DNV·GL

CRUISE UPDATE

2018

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DEAR READER,

The cruise industry's growth seems unstoppable, with yard capacity as the only limiting factor. Asia has joined the game – *Genting Dream* (Dream Cruises) and *Norwegian Joy* (Norwegian Cruise Line), both built by Meyer Werft, are vessels expressly designed for the burgeoning East Asian market. Meanwhile new yards are entering the market: Norway's Ulstein Verft brings its unique design expertise and innovative X-BOW® to the expedition vessel segment where fitness for extreme weather and sea conditions are key requirements.

In the forefront of innovation and performance enhancements driven by unrelenting passenger demand, cruise ship design is making great strides both in terms of new passenger features and improvements of the underlying maritime platform. As the market fans out to cater to an increasing diversity of customers, designers such as Hareide bring in fresh ideas inspired by other industries, and owners like Saga focus on specific audiences whose preferences they are intimately familiar with. DNV GL underpins new technologies with advanced research and development work, contributing digital and automation expertise to enhance safety, efficiency and reliability, and streamlining class and certification services.

Today's passengers expect eco-friendly ships, and new regulations impose strict emission limits. Increasingly, LNG is being adopted as a sulphur-free ship fuel that emits less CO_2 than HFO. But the search for non-fossil energy sources continues. Battery power is great for short-distance shipping, fuel-cell technology is evolving rapidly, and hybrid solutions are moving centre stage: Hurtigruten will commission their first hybrid cruise vessel this year. DNV GL is supporting various joint industry research projects into alternative fuels and propulsion concepts, and the work on further performance and efficiency enhancements is progressing as well.

The prospects for the cruise industry's near future are exiting. As a class society we stand ready to provide vigorous support to our partners, helping them realize their visions and ambitions with all our expertise and knowledge. Having said that, we encourage the entire industry to expect more from their classification partner! Providing far more than rules and regulation-based services, DNV GL is ready to be challenged by you, and we will do whatever it takes to rethink our way of working and find new means of contributing to safety at sea while strengthening your competitive advantage.

Enjoy the read!

CRUISE UPDATE

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WINNING TOGETHER IN A CHANGING WORLD

With the speed of innovation accelerating and radical changes on the way, cruise lines, their destinations, shipyards and the entire supply industry may be entering the most exciting decade in their history.

A global order book comprising more than 90 vessels, and growing – the cruise business has never before seen such exciting times. Contrary to the logic of other segments of the shipping industry, the cruise sector's success hinges upon its ability to grow its share in the leisure industry and attract new passengers. The only true limiting factor is yard capacity. DNV GL expects new yards to open both in Europe and Asia over the next five to ten years, which will further boost growth.

The speed of innovation heats up

Innovation in cruise ship building occurs in two dimensions: marine technology innovation, which involves all efforts to make ships more fit for purpose, energy-efficient and cost-efficient; and passenger-facing innovation, which develops new features to make the "product" more attractive to passengers and targets new passenger segments. There are dramatic improvements on both sides: technically, the shipbuilding industry is making giant strides towards improving fuel performance, developing new fuels and engine technologies. At the same time line operators and shipbuilders are carefully observing new trends and searching for ever new ideas to innovate the passenger experience and offer on-board entertainments never seen before.

Until recently ship design was, to a large extent, the domain of naval architects, and cruise ships in general used to look fairly similar. Today exciting new developments come from designers from outside the maritime industry. While the naval architect will always play a key role, there is a growing need for inspiration from other sources. Unconventional thinking will be key in the innovation of future cruise vessels, both with respect to traditional naval architecture and interior design. DNV GL as a class society has stepped up its cooperation with innovators to make sure new concepts can be realized within the maritime framework. The industry is likely to see more "signature" designs going forward, and individual design features will be the intellectual property of the respective owner, not the yard, and be an important factor in attracting passengers.

Identifying competitive advantages

Public awareness of climate change related to human activity is growing steadily around the world. The cruise industry must continue its effort to reduce emissions. Since ships – much like aeroplanes – have no other choice than to store large amounts of energy on board, they are excluded from certain non-fossil energy sources that are available to land-based consumers, such as wind, tidal and hydroelectric energy. Nuclear energy harbours too many risks and lacks public acceptance. Therefore it is difficult to roadmap the energy future of shipping. Two areas need to be addressed simultaneously: tuning the effectiveness of technical solutions and operational practices, which will optimize short-term profit, and continuing the search for more

environment-friendly fuels and engine configurations thus ensuring long-term success. All this amounts to a major challenge not only for cruise lines but also for engine manufacturers, the suppliers of the power plants for tomorrow's cruise ships. Conceivably new suppliers will position themselves for this market, going head to head with the established engine manufacturers.

The exploration vessel segment looks poised for dramatic changes. The current order book for exploration vessels is more than seven times the capacity of one of the historic market leaders, Lindblad Expeditions. Luxury features are entering this segment, and vessels are becoming larger. The new tonnage will enhance the passenger experience, while larger ship sizes will enable better profit margins and a lower price point. A key success factor for larger cruise vessels will be better solutions for passenger logistics.

As a new, more competitive fleet takes over, older tonnage will increasingly get "stranded". A look at the price point for Antarctic expeditions during the coming season reveals a tendency that is indicative of coming changes. Quite possibly, other niches of the cruise market will also see a revitalization, such as the ultra-luxury market and the destination segment. In addition, nobody should be surprised to see new residential vessels being contracted.

Digitalization drives efficiency and safety

Good data connectivity to shore has always been important for cruise ships. Therefore this segment will lead the drive to digitalize the maritime world. Fleet operational centres, which are being established everywhere, will profoundly change the way fleets are managed, allowing operators to track vessel performance in real time and pinpoint improvement opportunities. Autonomous technologies (refer to "Exploring automation" on page 22) will redefine bridge operation and be a step change in safety performance. Barrier management, introduced to the maritime industry over the last decade, will benefit from digitalization by enabling real-time barrier monitoring. The vision of "zero major maritime accidents" has never been closer. Digital technology will also allow cruise lines to interact with their passengers in much more sophisticated ways – pre, during and post voyage.

DNV GL pursues all these challenges and opportunities with passion, always seeking to help owners, yards and suppliers succeed. Realizing that "one size doesn't fit all", DNV GL has been tailoring its services to the specific client over the last years. Being flexible and able to challenge current ways of working while continuously adapting to a changing environment harbours great value for both sides. **HH**

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The prospects for the cruise industry remain bright with demand encouraging further diversification.

Photos: danielsbfoto - iStockphoto.com, DNV GL

CROSSING OVER TO CRUISE

The harsh climate of Norway's north-western coast forms the backdrop of a maritime tradition marked by resilience and determination to succeed. Ulstein Group, a third-generation, family-owned marine company, knows why being small means being successful.

The design of the planned Lindblad expedition vessel combines Ulstein's unique expertise with advanced on-board features.

In November 2017, the expedition cruise operator Lindblad Expeditions Holdings signed an agreement with Norwegian shipbuilder utilizing Ulstein's iconic X-BOW®. Ulstein Verft is to build a leading-edge polar expedition ship to be delivered in 2020, with an option for two additional vessels. The new ship will be built with DNV GL class. What makes this project remarkable is the fact that Ulstein has been known as a builder of offshore support vessels and is a newcomer to the cruise sector. Two similar projects, including a battery-powered hybrid ferry for Color Line and another expedition cruise ship for SunStone TBN, are likewise in the early stages.

"Ulstein is well known as a company that has designed and built some very sophisticated ships," says Helge Hermundsgård, Business Development Manager at DNV GL. "Ulstein designs always stand out a little. For example, they invented the X-BOW, which reduces slamming, enhances comfort on board and improves fuel efficiency." The obvious reason for an offshore vessel specialist to venture into the cruise sector is the sustained bust of the oil and gas business. But there is more behind it, says Tore Ulstein, Chairman of the Board, Deputy CEO and Chief Market & Innovation Officer of Ulstein Group. "To understand the philosophy of our family business, which just celebrated its 100th anniversary, it is worth taking a look at its history."

Driven by innovation

It all began with Martin Ulstein, today's owners' grandfather who was both a fisherman and a shipwright. "In those days, men used to go fishing during the fishing season and work in the repair yard during the off-season. So they had the experience of both – braving the harsh ocean environment, and maintaining and improving their ships. Our grandfather wanted to develop something of his own and challenge the ways things were done, so he started his own company building fishing boats in 1917."

In the 1950s, when the demand for car ferries emerged, Ulstein built their first steel ships. Eventually trawlers and ships for the oil and gas fields followed, and more recently, offshore support vessels for wind farms. "With all this experience as our foundation, we realized we were in a great position to move into the cruise industry, in particular, the smaller expedition-type vessels. These ships must provide a very stable and comfortable working platform for regions like Antarctica where the weather conditions are extremely harsh." Regions where reliability and stability are key. "Our experience with DP3 vessels becomes important when we sit together with DNV GL, our trusted partner of many years, to develop safe-return-to-port concepts," says Tore Ulstein. "These considerations are also relevant when we design the hull lines for expedition ships. Our X-BOW reduces up to ten per cent of involuntary speed loss in waves so the ship can maintain a higher transit speed. All this is useful when we cross over into cruise where those properties are greatly valued." The new expedition vessel will be Lindblad's first ship to feature Ulstein's signature X-BOW.

The expanding cruise sector offers Ulstein a great opportunity to challenge existing designs and practices. "But we also challenge ourselves – the way we work and design ships," Tore Ulstein notes. "Innovation means making them more efficient, smarter, and greener, not only with regard to propulsion or power generation and distribution systems, but also in terms of the hull form, which has a significant influence on the environmental impact."

Entering the cruise segment meant a paradigm change for Ulstein Group. But, says the Deputy CEO, "no matter what ship type we build, our perspective is always holistic: we need to understand what the customer needs. What is new about building cruise ships is the aspect of the passenger experience: cruise operators focus on what generates income for them. Based on our expertise we

"No matter what ship type we build, our perspective is always holistic: we need to understand what the customer needs."

Tore Ulstein, Chairman of the Board, Deputy CEO and Chief Market & Innovation Officer of Ulstein Group

provide a maritime platform that is robust, effective, safe and efficient. As for the hotel, the cabins, the features, the logistics, etc., we partner up with designers and architects who know what is needed in this business." Learning rapidly has always been a top priority at our company, says Ulstein. "We come from a very engineering-driven environment, and we are working hard to understand the business case of our clients – how these platforms can be improved to support a new and exciting passenger experience."

Unconventional business model

For a relatively small shipbuilding company like Ulstein Verft, differentiation in the market is key. Ship design is where Ulstein really excels. "We sell design solutions, equipment packages and support to other yards worldwide. We build prototypes here in Norway and use this practical experience to support our partner yards internationally. We train their teams in Ulsteinvik so they can build advanced vessels, for instance, in China. This transfer of knowledge enables our partner yards to implement our designs and solutions. And since we are a small yard, the big yards we work with don't consider us a threat." Well over 60 Ulstein-designed vessels have been built in China, Dubai, Brazil, Singapore and Europe over the years.

Another unique selling proposition is that the company is involved in all processes from the concept through to the operation of a new ship. "Because we are engaged in the entire value chain, we can take a holistic view on shipbuilding. This comprehensive, integrated know-how coupling all stages of the process is our advantage," Ulstein assures.

As a vendor of technology and knowledge, Ulstein Group must always think ahead. "We are not afraid that our know-how will end up in the wrong hands. My father used to say: 'If you use the money you earn on accelerating your own development and being proactive, you will become stronger.' Of course we have to be smart about the way we distribute our knowledge, and we avoid imparting all of it to a single party. We transfer our knowledge to become stronger and closer to our customers."

Ulstein does not want to become a slave to its own capacity and be under constant pressure to acquire new business, he adds. Rather than expanding their own shipbuilding capacity, the company drives its design and development capability to feed it to the partner yards abroad. "We are building up a virtual shipbuilding group without incurring the risks."

