

MARITIME IMPACT

ISSUE 02-16

THE MAGAZINE
FOR CUSTOMERS AND
BUSINESS PARTNERS

SMARTER OPERATIONS

MEET THE FUTURE

CYBERSECURITY

Identifying vulnerabilities before they can be exploited

CON-GREEN

Developing the next generation of feeder vessels

DIVING DEEP

Tailor-made submersibles take passengers up to 300 m below the surface



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Today's market needs smarter solutions - and a modern classification partner. Find out how our modern classification solutions can turn possibilities into opportunities - and make your operations safer, smarter and greener.

Learn more at dnvgl.com/maritime



Knut Ørbeck-Nilssen
CEO of DNV GL - Maritime

Welcome to Hamburg! Every two years, the SMM trade fair brings the maritime world to DNV GL's doorstep. Just a short way from our Maritime headquarters, the most important players in our industry are showing the best they have to offer.

SMM is billed as the industry's leading trade fair and one of the ways SMM demonstrates this is in the themes it chooses. This year the primary focus will be on digitalization - a topic that we have chosen as one of our core strategic areas going forward.

Smarter operations are built around digitally enhanced processes and several of the stories in this issue of MARITIME IMPACT feature new digital solutions to help our customers. A number of new applications in our customer portal My DNV GL offer everything from assessing a vessel's comparative efficiency, to checking readiness for the new EU MRV regulations, to determining cyber risks. Cybersecurity has become a vitally important topic in shipping, as systems are more dependent on software and more connected. In this issue we show how our Marine Cybernetics team identified and helped Siemens to prevent a critical vulnerability in a widely used programmable logic controller.

"Green propulsion" is another focus area at SMM. DNV GL has played a leading role in this field for many years - from overall efficiency, to new fuels like LNG and methanol, and next-generation solutions such as hybrid, electric and fuel cells. In MARITIME IMPACT there are several stories which showcase examples of the innovative ship propulsion technologies we are cooperating on with our customers, for example the first NO_x Tier III-certified engine from MAN, the solar- and wind-aided LNG-fuelled design for Peace Boat's Ecoship, and the highly efficient Con-Green container ship joint industry project.

Many of these topics will be discussed at the DNV GL Forum. This was one of the most popular events of SMM in 2014 and we hope that many of you will again take the opportunity to join us there. The DNV GL Forum allows us to offer you a broader view on the latest technologies, market conditions and challenges of the maritime world.

Taking the lead on digitalization and finding new and innovative ways to improve efficiency and reduce our environmental impact will ensure that the maritime industry remains at the centre of global trade and commerce. And with modern classification solutions, DNV GL is continually working to help our customers have the smarter operations that ensure success.

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

Knut Ørbeck-Nilssen

A VIEW FROM ABOVE

DNV GL is currently the only classification society to have tested the use of drones in production surveys in tanks and cargo holds.



In 2016 DNV GL carried out the first-ever production surveys using an unmanned aerial vehicle (UAV) or “drone” fitted with a camera. The photo shows a remotely piloted drone in action, inspecting the cargo hold on *CMA CGM Jamaica*. Using drones to check the condition of ship tanks can significantly reduce survey times and staging costs,

avoid damage to the tank coating, and improve safety for surveyors. A camera-equipped drone allows surveyors to examine difficult-to-reach structural components using video streamed to a tablet. When equipped with a powerful headlight and a good camera, a drone can produce video of sufficient quality for initial inspection purposes.



Photo: DNV GL

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IN BRIEF



The well intervention vessel *SIEM HELIX 1* was built at the German shipyard FSG.

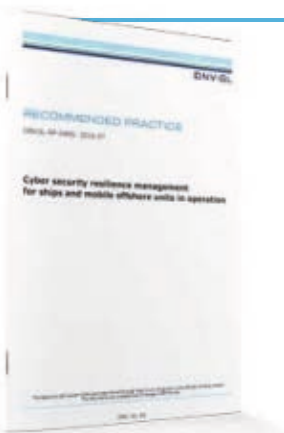
DNV GL welcomes *SIEM HELIX 1* into class

Flensburger Schiffbau-Gesellschaft (FSG) recently delivered the DNV GL-classed well intervention vessel *SIEM HELIX 1* to the Norwegian company Siem Offshore. For FSG, this is the first unit completely built and tested according to offshore standards.

The operator Helix Well Ops will use it to improve the yield from subsea oil wells and increase the cost-effectiveness of drainage and well intervention operations. Equipped with a 250-tonne offshore crane, *SIEM HELIX 1* can also assist in the

installation and removal of subsea equipment and structures. Certification to the DNV GL CRANE class notation demonstrates the ship's compliance with the applicable standards for these types of operations.

In addition, the vessel holds the DNV GL class notation COMF-V(2)C(3) addressing noise, vibration and indoor climate on board ships to ensure the highest possible comfort for the crew and personnel on board.



Enhancing the cybersecurity of maritime assets

With the widespread use of software-dependent systems, cybersecurity has become a critical operational and safety issue for the maritime industry.

Some of the most common threats to owners and operators include vulnerabilities in the electronic chart display and information system (ECDIS), the manipulation of AIS tracking data as well as jamming and spoofing of GPS and other satellite-based tracking systems.

DNV GL has published a Recommended Practice on "Cybersecurity Resilience Management" to help the industry address such threats. It builds on publications by BIMCO and the IMO and offers practical guidance for those responsible for cybersecurity in their respective organizations, covering risk assessment, general improvements to cybersecurity, and the verification of security improvements and management systems.



