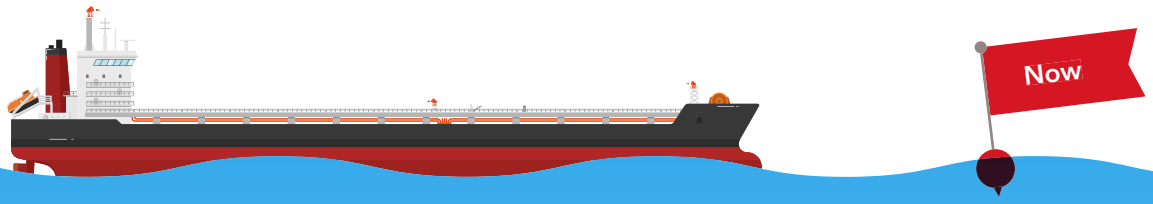
New safety requirements may call for breathing apparatus and protective gear for persons entering a tank that carried recategorized products.

Photos: andrej pol/ollaweila – Fotolia, DNV GL

PREPARING FOR MRV COMPLIANCE

The European Union's Monitoring, Reporting and Verification (MRV) regulation requires, as a first step towards compliance, monitoring plans for every ship to be submitted to independent verifiers by 31 August 2017 at the latest. This overview helps owners and operators get ready.



YOUR FOCUS/ CHALLENGES

Study the EU MRV regulation – familiarize yourself with the "M" (monitoring) and "R" (reporting") in particular. Identify challenges such as how to monitor cargo for particular vessels etc.

Assess your **reporting system** and decide whether it satisfies the MRV regulation. In case the system needs an extension or replacement, allocate resources to decide on the right system, its distribution and implementation on board your vessels.

Gain confidence in data reported by your crew by assessing the related data quality. This enables you to take corrective measures before reporting commences in 2018.

DNV GL SUPPORT

DNV GL has published an MRV guidance paper and offers webinars, regional meetings and seminars throughout 2017.

Should you have specific questions or need clarification on the regulation, please see the FAQs at **www.dnvgl.com/mrv** or contact your local DNV GL office directly.

DNV GL's MRV Readiness Check app provides a first assessment of whether you are EU MRV-ready or not. It guides you through a condensed checklist covering all aspects of the regulation, giving you a clear picture of your present preparation status and leaving you with a to-do list to plan your next steps. The app is available to our customers through *My DNV GL* free of charge.

Should more detailed support be required, DNV GL offers a tailored **MRV Ready service** through our Advisory department.

Navigator Insight is the DNV GL solution for ship-to-shore reporting. It comes with an on-board reporting tool for manual input of all the parameters required by the MRV regulation and can be extended to cover all aspects of daily ship operations. More than 450 plausibility checks enhance data quality before the data is sent ashore. More information can be found at **www.dnvgl.com/navigator-insight**.

MY DNV GL APP: MRVMP

The app

- The application will help users generate an MRV monitoring plan and hand it in for approval

Features

- Provides an easy-to-use, step-by-step template that helps with pre-filled technical information of the particular vessel to generate the MRV monitoring plan
- Smooth 1-click transition from plan to approval with discounted pricing for verification

Benefits

- Informs about the upcoming MRV regulation
- Saves time and effort on both the customer and DNV GL side
- All relevant vessel data is stored and accessible via *My DNV GL*
- Avoids the need for iterative clarifications

The upcoming EU MRV regulation requires careful attention. As a very first step, companies should assess whether tools already in place today will suffice for the MRV regulation and its reporting needs or whether they need to be extended or maybe even replaced by a new solution. Important questions to ask include:

- Is my system capturing all the required data? Is it also capable of differentiating between EU ports and non-EU ports, while reflecting on the different fuels and emissions at berth as well as many additional details such as anchoring time? Does it allow for repair calls in ports not subject to reporting requirements and so forth?
- Will I be able to efficiently extract and aggregate all the required data as necessary for the emissions report and corresponding verification?
- Is the system sufficiently implemented within the company to ensure a certain data quality which matters for MRV reporting, as data will be made publically available?