What draws owners to Ulstein, says DNV GL's Helge Hermundsgård, is the company's commitment to on-time delivery, very high quality and workmanship standards, and innovative ingenuity. Tore Ulstein adds: "Owners like to come to us because we are a small player. It means they will get more attention." With this in mind, Ulstein Group's Deputy CEO sees plenty of reason to feel confident about his company's future. ■ **AK**

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Photos: Ulstein Group

SYNERGIES, DIVERSIFICATION AND FLEXIBILITY

The world's largest builder of cruise ships is a complex conglomerate with operations in Asia, Europe and the Americas. From this enviable position Fincantieri can give fascinating insights into the present and future of the trade.

Trieste is a uniquely international Italian city: part of the Habsburg monarchy since the Middle Ages, it is proud of its pan-European heritage – and a perfect choice for the headquarters of the world's most international shipbuilding group, Fincantieri. With subsidiaries and affiliates on three continents, the group – the world's fourth-largest shipbuilder – comprises an impressive spectrum of capabilities from cruise ships, ro-pax and ferries to naval vessels, offshore, research and other specialized ships. Two major acquisitions in recent years have doubled the size of Fincantieri: Vard in 2013, and a prospective 51 per cent ownership stake in STX France which is currently in the finalizing stage.

This enormous global footprint and the task of integrating so many companies are not without challenges, says Fabrizio Cafagna, Vice President Basic Design, Merchant Ships Business Unit, Fincantieri. But above all they harbour great opportunities. "Both acquisitions are bringing up the value of Fincantieri and allow us to benefit from synergies, diversification and flexibility," he points out.

The benefits of size

"Synergies are created by leveraging upon common expertise in technical management and industrial capabilities within a common framework while increasing our buying power and enabling

Fincantieri's Monfalcone shipyard near Trieste, Italy. Many glamorous cruise vessels have been built at this site.

consolidated purchasing," explains the VP Basic Design, giving an example: the Vard shipyard in Romania has an enormous steel manufacturing capability. Fincantieri can now build large floating sections there, then tow them to Italy or Norway for assembly and outfitting. "This allows us to offer owners a shorter building time at the same high quality," says Cafagna. Diversification enables Fincantieri to build a greater variety of ships. "We didn't have these options in the past; they give us a very strong business position," Cafagna emphasizes. Along with diversification comes added flexibility – a wider choice of yards and resources to handle orders of all kinds and sizes. Right now two DNV GL-classed expedition cruise ships for Hapag-Lloyd Cruises are being built by Vard (refer to page 30). "Vard normally builds offshore and fishing vessels. But all our cruise ship yards are full," Cafagna explains. "Vard has all the capabilities and expertise to build ships the size of *HANSEATIC nature* and *HANSEATIC inspiration* – and stringent quality standards."

Cooperation is key

In an enterprise with a complex structure of business units, subsidiaries and affiliates at various stages of integration, a common vision is essential – it is the glue that holds it all together, Cafagna stresses. "We collaborate in areas such as IT infrastructure, software capabilities and top strategies. As the group evolves, new opportunities arise." Each business unit has technical expertise that can be of interest to the others. As an example Cafagna mentions the application of fuel cell technology: "This is a very clean source of energy that can be used to power specific systems on board. Fuel cells have been used in submarines for a long time. I can call my colleague at the naval yard and ask what they have used it for and how, so we can pick up the existing know-how and adapt it to our specific needs in the cruise segment." Fincantieri has also established a corporate knowledge-sharing programme. "We are leaders in technology integration," says Cafagna. Of course there is also know-how that cannot be shared freely, especially in naval shipbuilding. "Plus, we have to protect the intellectual property contributed by our customers," Cafagna points out.

The partnership with STX France is still in the early stages. It was the Chantiers de l'Atlantique shipyard in St-Nazaire that built the legendary *Harmony of the Seas* and *Symphony of the Seas* for Royal Caribbean International, both classed DNV GL. At the time they were commissioned, they were the biggest cruise ships the world had ever seen. "STX France is a huge company with a consolidated portfolio, a stable client base and a large order book," says Cafagna. "They are one of the very best companies. Their corporate and management structure and their own technical office will remain intact. We are not going to take anything out. We want to cooperate to create synergies in terms of experience, know-how and a shared supply chain, to name just a few benefits. Both companies are in a very good position, and we are moving forward step by step to explore what we can achieve together."

New challenges and opportunities are also beckoning in East Asia, especially China, where a young tourism industry caters to the preferences of an emerging middle class. China is investing in ports and other required infrastructure, and Fincantieri has established a cooperation partnership with China State Shipbuilding Corporation to enter this new market. "Of course it will take the country time to develop expertise in integrating all the technical processes, build up the supply chain, establish control and supervision, logistics and so forth. But eventually a network is going to form in eastern Asia to support it all." While the future is hard to predict and will probably have its ups and downs, Cafagna sees great promise in the Chinese market.

"The future of the cruise segment lies in radically new concepts, the ability to present something never seen before. We need innovation that challenges the traditional envelope."

Fabrizio Cafagna, Vice President Basic Design, Merchant Ships Business Unit, Fincantieri

Technology and market research

One of the great challenges confronting ship designers in these times of dramatic technology changes and full order books >

At the VARD-Tulcea shipyard with its enormous steel manufacturing capacity, Fincantieri builds floating sections for passenger and other ships.

Photos: Fincantieri

Symphony of the Seas at the STX France yard in St-Nazaire on 17 January 2018. She will embark on her maiden voyage in April 2018.

> is making sure the ships designed today will still be at the leading edge of technology when they are delivered several years from now – as well as after years of operation. When it comes to reducing the carbon footprint of cruise shipping, Cafagna affirms, there is no easy answer. "There is a strong trend towards LNG right now," he says. "But LNG is still a fossil source and will not last forever." Current alternatives, from batteries and hydrogen to fuel cells and biofuels, are not yet able to fully replace fossil fuels. "We cannot rely on a single technology. A mix of systems and energy sources, including hybrid systems, would mitigate the risk – at the cost of increasing the maintenance effort. But energy diversification prepares us better for changes in the market." (Refer to article on page 27 on alternative fuels.)

A call for integrated regulations

From passenger evacuation to emission control and operational efficiency, and from damage stability to the Polar Code, the regulatory framework is getting more and more complex. "It is essential for us to find sustainable solutions for implementing all these requirements," says Fabrizio Cafagna. "But at a higher level, we need an integrated approach to regulation. The regulatory bodies developing standards and rules should sit down together and try to understand the mutual implications of their work to help shipbuilders find the best overall design solutions."

Class can take a leading role in making this happen, both as a partner of the regulatory bodies and as a provider of services to owners and yards, comments Paal Johansen, Vice President and Global Cruise Ship Director at DNV GL. "We are well aware of the complexities of the regulatory landscape. Our Maritime Advisory services routinely assist shipbuilders with the resulting design issues, for example by assessing compliance and developing appropriate action plans." In addition, he says, virtualization – culminating in the "Digital Twin" concept – will make it much easier in future to reconcile the implications of various regulations for ship design, such as hull efficiency enhancements versus stability considerations.

Another issue on every shipowner's and shipbuilder's wish list is a more flexible surveying regime. "We need to explore new solutions, alternatives and technologies to find a more sustainable approach to classification," Cafagna urges. "For instance, we need to investigate together whether a specific new technology can be accommodated as part of a ship design." Here again relief is in sight, assures Paal Johansen: "Digitalization is advancing at an enormous speed, and sensor-based monitoring is opening the door to flexible, risk-based inspections and surveys. Over the coming years class will completely redefine its way of working." (Refer to our article "Exploring automation" on page 22.)

Unbroken upward trend

As the cruise market diversifies into segments targeting various passenger groups, Cafagna sees the trend towards larger ships continuing. "But the future of the cruise segment lies in radically new concepts," he believes, "the ability to present something never seen before. We need innovation that challenges the traditional envelope." And ships must be designed with plenty of rearrangement flexibility so they can be refurbished more easily to create a new passenger experience and remain competitive.

Contrary to most other ship types, cruise ships continue to be in great demand. "We are happy but we must be careful," cautions Cafagna. "As long as the global development shows a clear trend towards more investment in tourism for the next ten or 20 years, the cruise industry can count on continued popularity. But a downturn is sure to come sooner or later." Competition will intensify, he adds, and innovation will be the most important differentiator for builders: "If you are just good at doing one thing, you will not be able to expand," Cafagna concludes. **AK**

ABOUT FINCANTIERI

Fincantieri – Cantieri Navali Italiani is Europe's largest shipbuilding company and the fourth-largest in the world. Established in 1959, the company today operates yards on nearly all continents, building cruise ships, luxury yachts, merchant and platform support vessels and naval ships.

In 2013 the Fincantieri Group acquired Norwegian shipbuilder Vard with nine yards in Europe, Brazil and Vietnam. In September 2017 a deal was struck with STX France which sees Fincantieri acquiring a 51 per cent stake.

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Photos: DNV GL, Royal Caribbean International

ENVIRONMENTAL REVIEW: KNOWING WHAT TO EXPECT

Over the past decade, shipping has seen a surge of environmental regulations. Whether it is to ensure compliance or to make the right business decisions, DNV GL believes it is crucial to understand the existing and future regulatory framework, and has prepared a summary of the status quo.

The Ballast Water Management (BWM) Convention entered into force on 8 September 2017, more than 27 years after the start of negotiations and 13 years after its adoption in 2004. After complex discussions IMO also agreed a revised and extended implementation schedule last year. Briefly put, every ship in international trade will be obliged to comply sometime between 8 September 2017 and 8 September 2024. For ships of 400 GT and above the compliance date is linked to the renewal of the International Oil Pollution Prevention certificate through a set of somewhat intricate provisions, while ships below 400 GT must comply by 8 September 2024. In practical terms the entire international world fleet is to be compliant within 2024.

The U.S. Coast Guard is no longer granting grace periods for installation of ballast water management systems.

In the US, the domestic ballast water management regulations entered into force in 2013. New ships must comply upon delivery, while existing ships must comply by the first scheduled dry-docking after 1 January 2014 or 2016, depending on ballast water capacity. USCG type approval is required for the ballast water treatment systems; six such approvals have been granted so far. The USCG's previously liberal extension policy, where more than 12,300 ships have been granted deferred installation dates due to lack of approved systems, has changed after type approvals started to be granted. Presently the USCG is being very restrictive on granting extensions, and we expect the policy to tighten further. In practical terms, operators should now plan their installation dates based on the compliance dates in the regulation and not gamble on being granted extensions.

For more information on ballast water related topics please visit **dnvgl.com/bwm**. >

Photo: ©watman – stock.adobe.com

AIDAprima bunkers LNG from a lorry. The best choice of low-sulphur fuel depends on the individual ship and its operational pattern.

> SO_x regulations

IMO has agreed that the 0.5% global sulphur cap will be implemented from 1 January 2020. The decision has provided certainty to the maritime and bunker industries, but has also generated intense discussion on both the practicalities of implementation and on how to ensure robust enforcement and a level playing field. While IMO is continuing to discuss implementation and supporting measures, these are not expected to be finalized before MEPC 74 in Q2 2019.

Ship operators will need to decide their preferred compliance strategy, and this decision will have significant operational and financial implications. There is no one-size-fits-all solution on the table; scrubbers, LNG, and "hybrid" fuels are all realistic options, but the vast majority of vessels are expected to default to MGO. Local availability issues and price volatility are expected as consequences of the very different fuel demand picture materializing on 1 January 2020, and a significant number of non-compliance cases is to be expected in a transitional period.

Enforcement remains a critical concern, in particular with regard to operation on the high seas. In contrast to the situation with the emission control areas (ECAs), where enforcement is a port state matter, enforcement on the high seas is the responsibility of the flag state. Reasonable questions are being asked about the readiness of all flag states to provide uniform and robust enforcement and thereby ensure a globally level playing field.

Moving to regional and domestic matters it should be noted that in the EU the Water Framework Directive is putting constraints on the discharge of scrubber water. Belgium and Germany have in essence prohibited the discharge of scrubber water in most areas, constraining the operation of open-loop scrubbers.

In Asia China's regulations for domestic SECA-like requirements are being rolled out. These apply to the sea areas outside Hong Kong/Guangzhou and Shanghai, and in the Bohai Sea. China is taking a staged approach, initially requiring maximum 0.5% sulphur content in fuel burned in key ports in these areas, gradually expanding the coverage, and culminating in applying the requirements to fuel used in the sea areas from 2019 onwards. There is also the possibility that the requirement for all sea areas will be tightened to 0.1% in 2020, and that a formal ECA application may be submitted to IMO. In our view, there is a real possibility of such an application being extended to cover additional Chinese sea areas.

More information is available at **dnvgl.com/maritime/publications/global-sulphur-cap-2020.html** and **dnvgl.com/lowsulphur**.

NO_x regulations

The NO_x tier III requirements have entered into force in the North-American ECAs for ships constructed on or after 1 January 2016. In essence, anyone constructing a ship today needs to consider whether operation in the North-American ECAs will be part of the operational pattern upon delivery or might be at any time in the future. If so, NO_x control technology will be required on board that ship.

Additionally, IMO has agreed to apply NO_x Tier III requirements to ships operating in the North Sea and the Baltic ECAs. This will apply to ships constructed on or after 1 January 2021.

CO_2 and energy efficiency

Climate change concerns remain the driving political force behind CO_2 and energy efficiency regulations. In the EU, regulations for monitoring, reporting and verification (MRV) of CO_2 emissions have entered into force, requiring all ships above 5,000 GT sailing to or from European ports to report CO_2 emissions, cargo data and average energy efficiency. 2018 is the first year of reporting, with data being published annually by the EU starting mid-2019.

Part of the purpose behind the EU MRV regulations was to encourage IMO to work on a similar mechanism with global coverage. The EU regulation itself contains a provision for a review aimed at alignment with an international system, if such is developed. It is therefore significant that IMO has adopted a global mechanism for mandatory monitoring, reporting and verification of fuel consumption data for all ships 5,000 GT and above. The scheme, known as the IMO Fuel Consumption Data Collection System (IMO DCS) will have 2019 as its first year of operation.

The IMO DCS differs from the EU MRV in several important aspects, including confidentiality of data, calculation of efficiency metrics, and requirements for data verification. While these are all issues where the EU has a strong preference for the requirements of its own system, the European Commission has nevertheless initiated a formal review process aimed at aligning the EU MRV with the IMO DCS. There are encouraging signs of a legislative proposal to be published in May 2018, though it is expected to be challenging and likely time-consuming for the commission, parliament and the council to come to an agreement. We believe industry will need to cater to both reporting regimes for at least some years.

IMO is also seeing a reinvigorated discussion on CO_2 emission reduction goals for shipping, primarily triggered by the global climate change agreement reached in Paris in 2015. In addition to establishing the DCS, IMO has agreed to establish a strategy on GHG emission reduction. An initial version should be ready by MEPC 72 in April 2018. This is of great significance to the maritime industry as such a strategy will not only have implications for design and operational energy efficiency requirements but may also lay the foundation for an eventual agreement on carbon pricing.

More information on EU MRV (and IMO DCS) is available at **dnvgl.com/maritime/mrv-regulation.html** and **dnvgl.com/imodsc**.

Upcoming cruise-specific regulations in Norway

The cruise industry's environmental footprint is increasingly in focus – not unexpectedly so, given its high public profile. One case in point is the planned rollout of tighter regulations targeting a range of emissions and discharges in three Norwegian World Heritage fjords: Geirangerfjorden, Nærøyfjorden and Aurlandsfjorden. The regulation will target cruise ships specifically, and while the scope and effective date(s) have yet to be finalized, adoption is scheduled for end-2018. Amongst its likely key provisions is a requirement for all cruise ships to be NO_x Tier III-compliant by 2020 irrespective of construction date. While scrubbers are likely to be accepted as an alternative to 0.1% sulphur fuels, a ban on scrubber discharge water is expected. A requirement for scrubbers to have no visible water vapour emission is being considered, and exhaust gases are expected to be subject to stringent opacity requirements. A ban on the discharge of grey and black water, irrespective of on-board treatment, is a possibility. In practical terms the regulation is expected to establish significant hurdles for the operation of older ships in these fjords. **EN**

All technical and regulatory news can be found at **dnvgl.com/tecreg**.

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China is establishing ECAs at major ports, including Hong Kong (left). In Norway's Geirangerfjord (right), stricter emission limits will soon apply.

JOYFUL JOURNEYS FOR

The unusual circumstances of *Norwegian Joy's* genesis, which involved a complete change of the design concept for the on-board features to cater to the preferences of the Chinese market, required especially close cooperation between the yard, the owner and the classification society. DNV GL committed additional resources to ensure timely completion of the project.

Christened on 27 June 2017, *Norwegian Joy* was specifically designed for Chinese travellers, offering them unprecedented levels of on-board comfort, luxury and innovation. The second ship of Norwegian Cruise Line's Breakaway Plus class, she was built at Meyer Werft shipyard in Papenburg, Germany, and regularly berths at her home ports Shanghai and Tianjin.

Her five MAN common-rail injection engines power two ABB Azipod XO electric propulsion units. The engines can either run on heavy fuel oil or on distillate fuels, and are equipped with five exhaust emission treatment systems (scrubbers) enabling the ship to comply with the 0.1% sulphur limit inside emission control areas (ECAs). A Silverstream® air

LENGTH OVERALL
333.41
METRES

BEAM
41.40
METRES

DRAUGHT
8.70
METRES

TONNAGE
167,725
GT

Photo: © MEYER WERFT | Harald Hohenthal

CHINESE GUESTS

lubrication system produces a thin layer of micro air bubbles around the hull of the vessel to reduce frictional resistance and improve operational efficiency, reducing fuel consumption and emissions to air. *Norwegian Joy* is also at the forefront of innovation in terms of on-board features, including a two-level competitive go-cart race track on the top deck, the first ever to be featured on a cruise ship, and an open-air laser tag course.

Trustful partnership

Originally intended to operate in Alaskan waters, the ship was repurposed for the Chinese market 16 months before the scheduled delivery date. This meant that her interior design had to be modified to suite the preferences of Chinese passengers. Quick action was required to implement this change. DNV GL allocated additional personnel resources to re-approve more than 300 drawings and later deployed a surveyor team to perform the additional surveys. Further modifications were necessary to accommodate large fire zones and oversized lifeboats compliant with flag state requirements.

In addition, the owner's on-site team was changed one year before delivery, so new relationships had to be established between the owner, the yard and DNV GL. All these challenges could only be handled successfully by all three parties cooperating in a spirit of true partnership and mutual trust. ▮ **AK**

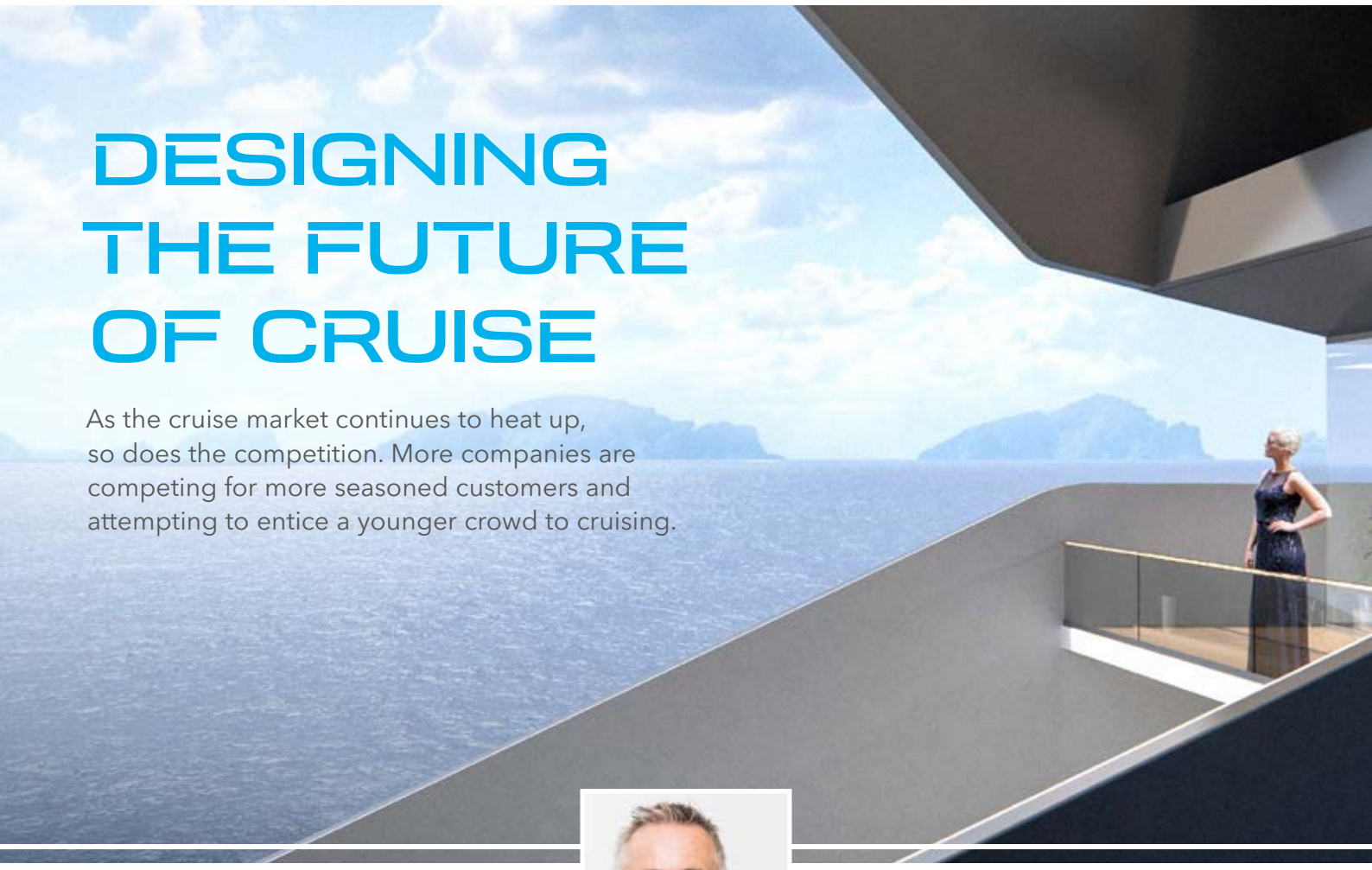
With Shanghai and Tianjin as her home ports, Norwegian Cruise Line's *Norwegian Joy* is designed entirely for the taste of the Chinese traveller.

CAPACITY
4,992
PASSENGERS / SPECIAL PERSONNEL

CREW
1,706

MAIN ENGINE POWER
78,000
KW

CLASS NOTATION
✠1A1 PASSENGER SHIP BIS BWM(T) LCS(DC)



DESIGNING THE FUTURE OF CRUISE

As the cruise market continues to heat up, so does the competition. More companies are competing for more seasoned customers and attempting to entice a younger crowd to cruising.

Design is increasingly acknowledged as a key element in making cruise more attractive for first-timers and experienced customers alike. But who will design the game-changing cruise ships of the future? Many are saying it will not be traditional marine designers, but rather those with experience from outside industries, anything from automobile, to airline, to IT.

Einar Hareide, CEO of Hareide Design, the award-winning industrial design community out of Norway, has had a toe in the water of marine design his whole career, but gained his initial experience in the automobile industry.

Fresh out of a master's programme in Gothenburg, Hareide attended the prestigious Center for Creative Studies in Detroit, returning to Sweden to do a stint at Saab in the late 1980s. From there he found his way to Stuttgart and Mercedes-Benz. "They had a 300 SL gullwing in the lobby. I used to walk by it in awe every day, feeling unworthy," he smiles. Perhaps spurred by a debt of honour, he paid fitting homage to the iconic auto by helping to convince Mercedes to reintroduce round headlights in their E-Class series.

Hareide returned to Saab in 1991, taking over as Design Director in 1995, but leaving the company when he began to feel that the new owners were undermining the uniqueness that was the secret of Saab's appeal. In 2000 he founded Hareide Design in Moss, just south of Oslo.