Once assessed and decided, companies will need to establish management procedures to ensure successful implementation of their monitoring systems and their proper usage on board. On the way towards compliance, we propose the following actions:

Companies have until 31 August 2017 to create and submit a ship-specific **monitoring plan** to the contracted verifiers indicating the method chosen to monitor and report emissions and other relevant information for each vessel over 5,000 GT that calls at EU and EFTA ports.

Preparing the monitoring plan can be a time-consuming task. Its content is specified in detail by the EU MRV regulation. Requirements include ship-specific data, such as emission sources, as well as information about the development and implementation of additional management procedures.

The first **reporting** period commences at the start of 2018. Based on your individual monitoring plans, your vessels will collect all the necessary data and transfer them ashore.

We suggest you initiate the processing of data in 2017 so there is still time to take corrective action in case any system or process shortcomings are discovered.

Prepare the emissions report and submit it to the contracted verifier. DNV GL has incorporated the guideline on verification for its verification activities.

DNV GL's MRV monitoring plan app supports you in preparing your monitoring plans for your entire fleet – semi-automatically and efficiently. The app pre-populates technical input fields in advance where data is already available from external data sources such as vessel particulars. It supports the definition of management procedures by offering predefined text blocks. Upon completion it compiles all information gathered in the correct format. The app is available to our customers through *My DNV GL* free of charge.

DNV GL's monitoring plan verification
We will verify whether your company has compliant monitoring plans and is ready to submit plausible emissions reports. DNV GL will design the verification process as digital as possible to reduce the additional work for you.

Navigator Insight is our suggested tool for ship-to-shore data collection and reporting.

DNV GL's emissions report verification
Verification of your emissions report(s) starts in January 2019. DNV GL will design the verification process as digital as possible to reduce the additional work for you. We will check your emissions report against your voyage log abstract and the external data we require.

Please refer to
www.dnvgl.com/mrv
for a comprehensive overview of all topics regarding the EU MRV regulation.

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CHECKING CONTROL NETWORK HEALTH

In a pilot project DNV GL teamed up with Greek owner Consolidated Marine Management (CMM) to find out how the health of on-board control and communication networks can be checked effectively to strengthen their overall robustness and resilience.

Any state-of-the-art vessel is equipped with a multitude of IT and OT (operational technology) devices that are not only interconnected and communicate with each other but are also in almost constant contact with the world beyond the ship, such as the Internet at large, vendor offices, and company headquarters. To give an example, the IT systems on board a tanker vessel comprise company reporting systems, crew entertainment and wireless networks as well as all the supporting infrastructure. The OT environment includes the integrated bridge, navigational equipment, cargo control, power and engine management systems, ballast water treatment and other marine systems.

"On-board communication networks are today the 'nervous system' of a vessel's integrated machinery," says Mate J. Csorba, Principal Specialist, Marine Cybernetics Advisory at DNV GL – Maritime. "A growing share of disruptions and downtime in offshore operations can be attributed to problems with networked equipment. Currently these are usually tackled by ad hoc troubleshooting, which makes testing and verification increasingly complex. Safety-enhancing systems are more important than ever."

The purpose of a network health test is to establish the performance and integrity of a communication system at a given point of time. This approach is called "snapshotting" and shall detect any faults, including capacity problems, failing communication devices and misconfigurations that can lead to off-hire. Control systems on board vessels very often consist of the same building blocks as land-based industrial control systems. However, some of the operational requirements are specific to the maritime environment and need to be given special attention.