"Owners are seeking new solutions. That means the industry has to be open for design ideas that challenge traditions."

Einar Hareide
CEO of Hareide Design

Returning to maritime roots

Hareide wanted to think more long-term, and more Scandinavian. "I was born into the Norwegian coastal culture and mentality," he recalls. "We have strong maritime traditions, and I wanted to combine my heritage with my experience from the auto industry."

Maritime stalwarts like Kongsberg and Rolls-Royce Marine were Hareide Design's first customers, but the Norwegian industry proved to be more process- than design-oriented. "Norwegian industry is aligned differently than in more diverse industrial countries," Hareide relates. "Design in Norway often comes in after engineering."

Hareide came prepared to bring outside impulses and knowledge to maritime design. "You have to start by asking which factors influence design. Environment, regulations, materials – all of these figure in, and there are many parallel processes." He works purposely with concept designs in order to create expectations and entice hesitant clients to test new waters. "Many clients are reactive, and then it's often too little, too late. They need to be nudged to think differently from the start."

The latest superyacht concept by Hareide Design based on a classic 108 m monohull design featuring a unique combination of elegance and modernity.

That sentiment is shared by Helge Hermundsgård, Business Development Manager at DNV GL, long-time class partners with Hareide Design. "We have learned it is important to establish close cooperation between designers, naval architects and class early on to enable the realization of new designs. Early collaboration helps everyone identify the factors necessary to bring a new design to market."

Opening up by design

Hareide observes that many maritime designs are similar, with modern cruise ships offering few notable exceptions. "They tend to be functional, but not inspiring," he observes. "The challenge is to break away from the present, from traditions. Functionality has to come first, but new areas need to be explored."

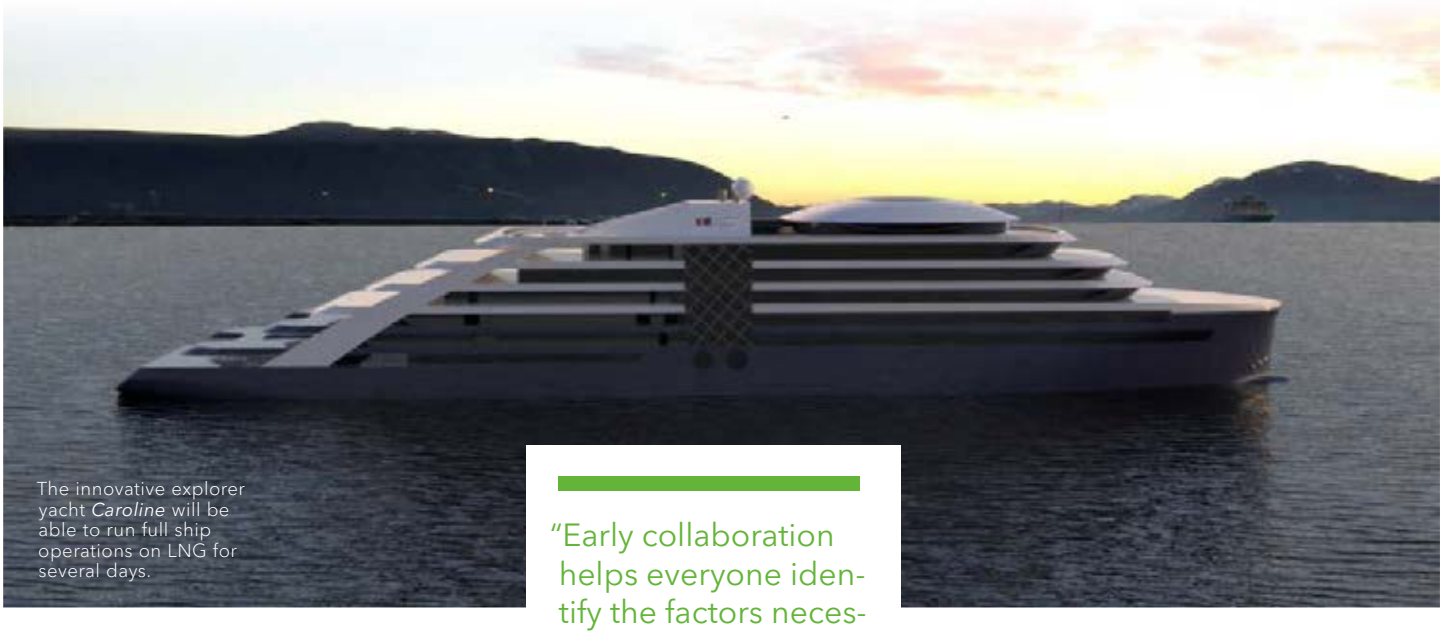
He has noticed the same trend in luxury yachts: "They all look alike. Luxury yachts are typically very sleek, but closed off from the outside." In other words, owners are concerned about appearance, but even more protective of their privacy.

The new generation of superyacht owners have other expectations, Hareide says: "Open is good now. The next generation is less introverted. They are used to sharing their lives through social media, and they want their lifestyles to be seen. And they want their surroundings to be brought into their inside space. If you are cruising in the Bahamas, why close that experience out?"

Hareide's latest yacht design takes this philosophy to heart, opening up life on board through floor-to-ceiling glass walls and open, multi-use spaces that call to mind parks and viewpoints more than ships' decks or staterooms. "Owners are seeking >

An elevated dining and viewing area, a tranquil garden surrounding a 20 m pool and a seamless transition to the water at the stern are contributing a completely new and exciting experience on board.

Photos: Hareide Design



The innovative explorer yacht *Caroline* will be able to run full ship operations on LNG for several days.

> new solutions. That means the industry has to be open for design ideas that challenge traditions."

New ways of working

"If we are going to produce new ideas, we have to work in new ways," Hareide says, noting that industrial design is the spider on the web: "We have to satisfy all needs and requirements in a 360-degree perspective. Once the discussion is going, that's when the hard work starts. Our job is to defend what is unique in order to generate enthusiasm."

The new explorer yacht *Caroline*, that Hareide is designing for Norwegian Yacht Voyages, is a good example of openness in both the design process and the design itself. "The brand has been through many phases. The design has evolved from fairly traditional to something dramatic the world has never seen."

The process has been equally groundbreaking: "Secrecy and non-disclosure might work for well-established players, but we strongly believe in creating a transparent brand." Real-time remote collaboration allows Hareide and colleague Ulf Wynnesdale to put together "the ultimate design team," and to invite partners and future guests to share their thoughts and comments throughout the process. "By gathering input from all sides, we are able to create a brand that will offer exactly what the market wants."

The new ways of working may be more effective and allow for more creative input, but Hareide is clear on the need to control quality: "We want open input, but we still have to have control. You can't allow too many chefs in the kitchen!"

Designing the answer

Though cruise may be growing, it still holds negative associations for some, with an elderly customer base as one of the most common conceptions, although it already offers a wide range of facilities and experiences for different target groups. "There are still enough people who think of cruises as boring and posing an image problem." Design can change this impression, says Hareide. "The future of cruise will be all about the experience. New generations want to learn and explore, to experience things first hand, and open design will be the key to delivering on these expectations."

> "Early collaboration helps everyone identify the factors necessary to bring a new design to market."
>
> **Helge Hermundsgård**
> Business Development Manager at DNV GL

Hareide believes this lesson applies across all cruise segments, including the emerging Chinese cruise market. The Chinese middle class is also hungry for new experiences, he notes, and creative design can help satisfy that need.

"Design gives a feeling of personal ownership, a kind of modern exclusivity, unique but accessible, and customized to each user. But of course we still have to comply with basic rules, so good collaboration with the class societies is as important as good communication with the end user."

DNV GL is fully committed to its role in forming the future of cruise: "Designers from outside the traditional maritime world are making the cruise product more attractive for passengers, drawing on their inspiration and experience from other industries. Our job is to enable them to help owners and naval architects shape the cruise ships of the future," says Hermundsgård.

Einar Hareide is convinced that new impulses in cruise design will come from unconventional sources: "Hotel, entertainment, automobile, anything where the appeal hinges on the experience." Design can itself be part of that experience, he believes, while enhancing the impact of the surrounding environment. "Either way, it will be more and more important for travellers to return home with memorable experiences, to feel that they have learned something on their journey." **KG**

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Photos: DNV GL, Hareide Design

THE NEW SAGA

Having ordered its first newbuilds, Saga Cruises takes a highly individual approach to designing and building the vessels it wants and its guests deserve.

When, in 2015, Saga Cruises ordered its first newbuild from the renowned German yard Meyer Werft, this marked the beginning of a new era for the British passenger ship operator which has been in the cruise business since 1997. The first ship, *Spirit of Discovery*, is due to take her inaugural cruise in July next year, while her sister ship, *Spirit of Adventure* is expected to be ready for the summer 2020 season.

"Our two *Spirits* embody everything we've learned in the cruising business," says David Pickett, New Build Director, who heads up a team tasked with meeting the design demands of the new 236-metre-long, 31-metre-wide vessels. Several members of his team are currently based at the site office in Papenburg, working closely with project managers from the yard as well as partners from DNV GL. The first steel was cut as this article went into print.

Since establishing a site team presence in Papenburg, Saga were able to familiarize themselves with the yard's procedures and processes as well as its quality management and assurance system. Meyer Werft and Saga jointly customized the approach they wanted to take in this project. The yard was remarkably receptive to the suggestions of the Saga team, says Pickett.

SPECIFICATIONS *SPIRIT OF DISCOVERY & SPIRIT OF ADVENTURE*

- Length: 236 metres
- Breadth: 31 metres
- Tonnage: 58,250 GT
- Passenger capacity: ≥1,000
- Delivery: 2019 (*Spirit of Discovery*), 2020 (*Spirit of Adventure*)
- Shipyard: Meyer Werft

The yard is well organized and strict on time management, which calls for a special sort of collaboration. DNV GL personnel are based on site to provide more agile response, which is essential for projects involving complex vessels where small changes in one system can have a cascade of effects on others. "Rapid liaison is critical to avoid holding up production. Being a small team is an advantage as we can move quickly and cohesively," comments Pickett.

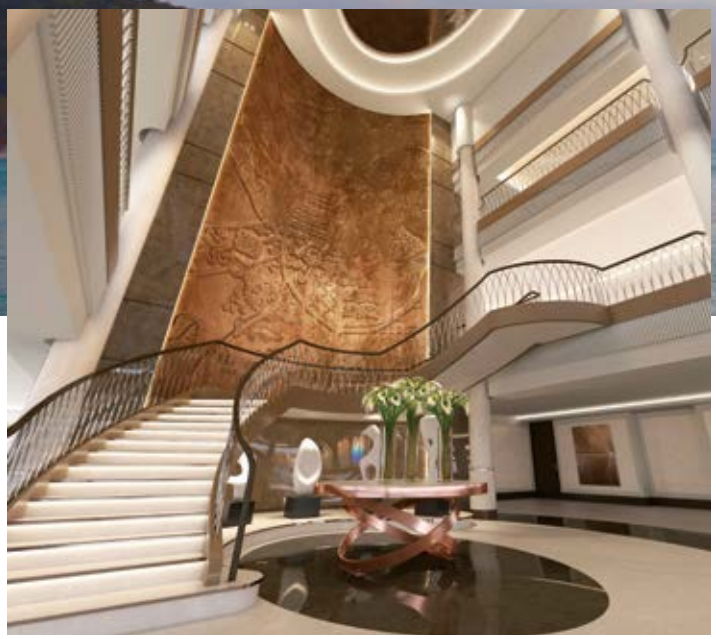
Energy efficiency

The Saga team and their counterparts from Meyer Werft have spent the two-year lead time before production commences putting their heads together to devise a range of energy-saving measures, which together are expected to reduce fuel consumption by around 8.5 per cent, compared to the initial design. "We've achieved significant reductions in hotel design load. HVAC is a major consumer on any passenger ship. Multi-stage chillers – with a larger number of smaller compressor units than conventional designs – enable finer and more energy-efficient climate control," explains Pickett.