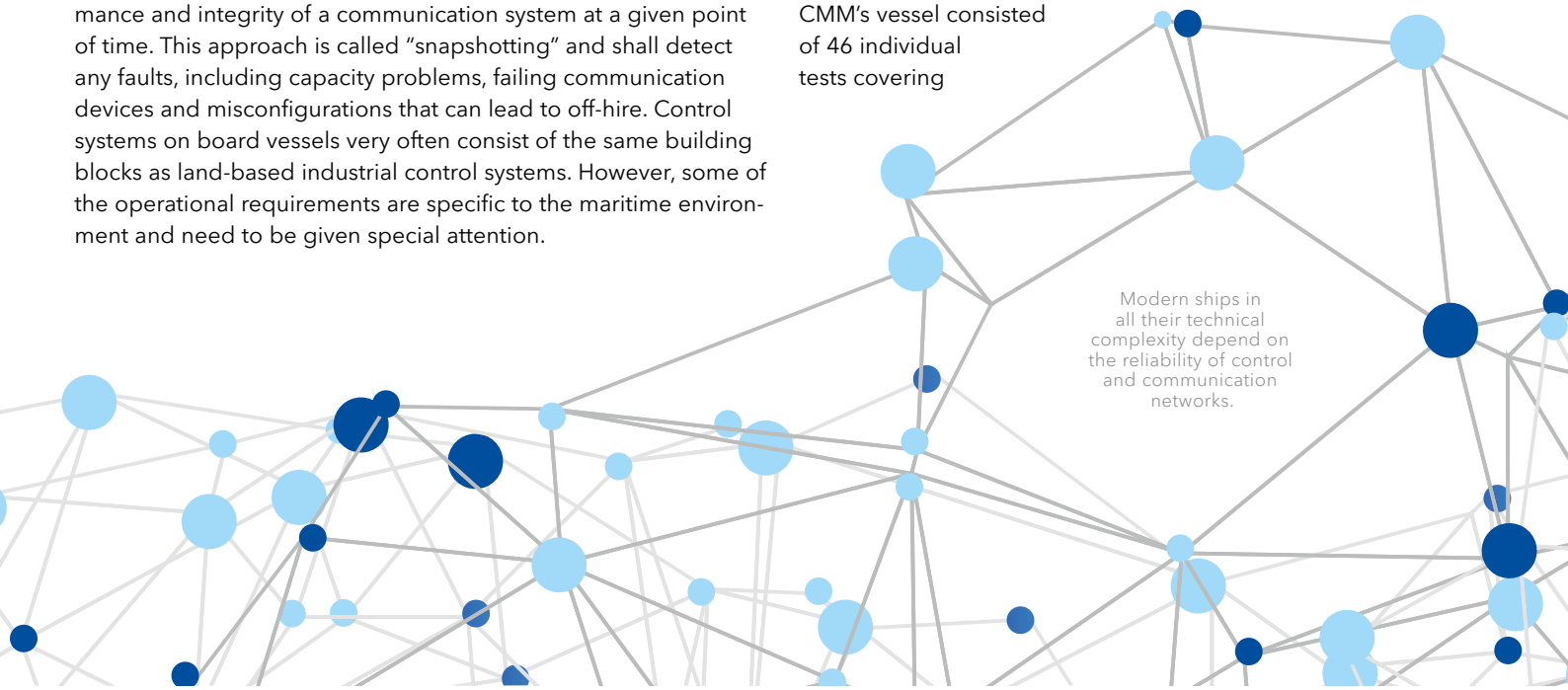
In the event that any issues are revealed, specific mitigating actions help increase the overall robustness and resilience of the communication and control systems on board. Even if remedial action is not possible, network health testing is still very beneficial by bringing the true condition of the systems to the attention of the system administrators.

Significant savings

The overall aim, therefore, is to obtain the capability to detect any intermittent errors and predict future failures such as emerging network degradation, capacity or configuration problems, or other threats to the availability and integrity of the tested control system network.

"We believe that with advanced technology-based assessments, our customers can reap significant savings. Having a comprehensive overview of the health of the on-board network will allow owners to schedule preventive measures at convenient times, enable better maintenance planning and perhaps even benefit from an extended lifespan of ageing assets," says Csorba.

The pilot project on board CMM's vessel consisted of 46 individual tests covering



Modern ships in all their technical complexity depend on the reliability of control and communication networks.

Reliability of control and communication networks is vital for safe and efficient vessel operation.

Photos: Alex/momentscatcher - Fotolia, CMM, DNV GL

Ethernet-based control and auxiliary system networks, CAN-bus connectivity for sensors and the alarm system, and a selection of DNV GL class rules addressing on-board communication networks. In practice this resulted in a focus on the alarm monitoring system, the ballast water treatment system, the main engine shaft power and performance monitoring systems, the main engine control and monitoring system, and auxiliary networks.

The tests were conducted mainly from the engine control room, the cargo control room, and the bridge. Active stress tests were used to verify whether the communication network is robust enough in specific failure scenarios, while passive measurements were employed to find indications of any potential problems and deviations from a system's installation documentation.

"CMM's vessel, a chemical tanker, was built in 2015 and has modern IT software and hardware on board which proved to be in very good condition," comments Nikolaos Kakalis, Manager for R&D and Advisory Services in South East Europe and Middle East at DNV GL. "The results did not reveal any discrepancies, and as such were considered as an initial snapshot of the health status of the vessel's communication systems. This 'healthy' snapshot can be used as a reference to quickly identify any future changes or deviations and as a troubleshooting aid if any issues with individual systems are encountered at a later time," says Kakalis.

Partnering to ensure network integrity

"This was an important first step, and we are very grateful for CMM's excellent cooperation in this test," says Csorba. "As we continue to develop such concepts further, it is possible that we will be able to collect data more extensively using automated on-board sensors which report on the system's health between port stays, and enable remote access procedures which could allow us to do system tests from shore in more or less real time."

Inspired by this example of a successful development partnership, Nikolaos Kakalis points out: "To us at DNV GL, Greece is our third home market, after Germany and Norway. We are glad to work with the Greek shipping community to introduce and co-develop advanced technology-based services that will help our customers manage their risks in practice." ■ **SIAD**

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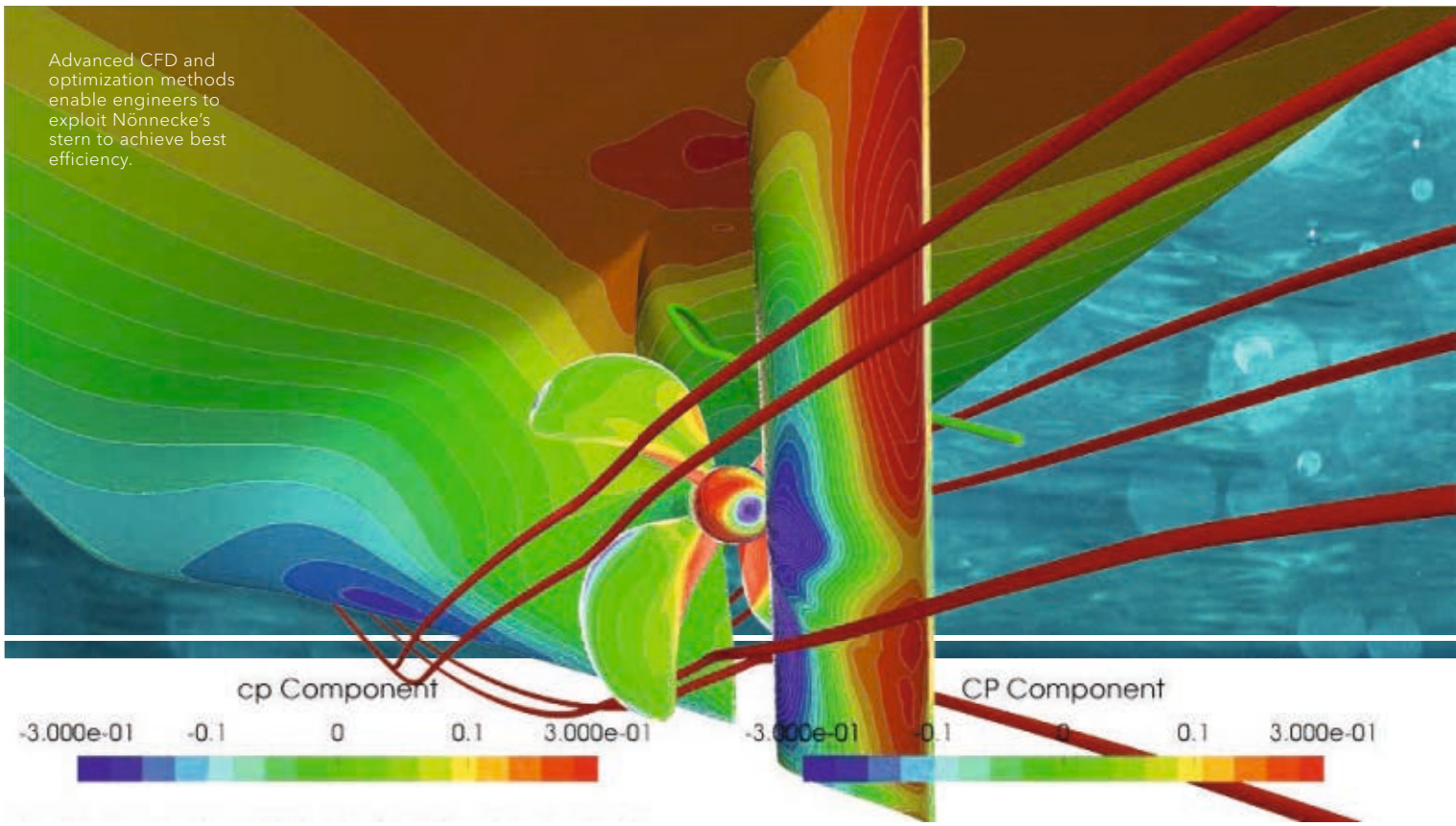