Overall, the guiding principle was to exploit naturally occurring energy flows >

Saga Cruises' *Spirit of Discovery* is currently under construction at Meyer Werft shipyard and will be delivered in 2019.

Photo: Saga Cruises



A generous, contemporary style combined with a certain sense of tradition was chosen by the owner for the interior of two new Saga ships, which cater primarily to a senior, affluent market. They also offer a wide range of dining, entertainment and recreational choices.

> to reduce complexity and power expenditure. Some of the improvements are less visible. For instance, CO_2 was chosen as a refrigerant as it is ozone-neutral. "We cannot build a zero-emission cruise ship but we did what we could to reduce our energy footprint and mitigate the environmental impact of the vessels," notes Pickett.

Saga invested 600,000 euros in technical modifications which are expected to yield annual savings of about 800,000 euros. Since the operator ordered two identical ships, which allow for uniquely accurate benchmarking and performance monitoring, the company will be able to keep a close check on this.

New build, new decisions

Before ordering the two new *Spirits*, Saga bought and operated existing tonnage. After each acquisition, the priority was to refurbish the vessel's existing spaces and modify systems already in place to maximum effect. Newbuilds, however, require an entirely different mindset. "Even with a basic specification in place, there were lots of decisions we had never made before, especially on the hotel side. Everything from basic parameters such as cabin size and space per passenger in public spaces, to the signature features, which are what really sells the ship." Some decisions were easier than others. Fitting a tiered theatre capable of recreating the atmosphere of a show in London's West End brings an immediate uplift to the entertainment programme. The new vessels also provide more dining options and recreational choices, from fully equipped gyms to dedicated card rooms.

Working from a blank slate gave Saga an opportunity to take its experience of what works well on its current ships and articulate it more efficiently, and to update the architectural design with a fresh, contemporary accent that still retains a sense of tradition. "Because they're our first newbuilds, we are not encumbered by a template. We have the freedom to improve what we like, and discard what we don't," elaborates Pickett.

Demographics and ergonomics

Saga tends to cater to a senior, more affluent target market, but Pickett is adamant these aren't ships for "an older generation". "The baby boomer generation is moving into our sights and their tastes haven't changed just because they've reached a particular birthday. People are living longer but they're also staying fit and active longer."

"The presence of DNV GL as an independent arbiter who can draw informed, objective conclusions is invaluable."

David Pickett, New Build Director, Saga Cruises

Nevertheless close attention was paid to small details that would make life easier, such as minimizing change of levels and ensuring high-contrast lighting and colour schemes. "The focus was to remove obstacles in the functional parts of the ship that our guests use every day," explains Pickett. "This improves usability for everyone."

Passenger feedback

In fact, guests were engaged extensively in the design process. In addition to focus groups, a small party was invited to Papenburg to test-drive mockups of the cabins, evaluating everything from the accessibility of the storage and the comfort of the mattresses to the usability of the bathroom fittings.

"The feedback was painful at times," admits Pickett. "We had to rework certain aspects from scratch. However, ultimately it was worthwhile, as it provided much richer input than interviews alone and validated design elements critical to passenger experience."

Some passengers expressed concern about the increased vessel size. Saga's existing ships typically have 750 berths, while the newbuilds, weighing in at 58,000 gt, can accommodate just under 1,000. "We understand some guests feel more comfortable on a smaller ship," Pickett responds. "But a larger platform allows for more dining and entertainment options. We believe the new vessels strike that balance between large-ship efficiency and small-ship intimacy." Despite their larger size, Saga will maintain its 2:1 passenger-to-crew ratio, a policy which Pickett believes is vital to delivering the high-quality service and friendly atmosphere passengers expect.

Class society expectations

Commenting on the role of DNV GL, Pickett states: "Their independence is key, without a sliver of doubt. As a new owner working with a shipyard for the first time, teething problems are inevitable. The presence of DNV GL as an independent arbiter who can draw informed, objective conclusions is invaluable."

An ability to understand the bigger picture – both the direction and implications of regulatory changes and technological advances – was also welcome. "Creativity and curiosity are attributes that are often overlooked. It is stimulating to work with a partner that understands the envelope yet is willing to push the boundaries, as opposed to focusing solely on the compliance aspects of a project." **KT**

Photos: DNV GL, Saga Cruises

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The two sister vessels will each feature a tiered theatre similar to those in London's West End, as well as luxurious swimming pools.

EXPLORING AUTOMATION

While nobody would ever consider letting a cruise ship operate without a bridge crew, autonomous shipping technology offers great enhancement potential for aspects such as navigation support, equipment monitoring and safety improvements.

"We began working on autonomy in 2014," says Bjørn-Johan Vartdal, Head of DNV GL's Maritime Research Group. "At that time there was no interest in the subject matter from the industry side. But that has changed dramatically within these four years." This remarkable shift of focus will potentially impact not only the way ships are operated but also the work of DNV GL as a classification society – and safety on board.

Towards the thinking ship

Digital technology and big data are revolutionizing the world around us, from aviation to driverless cars and smart homes. When equipment monitoring sensors transmit their readings to a computer application for evaluation, action can be initiated as soon as an issue is detected. Cameras can let a ship "see" its environment, and the associated software can "learn" to recognize obstacles, weather and sea conditions, and make appropriate decisions or present crucial information to the bridge for decision support.

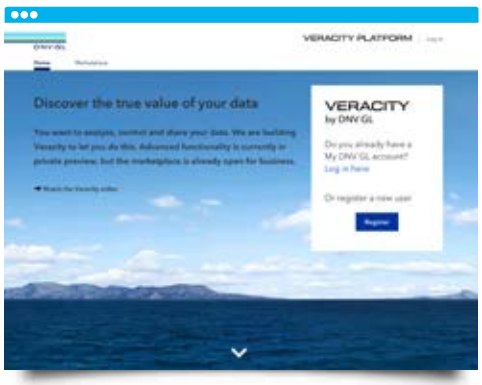
Situation awareness has been the subject of comprehensive research at DNV GL. While most of the staff on board a cruise ship is indispensable and cannot be replaced by digital technology, autonomous systems can enable a host of applications that reduce human effort, improve operational efficiency, and help avoid incidents caused by human error. "There are countless functions and processes on a cruise ship that lend themselves to automation or remote controlling," Vartdal points out. "Consolidated ship and environmental data deliver key insights to the bridge even today. There is a direct evolutionary line from navigational decision support to so-called driver assistance systems that essentially take over navigation with the captain just overseeing the process. That is a vision we want to make a reality."

Protecting passengers

An area where sensor-based digital systems can truly make a difference is safety. "Many shipping incidents are related to the crew being inattentive," says Vartdal. "Automated systems raise the crew's awareness and help avoid accidents when a critical situation is detected. These technologies are especially important for cruise ships because of the many human

An ocean of opportunities: digitalization is paving the way towards safer, smarter and greener ship operation.

Photo: DNV GL, Mariusz Blach/Vjom - stock.adobe.com



DNV GL's open industry platform Veracity enables secure and easy sharing of data, includes a developer community and provides access to all digital services of DNV GL.

Register now at www.veracity.com

lives on board. They can prevent the officer of the deck from falling asleep, or recognize when another ship is on the radar that might cause a collision, and alert the crew, change the course, contact the other vessel, etc." To qualify for real-life use, such systems need to be "taught" using large amounts of data from ship operators. "We encourage system developers and shipping companies to cooperate to build up this database," says Vartdal. "Basic situation awareness systems could be ready for deployment in three to five years." DNV GL supports these pioneering initiatives and is involved in various trials, he adds.

Class ensures system reliability

In fact, DNV GL is prioritizing the decision support and driver assistance topics in the development of class rules. "We hope to have some rules ready by the end of this year," says Vartdal. "Our job is to make sure these devices are safe. Our requirements will define what constitutes adequate awareness, and what specific conditions ships must meet. We work very closely with system manufacturers. It is crucial that we deeply understand the limitations of these systems."

"Automated systems raise the crew's awareness and help avoid accidents when a critical situation is detected."

Bjørn-Johan Vartdal
Head of Maritime Research Group

Class and shipowners can benefit from "autonomous" technology in other ways as well: "Several of our projects focus on what we call 'sensor-based class," describes Vartdal. "Comprehensive condition monitoring can deliver a more qualified view of an entire ship's state. We want to build classification services that use this information to identify risk areas on board and focus surveys on these issues, rather than just performing the traditional scheduled survey that only gives us a snapshot of the vessel's condition at one point in time."

One of those projects is specifically geared towards cruise ships. "Together with Kongsberg and RCL, we are exploring an approach we call dynamic barrier management," says Vartdal. While conventional barrier management periodically inspects barriers designed to prevent damaging events or limit their consequences, this approach uses sensor information to determine the condition of the barriers continuously in real time, and determine whether they need to be inspected or repaired. "This approach will enable a needs- and risk-based survey regime that achieves better results in less time," says Vartdal. "It will improve safety by identifying potential hazards in a continuous process."

As a stepping stone towards this real-time monitoring environment, DNV GL has created its open platform Veracity, an online exchange hub providing access to all digital services – including third-party services – and applications as well as shared data, all in a controlled, secure environment. In another project, DNV GL and several industry partners are developing an open simulation platform for the maritime industry that facilitates the creation of "digital twins" of vessels by combining all the individual component simulation models into a comprehensive virtualisation of the entire ship. "A digital twin is a great tool for optimizing hull forms, power systems, vibration performance and fuel efficiency of a cruise ship before it is built," describes Vartdal. Furthermore it can help class handle system complexity or be used for diagnostics and investigating the causes of incidents. "The digital twin integrates all the knowledge inherent in a ship. It can streamline ship design, cut the operating costs and enable safer ship operation." **AK**

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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 the Veracity marketplace. 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, DNV GL customers can now 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 Smart Survey Booking tool in October 2017, we have also started using intelligent software agents to help customers find the best time and place to book a survey," adds Ørbeck-Nilssen (see info box – Smart 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 250,000 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.

ELECTRONIC CERTIFICATES

Started in October 2017, DNV GL introduced electronic certificates for the class and statutory regimes. In the first four month since the launch over 50,000 certificates on more than 6,000 vessels have been issued. Vessels issued with electronic certificates have successfully been through close to 1,000 port state inspections worldwide. Accessible from anywhere in the world, electronic certificates bring many advantages to both DNV GL and its customers. The port state process is made more efficient, by enabling owners to use a secure electronic certificate folder to grant temporary access to authorities through our fleet status portal. 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 Fleet Status in Veracity provides a comprehensive overview of key ship data that cannot get lost and is just a few clicks away. Electronic certificates are rolled out gradually and are being 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

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 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 >

SMART SURVEY BOOKING

The Smart Survey Booking 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 by choosing different ports in the tool.
- Once the date is set, the tool attaches relevant survey preparation notes to the booking confirmation to help the operator prepare for the inspection.

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

PSC PLANNER

The Port State Control (PSC) Planner is 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.

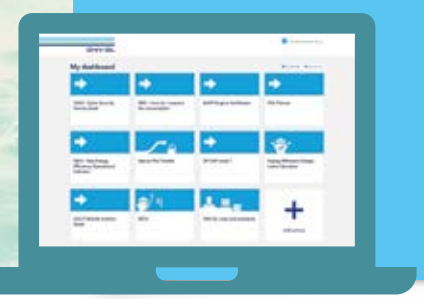
Find out more at:
www.dnvgl.com/maritime/mydnvgl-service-overview/psc-planner.html

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." **AJO**

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. On average, DATE was used 2,300 times per month in 2017, 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 more than 250,000 requests already and has direct access to more than 1,000,000 drawings and over 15 years of survey findings and is learning continually. In the future, it could even answer simple questions on its own.



VERACITY

The Veracity industry data platform is designed to help companies improve data quality and manage the ownership, security, sharing and use of data. Veracitiy consists of three parts: data containers, secure keys for sharing data, and a marketplace for digital services, data and analytics.

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.