Advanced CFD and optimization methods enable engineers to exploit Nönnecke's stern to achieve best efficiency.

HOW TO SCULPT AN ASYMMETRIC STERN

Advanced computer technology and modelling techniques are helping revive an old idea: twisting the stern section of the hull to optimize flow and save fuel.

The history of shipbuilding harbours many surprises, and the biography of Ernst A. Nönnecke is one example: a trained shipbuilding engineer and an accomplished opera singer at the same time, Nönnecke, born in Hamburg in 1921, had a reputation for his intuitive, rather artistic approach to shipbuilding; was also a sculptor. In the late 1960s he came up with the brilliant idea of designing a ship with an asymmetric stern to account for the different flow conditions to the right versus left side of the propeller. His concept for optimizing flow and propulsion efficiency came more than a generation too early, however: the manual calculations proved to be extremely tedious, and implementing the design at the yard was even more tricky – and costly.

IT brings the breakthrough

But Nönnecke's invention was by no means a wasted effort. It was implemented various times during the following decades, if with great effort, and the few ships built with twisted aft sections did prove the merits of the concept as an elegant alternative to retrofitting so-called pre-swirl devices such as fins or ducts to optimize the utilization of the propulsion systems' rotational losses.

But the real breakthrough came more recently, enabled by high-performing computers and advanced software. "What computers can do so much better than people," explains Dr Karsten Hochkirch, Head of Department – Fluid Engineering at DNV GL, "is find the right balance between improved propulsion efficiency and increased resistance." This can be accomplished only by performing complex iterative calculations for a large number of design variants – a perfect job for computers.

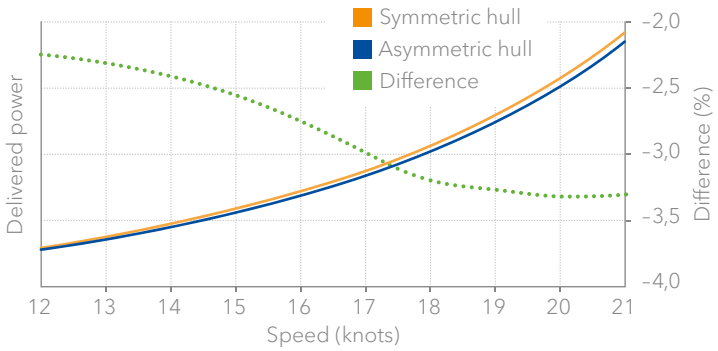
High-fidelity computational fluid dynamics (CFD) today provides the right toolset for designing complex shapes efficiently. Used in combination with the formal parametric optimization procedure developed by DNV GL, this approach makes design optimization much more manageable and efficient. Within the scope of its ECO Lines hull design optimization services, DNV GL now offers

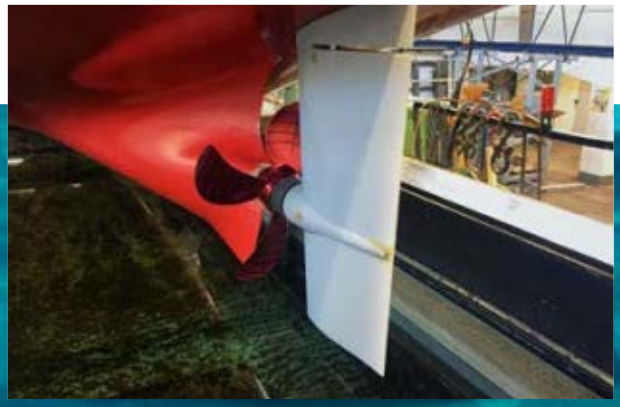
asymmetric stern optimization. The procedure gives significant freedom in shape variation without altering the key design requirements. Using special CFD tools and custom-developed code tested and proven in hundreds of towing tank trials, the DNV GL experts combine ship and propulsion simulation techniques based on viscous Reynolds-averaged Navier–Stokes (RANS) equations with dedicated, state-of-the-art propeller analysis code to determine the propulsion efficiency of a given model with high accuracy.