Photos: DNV GL, Devrimb-Thinkstock, zinkevych - Fotolia

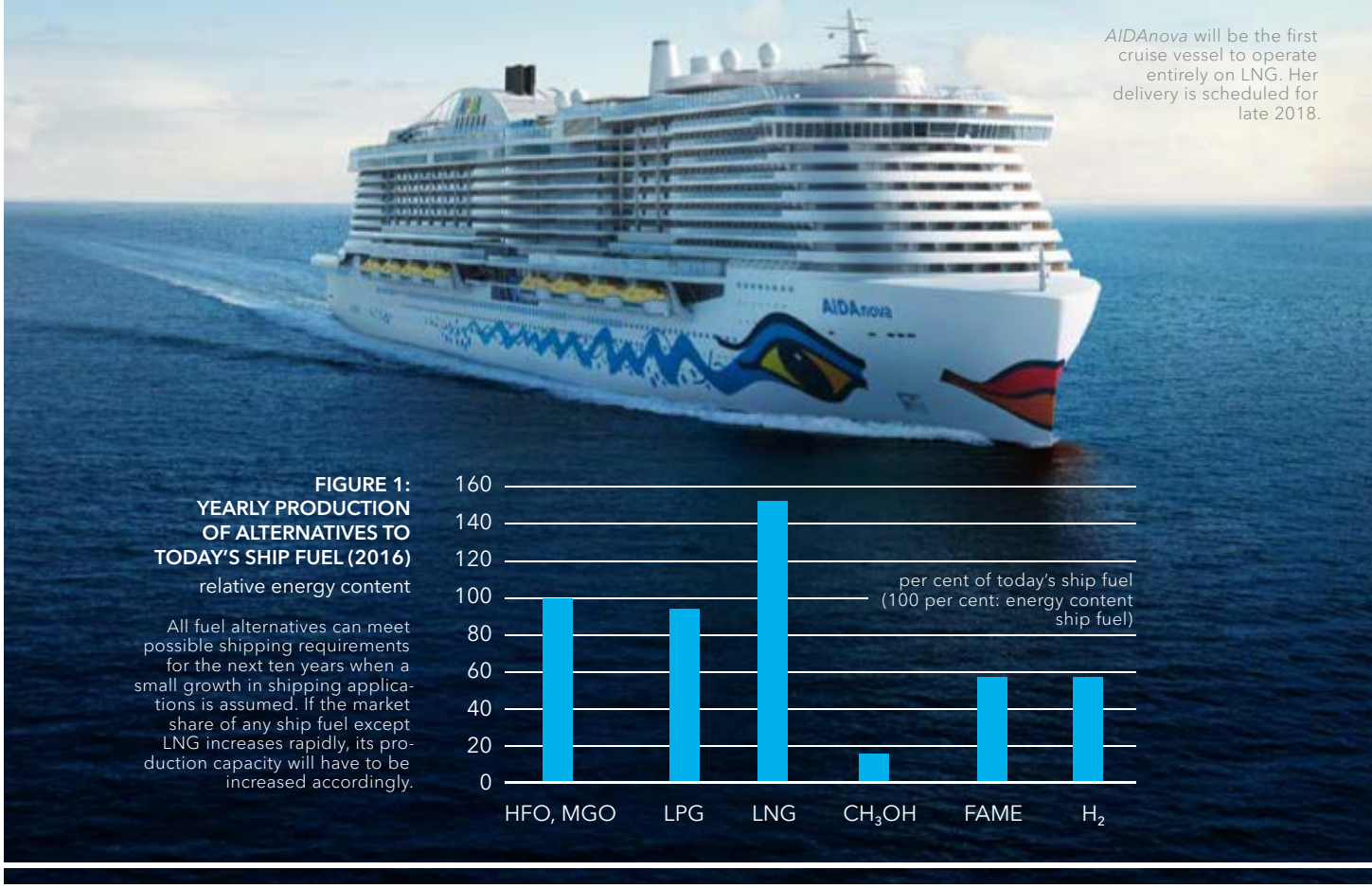
AN OUTLOOK ON THE ENERGY FUTURE

While stationary alternative energy sources for land use are no longer a cause for concern, ships must carry their energy along while adhering to the new, stringent emission limits. CRUISE UPDATE looks at the viability of various alternative fuel options.

Amid the international environmental and climate-protection efforts, an impressive number of emission restrictions for ship fuels have come into force recently or will do so within the next few years. They are driving the search for low-emission alternatives to oil-based fuels. Facing the 0.5 per cent global fuel cap expected to take effect on 1 January 2020, the upcoming NO_x limits, and increasing pressure to reduce the CO_2 footprint, the shipping industry has no choice but to accept that sooner or later fossil fuels will be a matter of the past. A wide range of options are being discussed, and technologies such as fuel cell or combined gas and steam (COGES) systems in combination with cleaner ship fuels have appeared on the agenda.

As the cruise industry already had to find out, many years can pass between the technical maturity of an innovative technology – such as LNG – until it is ready to be embraced by the industry, which needs clarity on the regulatory front, an appropriate infrastructure, and some degree of cost predictability.

The enthusiasm felt at the time of the first pioneering LNG projects, such as the GASPAX concept for an LNG-fuelled cruise ship presented by Meyer Werft, MAN Diesel & Turbo and DNV GL in 2010, was temporarily dampened by the shipping crisis resulting from the global recession in 2008/2009, and the oil price collapse in 2014/2015. It took five more years since the GASPAX launch until the Marine Safety Committee (MSC) of the IMO adopted the "International Code of Safety for Ships Using >



AIDAnova will be the first cruise vessel to operate entirely on LNG. Her delivery is scheduled for late 2018.

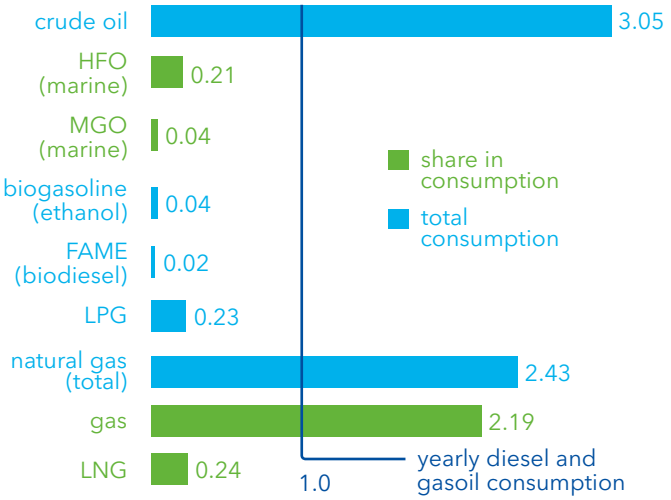
FIGURE 1: YEARLY PRODUCTION OF ALTERNATIVES TO TODAY'S SHIP FUEL (2016)
relative energy content

All fuel alternatives can meet possible shipping requirements for the next ten years when a small growth in shipping applications is assumed. If the market share of any ship fuel except LNG increases rapidly, its production capacity will have to be increased accordingly.

Photo: AIDA Cruises

FIGURE 2: YEARLY ENERGY CONSUMPTION IN RELATION TO DIESEL AND GASOIL CONSUMPTION

Figures represent 2016 statistics.



> Gases or Other Low-Flashpoint Fuels", known as the IGF Code. The first LNG-fuelled cruise ships were ordered only four days later. But with the sulphur cap nearing, LNG is now making inroads as a fuel for international merchant and cruise ships. 120 LNG-powered ships of all types are in operation today, and about 126 more are on order, including 24 LNG-ready cruise ships. According to the DNV GL overview of LNG-fuelled ships (excluding large LNG carriers), roughly 180 ships will be running on LNG by the end of 2018 (an updated list is available within the free version of our LNG intelligence portal LNGi at **dnvgl.com/lngi**). But is LNG the only alternative to today's oil-based ships?

The fuel challenge in shipping

The sulphur cap is clearly a game changer and has shipowners, operators and shipbuilders wondering which way to go. As shown in the diagram (fig. 2), the combined consumption of HFO and MGO accounts for roughly 25 per cent of the diesel and petrol production (2016). This is equivalent to the energy consumption when burning LNG (24 per cent). However, LNG represents only a small proportion (ca. 10 per cent) of the total gas market today, and could be supplied in much larger quantities if required.

Once the IMO sulphur cap is in force, up to 48 million tonnes of fuel with a sulphur content of 0.1 per cent or less will be needed annually. Most of the fuel consumed (70 to 88 per cent) will have a low sulphur content of 0.1 to 0.5 per cent and may take the role of the high-sulphur fuel used today. Assuming an installed base of roughly 4,000 scrubber systems by 2020, no more than eleven per cent of the fuel consumed globally will be high-sulphur fuel. This raises the question whether it will even be feasible to continue producing it, and if so, what HFO will cost under these circumstances.

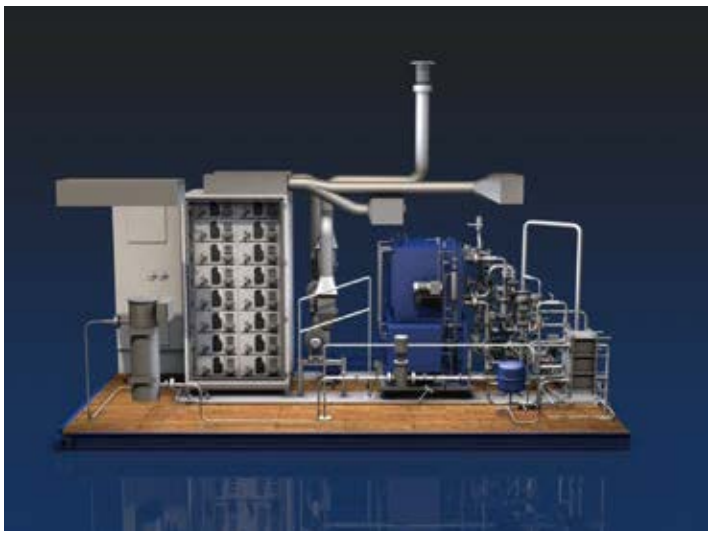
These are the practical challenges resulting from sulphur reduction. At the same time the accelerating worldwide trend towards restricting NO_x and particle emissions is reason enough to intensify the search for fuels and technologies that can help meet the challenges ahead.

Feasible options

Among the alternative or transitional ship fuels being discussed, DNV GL has identified LNG, LPG, methanol, biofuels and hydrogen as the most promising options. New technologies with reasonable potential for ship application include battery systems, fuel cell systems and wind-assisted propulsion. As DNV GL's PERFECt ship concept study has demonstrated, the well-known combined-cycle gas and steam turbine technology might be a viable solution for ships in the power range above 30 megawatts once low-sulphur fuels are widely in use.

The biggest hurdles for other alternative ship fuels and propulsion technologies are unrelated to availability: whatever it takes to

Kleven yard is building two hybrid expedition vessels, classed DNV GL, for Hurtigruten which will use battery technology for peak shaving or temporary fully electric operation.



Fuel cells are very clean. While hardly an option for the massive power needs of large cruise ships, they can play a key role in hybrid systems.

Current refinery production capacities (pictured: Antwerp oil port) will have to be expanded to supply adequate quantities of most alternative fuels.

apply current engine and gas turbine technology in conjunction with the low-emission fuels named above is readily available or can be developed without substantial effort. Fuel cell technology in combination with various fuels can achieve efficiencies equal to or better than those of current propulsion systems. However, fuel cell applications for ships are still in their infancy. The most advanced developments are those related to the DNV GL-supported e4ships lighthouse project in Germany, with Meyer Werft and Thyssen Krupp Marine Systems leading the initiatives for seagoing vessels. Wind-assisted propulsion likewise has a certain potential to reduce fuel consumption, especially on slow ships, but the business case remains challenging.

Batteries used for energy storage, while not a primary energy source, have major potential for ships running on short distances, or as supplementary energy sources on board any ship if used to increase the efficiency of the propulsion system. In deep-sea shipping, batteries cannot conceivably substitute "real" fuel.

Photos: DNV GL, e4ships, Hurtigruten, @Sebastian - stock.adobe.com

Where to go from here

The primary challenges associated with alternative fuels in shipping result from environmental considerations, availability of sufficient fuel quantities, fuel costs, and the rules of the IGF Code.

Environmental and price challenges continue to drive the interest in alternative ship fuels, but the number of realistic candidates remains small. After LNG has overcome the hurdles of international legislation, methanol and biofuels will follow suit very soon; the development of rules for LPG and hydrogen within the scope of the IMO IGF Code will take considerably longer. Yet, the foreseeable volume requirements for shipping could in principle be met by all fuel alternatives mentioned above over the coming years. But a major rise in demand would without doubt require massive investments in production capacity, except LNG, which can also be available in higher quantities than the currently forecasted demand (comp. Fig. 1 for production capacities. Note that LNG includes increase in production until 2020).

Without government action in the form of tax breaks or subsidies, renewable fuels will find it difficult to compete with the prices of conventional fossil fuels. LNG and LPG are the only fossil fuels capable of achieving a reasonable CO_2 reduction. "CO_2-free" shipping seems possible only with fuels produced from regenerative sources. If the shipping sector resorts to synthetic fuels produced from hydrogen and CO_2 using regenerative energy, the available alternatives will be liquefied methane (which is very similar to LNG) and diesel-like fuels. ■ **GW**

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READY TO FACE THE EXTREMES

Whether Arctic, Antarctic or Amazon, today's expedition cruise ships take their passengers to the most remote natural wonders. Hapag-Lloyd Cruises is one of the sector's major players. Head of New Builds Henning Brauer speaks about challenges to overcome when constructing these vessels, and the plans for the future.

On a grey Friday afternoon, Dr Henning Brauer is sitting in his office in Hamburg's iconic Berliner Bogen office complex. The rain is relentlessly hammering the windows. The Arctic and its natural wonders is far away. Yet it is here, on the desk of the Head of New Builds, that the plans for the next-generation ships of Hapag-Lloyd Cruises are slowly taking shape – in drawings, software applications and in Brauer's head.

The shipbuilding engineer joined the company eight years ago, initially working with the *Europa 2* project team. Today he heads a team of five, overseeing the complex design process for

Dr Henning Brauer is Head of New Builds at Hapag-Lloyd Cruises.

Hapag-Lloyd Cruises' two future expedition cruise ships *HANSEATIC nature* and *HANSEATIC inspiration*. "This contract is a real challenge," says Brauer, his eyes shining with excitement. "These vessels not only have to be comfortable, economical and efficient; they must satisfy the most stringent environmental requirements as well," the 39-year-old shipbuilder points out. Their destinations will be the highly regulated Arctic, Antarctic and Amazon regions. "It is the desire to experience nature that makes customers book with us," says Brauer. Expedition cruises have never been more popular among passengers: "All the numbers tell us that these vessels will be very well occupied. We are already receiving some enquiries for these newbuilds," reports Karl J. Pojer, President and CEO of Hapag-Lloyd Cruises.

Expedition pioneers

But future passengers must still be patient and wait until the two vessels will finally launch. The expedition ships are under construction at Vard shipyard. Earlier this year the keels were laid down and steel cutting began; *HANSEATIC nature* is scheduled to be christened and take her maiden voyage in April 2019. *HANSEATIC inspiration* is to follow her six months later.

What is unusual about this project: Vard have been experts in building offshore and fishing vessels but the Hapag-Lloyd Cruises contract is the yard's first engagement in the cruise ship segment. This situation is not unlike the order placed by Hurtigruten with Kleven Verft: The Scandinavian cruise ship owner is having as many as four new expedition ships built at the yard which has so far been focused on supply and other specialized vessels.

"A small ship is no less complex than a big one. However, an expedition vessel is clearly more demanding than a conventional cruise ship," Brauer points out. "Vard have been able to convince us of their high quality standards." The Norwegian yard had >

Photos: Hapag-Lloyd Cruises

Both newbuilds will be launched in 2019 and will travel to the most exotic destinations.

In June 2017 the keel laying of *HANSEATIC nature* took place at Vard shipyard.

> plenty of experience building smaller vessels as well as ice-class ships, he adds.

Close cooperation

Apart from making the best of the limited space available on board, implementing the new Polar Code is probably the most challenging aspect in designing the vessels. "The tightened regulations ensure a higher level of safety – while at the same time making the ship roughly 200 tonnes heavier, costing plenty of precious space and raising the costs. All these are factors we have to compensate for by enhancing efficiency in other places," Brauer explains. Hapag-Lloyd Cruises and Vard are handling this together. "We are honoured to have been chosen by Hapag-Lloyd Cruises for this project," says Roy Reite, President and CEO of Vard. "A leading player like Hapag-Lloyd Cruises placing their trust in Vard's capabilities to develop these unique, high-end vessels shows the recognition we have quickly earned in this segment of the specialty shipbuilding market."

DNV GL is providing specific assistance to the owner and the yard: "For example, our Maritime Advisory services help owners quickly determine the Polar Code's requirements relevant to their vessels, assess how close they are to compliance, and develop an action plan," says Steven Sawhill, Discipline Leader, Cold Climate Advisory Services at DNV GL – Maritime.

Since increased fuel consumption will play a key role for the new ships, which will be built to a higher ice class, DNV GL has optimized the interplay between the hull form, the initial general arrangement and the stability requirements. This will lead to a reduced fuel bill of up to ten per cent.

The experts of DNV GL, Vard and Hapag-Lloyd Cruises had investigated more than 100,000 different hull shapes during the development stage. "We were very pleased to have been able to exceed Hapag-Lloyd Cruises' expectations and offer an optimization solution that demonstrates that efficiency and sustainability go hand in hand," says Knut Ørbeck-Nilssen, CEO DNV GL – Maritime.

> "These vessels not only have to be comfortable, economical and efficient; they must satisfy the most stringent environmental requirements as well."
>
> **Dr Henning Brauer**, Head of New Builds at Hapag-Lloyd Cruises

Sensitive sea regions

The glass walls of Brauer's first-floor office are covered with engineering drawings: cross sections, detail representations, deck floor plans. "The challenge in shipbuilding is in the details," says Brauer, looking at the drawings. "From wiring and colours through to every individual piece of steel, everything must be perfectly matched." Which makes the designer's work incredibly complex. Not to forget the tight environmental regulations. "We will be navigating in sensitive sea regions. No wonder the demands are extreme," the ship expert adds. To meet the new regulatory requirements, the ships must be built 15 to 20 per cent larger per passenger than 30 years ago, Brauer estimates. Not only are they more complex to design and build; their operational systems are much more sophisticated as well: a selective catalytic reduction system filters out 95 per cent of noxious emissions; a Promas rudder with a custom-designed propeller cuts fuel consumption;

Hapag-Lloyd Cruises' President and CEO Karl J. Pojer (l.) and Tudorel Topa, Senior Vice President of Vard, celebrated *HANSEATIC inspiration*'s steel cutting in October 2017.

and state-of-the-art "E-Zodiacs" feature electric propulsion. And when it comes to waste disposal and wastewater-treatment, the owner naturally favours sustainable technologies as well.

"In building these ships we make sure we are always on the safe side by going beyond what the regulations require," Brauer says. After all, the longest trip without shore excursions is 32 days. "If anything goes wrong, we will be on our own. There will be nothing but ice for thousands of miles."

The regions beyond the 60th parallel are definitely considered to require the highest navigational skills. But with highly qualified crews, advanced technology and smart ship design, Hapag-Lloyd Cruises can count itself among the top players. "We have been active in this segment since the early 1990s and are in fact one of its pioneers. Our extensive experience is a clear competitive advantage," says Brauer. Reason enough for the industry to watch the development carefully.

With its advanced newbuilds *HANSEATIC nature* and *HANSEATIC inspiration*, Hapag-Lloyd Cruises is once again raising the bar, combining its expertise from two segments: expedition and luxury cruises. **NIS/SJ**

Photos: Hapag-Lloyd Cruises

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THE NEW POLAR CODE

The Polar Code went into effect on 1 January 2017, imposing new rules on ships navigating Arctic and Antarctic waters. The code defines how these vessels must be designed, crewed and prepared.

For example, improved damage stability and fuel tank protection are required of ships with polar ice class. "The Polar Code's provisions help ensure shipowners and operators understand the capabilities and limitations of their vessels for operating in polar environments. This reduces the likelihood of mistakes and poor judgement, thus increasing safety and improving protection of the polar environment. The code also gives owners and operators a structure for conducting relevant operational risk assessments," says Steven Sawhill, Discipline Leader, Cold Climate Advisory Services at DNV GL – Maritime.

The stricter regulation was passed by the IMO to ensure both the safety of life at sea and to protect the sensitive environment in the Arctic and Antarctic, while the commercial shipping activity in these regions is increasing. DNV GL contributed to the code: "The Polar Code adopted some of the functional goals we developed and implemented in our winterization notation," says Sawhill.

WE DON'T COMPETE ON SAFETY

Nothing is more important on board a cruise ship than safeguarding the lives of the people and arriving at the destination without a safety incident. Proactive thinking, advanced technology, a reliable flow of information and close cooperation across the industry are key success factors.

Being in charge of all safety-related management systems of the world's second-largest cruise line operator is not an easy task. You need an eye for the big picture as much as for the details that complicate daily life; you need a well-defined organizational structure to support the full range of activities from drafting procedures and training staff to performing audits and interacting effectively with your partners and stakeholders across the industry; and you need a deep understanding of the most important factor in the safety equation: people.

Tracy Murrell, VP Maritime Safety, DPA at Royal Caribbean Cruises (RCL), has a leitmotif: the human factor. "Our highest priority is recruiting the right people, giving them proper training, the right tools, the right competency and the right procedures. We aim to engineer-out the human interaction so that the crew can monitor and intervene as necessary; we want to free them up to have better situational awareness."

Typical human behaviour patterns are complacency and normalizing deviance, says the safety expert. This goes for both the people on board and on shore: "In the end we are all part of an incident when it happens, and we all have to look at ourselves and ask: 'What role did we play in this, and what could we have done to prevent it?' We must take that inward look as a company rather than pointing the finger at the fleet."

Choosing purely technical remedies is the wrong approach, says Murrell: "We should look beyond the operator and scrutinize the systems they operate, the ergonomics, the workplace design, the functionality, the humans who programmed the systems, designed the layout of the bridge and engine control room, or potentially overloaded the watch stander with too much information for people to process. And we must continue developing our skills for managing complexity." Modern cognitive neuroscience can help, Murrell notes: "We need to better apply that to the design of systems, working together with system designers and putting the right procedures in place to mitigate risks."

The right approach to audits

Audits are an important means to keep track of the safety culture on board. "Our auditors are an incredible resource for us. It is through them that we get a feel for what is going on in the fleet," says Murrell. "We have changed our approach to internal audits: instead of just conducting an interview and inspection and writing up nonconformities and findings, our auditors now provide support and educate the crews where there might be a gap in knowledge or skill. This way we bring people along on our journey rather than just criticize – an approach that has been received well by the fleet."

As for external audits, says Captain John Chrysostom, Principal Lead Auditor at DNV GL, the time constraint is a limiting factor:

Tracy Murrell, VP Maritime Safety, DPA at Royal Caribbean Cruises, and Captain John Chrysostom, Principal Lead Auditor at DNV GL.

Helping the crew deal with complexity, such as in the engine room of *Allure of the Seas*, is key to successful safety management.

Photos: Royal Caribbean International

"The audit focus areas are chosen after discussions with the various brand presidents, prior to the office audits. Since we audit more than 100 seafarers, we have to restrict the number of focus areas to about two." An audit plan sent to the crew ahead of time specifies the planned activities for the audit so the crew can prepare for it: "Ultimately it is all about increasing awareness on board." To that end, suggests Tracy Murrell, it would be great to be able to make key insights transparent for the entire fleet at all times. "Information drives behaviour. Everybody should see the existing challenges at all times so they can shift focus accordingly." A concept that could be realized using modern communication technology. "Our current digitalization efforts aim to use more data-driven tools to guide our safety initiatives and enable transparent communication with the fleet, getting safety information out as quickly as possible so that action can be taken and awareness is heightened." Examples include safety training and information apps, videos, 3D graphics, and virtual reality, she adds.