The formal hull shape optimization procedure begins by defining the objectives and optimizing the parametric model of the ship. What follows is a cyclic, iterative process to select the best-performing solution out of thousands of virtual model variations. In the RANS cycle, which is part of the routine, the results of the viscous flow calculations are used as input to the propeller

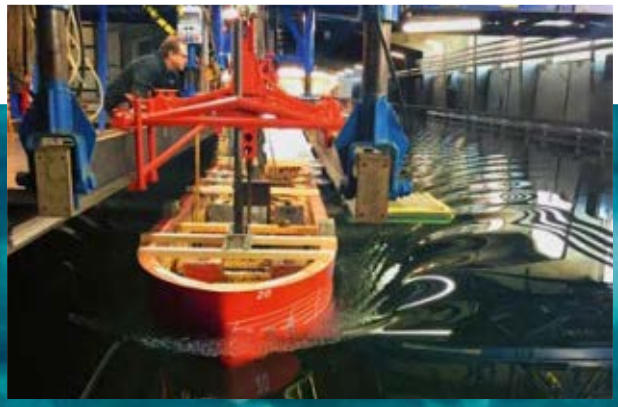
PROPULSION POWER REQUIRED FOR VARIOUS HULL FORMS

Model test predictions for an optimized symmetric hull vs its asymmetric version show a 3 per cent improvement for the latter near the 17 kn design speed.





Tank test model of a handymax bulk asymmetric stern shape.



The traditional towing tank test confirms the improved propulsive efficiency.

computation tool, whose output is then fed back into the next round of viscous flow calculations. In a final stage, the most efficient models undergo virtual towing tank tests until the best variant has been identified. This entire process requires enormous computing power: "There are around 7,000 CPUs in the basement of the DNV GL building doing the work Nönnecke did by himself," Hochkirch points out. When all computer work is done, a real-life scale model of the final design is built and taken to a traditional towing tank to verify the data.

The actual production processes at the yard have become much simpler as well thanks to advanced CAD/CAM techniques and modern, CNC-controlled fabrication methods.

Considerable fuel savings

Several projects have demonstrated the potential of the DNV GL approach. In the case of a 38,000 dwt tanker design, the resulting twisted stern enabled a four per cent decrease in propulsion power compared to the original design. In another project, a 3,000 TEU container ship was to be modified to minimize power consumption. Starting from a well-optimized symmetric baseline design, the asymmetric aft ship reduced propulsion power by three per cent, a result confirmed in model tests.

These and other examples have shown that the achievable gains in propulsion efficiency are generally higher for bulk carriers and tankers than for container ships. Depending on vessel design and operating profile, fuel efficiency improvements of up to five per cent are possible when starting from a well-designed symmetric baseline. Added benefits of a twisted stern include higher structural robustness and minimized vibration and fatigue.

The Fluid Engineering team at DNV GL can draw on decades of experience pioneering parametric hull line optimization. Implemented in close cooperation with both the customer and the yard, its ECO Lines asymmetric stern optimization service ensures reliable calculations, confirmed results from proven experts, and accurate execution at the yard. Ernst A. Nönnecke's ingenious idea is finally coming to full fruition. ■ **AK**

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About DNV GL
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. Operating in more than 100 countries, our professionals are dedicated to helping our customers in the maritime, oil & gas, energy and other industries to make the world safer, smarter and greener.

DNV GL is the world's leading classification society and a recognized advisor for the maritime industry. We enhance safety, quality, energy efficiency and environmental performance of the global shipping industry – across all vessel types and offshore structures. We invest heavily in research and development to find solutions, together with the industry, that address strategic, operational or regulatory challenges.

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