Learning from past incidents is crucial to keep ships and people out of harm's way. By interpreting data from RCL's fleet-wide accident reporting system, the company can identify trends, understand behavioural patterns and derive proactive safety measures. But including information from the entire industry would multiply these benefits. "I would like to see much more cooperation among the industry members on safety – flag, class, the companies, even Port State Control," emphasizes Murrell.

As an industry we should never compete on safety, says John Chrysostom, adding: "We need to institutionalize our knowledge sharing." The airline industry's Aviation Safety Action Programme (ASAP) can serve as a model, Tracy Murrell points out: "We are already working with aviation companies to learn from them." What can get in the way is that "we don't always all speak the same language regarding what we are capturing," she notes. "Our industry needs to agree on a common language and common parameters for reporting this information, and modify its systems accordingly. Class could play an important role in this."

A partnership for safety

Aggregating and correlating data from company databases, audit, accident and near-miss reports, DNV GL's industry-wide data and other sources could guide the industry to the areas to focus on, says Tracy Murrell. "Everyone in the industry would benefit." DNV GL supports these efforts on many levels, redefining the way class and operators work together. The upgraded DNV GL ECO Insight fleet performance management platform, for example, allows data to be shared without compromising privacy interests.

DNV GL also offers an innovative approach to safety management system (SMS) certification featuring customer-specific Fit-for-purpose audits and combined certification packages for ISM, ISPS, MLC 2006, as well as ISO 9001, ISO 14001, OHSAS 18001, and ISO 50001. The Fit-for-purpose partnership improves the effectiveness of audits, surveys and inspections and reduces verification pressure and operation disruptions by utilizing synergies from overlapping requirements (refer to box).

"DNV GL wants the customers and their crews to grow," explains John Chrysostom. "When we, as auditors, leave the ship and can say we have raised the level of safety, environment protection and compliance, we have done our job." **AK**

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DNV GL – A NEW PARTNERSHIP APPROACH TO ENABLE DELIVERY ON MANAGEMENT SYSTEM POTENTIAL

With a new service delivery model DNV GL is seeking to support customers' efforts to tune their management systems to their full potential. The core purpose is to improve information gathering and analysis. Auditors, as the customers' partners, identify focus areas for audits according to the customer's needs and performance record. In a pre-DOC audit dialogue they discuss performance, challenges and global focus areas, then define the focus area(s) for the upcoming audits jointly with the customer.

The underlying assumption is that the holder of the Document of Compliance (DOC) is best placed to identify and handle its own management system needs. The role of DNV GL as a Recognized Organization (RO) is to assess the effectiveness of the safety management system towards achieving specified objectives, rather than just verifying conformity with requirements. The success of this new approach hinges upon the customer's willingness to commit adequate resources to the joint effort.

1

STYLE WITH CLASS

DNV GL and Fred. Olsen Cruise Lines combine centuries of experience to ensure a bright future for some of the most elegant cruise ships on the water.

Fred. Olsen is a family-owned business with strong maritime traditions. "Most of the family was baptized in salt water," jokes Fred. Olsen Jr., Chairman of Fred. Olsen Cruise Lines. His great-great-grandfather founded Fred. Olsen in 1848 in the tiny coastal town of Hvitsten, just down the fjord from Oslo.

"My family has always had a strong connection to DNV," Olsen Jr. says, "but we were very happy when the merger with Germanischer Lloyd was announced. We felt that the joining of two leading class societies with such long traditions gave the new company an even broader base."

If not for that reason alone, Fred. Olsen recently moved the last remaining two of their ships to DNV GL, completing the fleet portfolio. "We were very happy to be able to transfer the *Balmoral* and the *Braemar* to DNV GL. For us, running our business is a way of life, and DNV GL has proven that they will go the extra mile when we need them," Olsen confirms.

"We want to use DNV GL as a sparring partner to help us zero in on the right targets."

Fred. Olsen Jr., chairman of Fred. Olsen Cruise Lines

A tradition of innovation

Dedication to tradition is a Fred. Olsen trademark, but passion for innovation is what has driven the company forward since the beginning. "My grandfather was one of the first to use diesel engines, back in 1914," Olsen tells. "We have always been innovative and inventive, and we have tried many things, not all of them successful. But we always try to learn as much from our mistakes as our successes."

That willingness to adapt will come in handy in the coming years, as running a cruise business will require some nimble manoeuvring: "Like everyone, we are going to have to adjust to changes in emission regulations, and we are already looking for new fuel alternatives, such as LNG or hydrogen. We have to be willing to change with the times and the technologies."

In such times, it's good to have a trusted partner with a broad knowledge base to help explore new waters and plot a safe course. This is where Fred. Olsen Jr. has clear expectations of DNV GL.

"We need to have a good dialogue with our classification partner. We have to be able to solve problems and take on challenges together." Olsen's confidence in DNV GL is based on their deep technical knowledge and long experience, but just as much on their business savvy. "Our goals have to be ambitious enough, but not too ambitious. We want to use DNV GL as a sparring partner to help us zero-in on the right targets."

Above all, trust is critical to a solid partnership: "DNV GL has become even more solution-oriented in recent years. We can bring anything to the table and trust them to be professional and progressive," Olsen emphasizes. In all, the fourth Fred. Olsen seems comfortable with his company's commitment to DNV GL: "We have good and close cooperation now, and I expect more of the same in the future."

"B" for British

"Our brand has always been classic, and we have always had a connection to the UK market," Olsen relates. That relationship started with a liner service between Norway and Newcastle in 1906. "British passengers have a clear idea of what they want. They need to feel at home." Fred Olsen Jr. learned that lesson from tours aboard the *Black Watch*, perhaps the most classic of all

Starting with the *Bayard* in 1896, all Fred. Olsen ships have been given names starting with the letter "B". The names of the current cruise fleet also contain historical British references: **1. *Boudicca*:** named after the fierce 1st century British warrior queen. **2. *Black Watch*:** the 3rd Battalion of The Royal Regiment of Scotland, founded in 1881. **3. *Braemar*:** a village in Aberdeenshire, Scotland, site of the annual Highland Games Gathering. **4. *Balmoral*:** the storied castle that has served as the Royal Family's Scottish residence since 1852.

their venerable cruise vessels. "A lot of the secret lies in attention to detail," he confides. "Every little thing matters." That devotion to classic cruising, in the company and among their loyal passengers, demands a different approach from most cruise companies. Notably, they have historically favoured the more elegant design of older ships, purchasing used vessels and refurbishing them to the high standard that Fred. Olsen cruises are famous for. "We looked into commissioning a newbuild in 2006, but decided instead to lengthen two of our vessels. We were able to add capacity for 700 passengers, and still maintain our tradition of classic ships." By the same token, they have chosen to focus on more traditional offerings: "With us, the cruise itself is the attraction. We don't have go-cart tracks or climbing walls. The point is to enjoy life on the ship."

Nor is he sure that the newest trend, Arctic cruising, is for them – or their passengers. "For one thing, our guests tend to like warmer weather," he smiles. That's not to say they don't intend to become more adventurous, just in more hospitable climates.

Class never goes out of style

For their particular version of excursion cruising, Fred. Olsen is once again looking at newbuilding, this time a top-tier ship for around 600 passengers, with a focus on service and flexibility. While the new acquisition will certainly not go the theme park route, more activities will be offered from the ship, like RIB excursions. Fred. Olsen also offers what they call "mystery cruises", where not all destinations and activities are disclosed, and guests get to nominate their calls of choice. "It has proven to be very popular, but it only works with our more intimate format," Olsen says. "We couldn't be that flexible if we were sending 4,000 passengers ashore." While the typical Fred. Olsen cruise devotee may be getting on in years, Fred Jr. assures that new generations of classic cruise fans keep the order books full. "We were recently voted one of the top three most popular brands in the UK," he says. "The customized itineraries we offer appeal to anyone looking for a more personal experience."

And new offerings are always in the pipeline: "We are looking at river cruises, working from our strong customer base," he says. "We already use *Braemar* for combination ocean-river cruises, and we have hired a river cruise boat for two years to test the market."

Whatever future plans they have will include the same fastidious attention to detail, and tradition. "No matter where we sail, we will continue to offer the English experience, and we will keep our strong Norwegian reference intact." **KG**

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Photos: DNV GL, Fred. Olsen Cruise Lines

WASTE TO POWER

Large cruise ships generate substantial amounts waste per day – Norwegian manufacturer TECO TECH has developed a solution that could enable shipowners to turn this waste into energy at sea.

More than 27 million holidaymakers travel around the world on cruise ships each year, and considering with up to 9,000 people living on one ship alone, vessels need be equipped to dispose of large amounts of waste. Currently, operators do this through incineration or disposal on land, in accordance with the standards set by Marpol Annex V.

TECO TECH has developed a system that uses gasification as the means of waste disposal for heat recovery through proprietary sodium heat pipe economizers. To take their technology one step closer to implementation, the company has teamed up with DNV GL as well as Royal Caribbean Cruises (RCL), Carnival Corporation and Norwegian Cruise Line (NCL) to carry out a technology qualification project.

"Technology qualification is a DNV GL service where we carry out a comprehensive risk analysis that goes down to the component level in order to identify potential weaknesses in a newly developed system," explains Océane King, Head of Section, Advisory Americas at DNV GL – Maritime. "We are very fortunate to have representatives from three major cruise lines with us at our workshops. Their questions, feedback and operational experience provides valuable input to our discussions, and increased communication between stakeholders is the catalyst that brings new solutions to market. As waste-to-energy systems are already in wide use in land-based industries, DNV GL has put forward maritime and energy experts to create the final technology qualification plan," she adds.

Food, beverages and other goods: in ports rubbish is unloaded from the cruise ships, and new supplies are taken on board.

"As waste-to-energy systems are already in wide use in land-based industries, DNV GL has put forward maritime and energy experts to create the final technology qualification plan."

Océane King
Head of Section,
Advisory Americas

How it works

Disposing of solid waste through gasification, means converting it to usable synthesis gas, or syngas. It is the production of this syngas which makes gasification so different from incineration. In the gasification process, the municipal solid waste (MSW) is not a fuel but a feed stock for a high-temperature chemical conversion process. "Organic or fossil fuel-based carbonaceous materials are mainly converted into three components: carbon monoxide, hydrogen and carbon dioxide. This is achieved by reacting the material at high temperatures, without combustion. Instead, the system uses controlled amounts of oxygen and/or steam," explains Henrik Brixen, CEO of TECO TECH. The resulting gas mixture is called syngas (from synthesis gas) or producer gas and is itself a fuel. The power derived from gasification and combustion of the resultant gas is considered to be a source of renewable energy, if the gasified compounds were obtained from biomass.

Benefits and challenges

If the risks associated with the technology are addressed, the potential benefits are significant. "Looking at the different vessel segments, our gasification unit would offer the greatest benefits to the cruise industry. It would not only cut down their vessels' energy consumption, it could also generate large amount of syngas, which could be used to power other systems on board," says Henrik Brixen.

Adapting land-based technologies for operation at sea always follows a path of trial and error. "DNV GL's technology qualification was a great way for us to involve potential customers early on and help to reduce uncertainties. DNV GL brings competence from the maritime and the energy industry to the table, and with an approach to qualifying this new technology based on systematic analysis, testing, and verification, we are confident that this project will help us to demonstrate our solution's viability for the maritime world," he adds.

"For us at RCL, the workshops with other owners, TECO TECH and DNV GL have been very valuable in helping us better understand marine gasification technology with its benefits and potential challenges. The project is an important step towards potentially installing this kind of technology in the future," says Kimmo Heikkila, Director, Powerplant & Technical Systems, at RCL. ■ **MF/AJO**

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Workshop attendees, from left to right: Antoine Gurrey (NCL), Tobias King (DNV GL), Dag Sandal (DNV GL), Frans Lamers (DNV GL Energy), Tor Holm (Carnival), Sam Helenius (RCL), Kimmo Heikkila (RCL), Océane King (DNV GL), Øyvind Skåra (DNV GL), Henrik Brixen (TECO TECH).

Photos: Carnival Corporation, Damir Cvetojevic, DNV GL

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