Download the Recommended Practice here: dnvgl.com/rpcs

New controllable pitch propeller by Otto Piening

DNV GL has awarded Otto Piening type approval for a new controllable pitch propeller that can be operated using a hydraulic and lubrication system based on water rather than oil.

The approval comprises of test bench investigations of water-based operation which were carried out under DNV GL supervision. A sample propeller design was also checked for compliance with DNV GL rules. The propellers are intended for the megayacht market as well as research, naval and coastguard vessels. The new propeller is a development of Otto



Type approval certificate for the innovative PCP (f.l.): Pierre Adam (Piening), Dieter Ekart (DNV GL), Mathias Pein (CEO Piening) and Olaf Richter (DNV GL).

Piening's Type PCP (Piening Controllable Propeller) controllable pitch propellers. The hub has been improved in terms of its hub/diam-

eter ratio. Additionally, structural revisions allow easier assembly and disassembly of the blades and pitch control mechanism.

Green Coastal Shipping Programme heads for Phase II

The second phase of the Green Coastal Shipping Programme (GCSP) has been launched.

The first phase, which had more than 30 participants and was led by DNV GL, resulted in five pilot projects covering various ship types and infrastructures, with an emphasis on LNG and battery hybridization. The second phase continues three of

those five projects and adds new pilots, including the DNV GL unmanned, electrically powered Re-Volt concept. Alternative fuels such as biofuel and hydrogen are also focal topics. "We need to ensure that theory and practical solutions converge," explains programme director Narve Mjøs. "The technology is developing fast, and so will we."



The Re-Volt concept is now part of the Green Coastal Shipping Programme.

Photos: DNV GL, FSG, Otto Piening GmbH





THE NEW ECOSHIP

The Japanese NGO Peace Boat takes a daring step into the future of sustainable shipping, joining forces with industry experts to develop the most eco-friendly cruise ship ever.

Cruise vessels are among the most demanding ship newbuilding jobs in the world. Technically sophisticated and subject to very strict regulatory requirements, major cruise vessels demand levels of safety, quality, innovation and engineering expertise unlike most other projects. This makes it all the more astounding that Peace Boat, the Japan-based international non-governmental organization (NGO), would set themselves the task of developing what might be the most innovative and ecologically friendly cruise vessel ever.

“Peace Boat has been sailing since 1983 on our educational and advocacy voyages for peace and sustainability. We have used chartered ships to date, and have become increasingly determined to close the gap between our message and the reality of operating a cruise ship,” says Yoshioka Tatsuya, co-founder and Director of Peace Boat. “We know that cruising is very visible to the public and it therefore has >

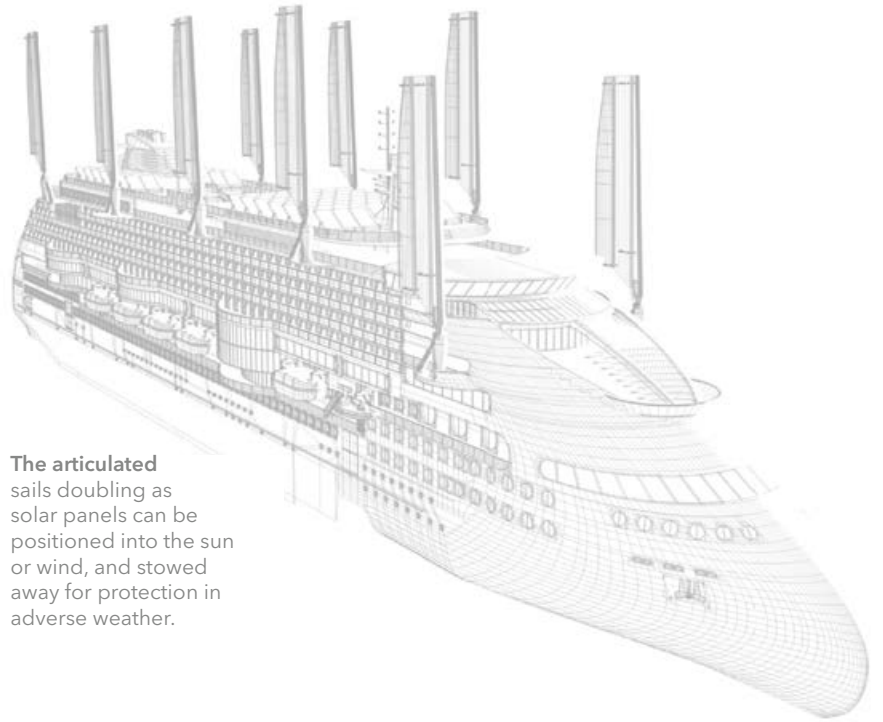


Photos: Peace Boat/DNV GL

Hybrid propulsion combines solar panels with wind, LNG and MDO for the smallest possible ecological footprint.



Photos: Peace Boat/DNV GL



The articulated sails doubling as solar panels can be positioned into the sun or wind, and stowed away for protection in adverse weather.

> both great potential and great responsibility to make changes that will accelerate sustainable innovation." From this vision, Peace Boat set out to create a vessel design and a set of specifications that would see the EcoShip not only act as a floating exhibition centre for the latest environmentally friendly technologies and stay ahead of the regulations, but offer a transition model towards a low-carbon economy.

The design process was in its own way a departure from traditional models of shipbuilding. In April

2014, Peace Boat gathered world experts on naval architecture, marine engineering, renewable energy, energy efficiency, maritime law, biomimicry, and biophilia in Hamburg for an EcoShip design charrette.

The aim was to come up with a holistic, integrated design approach, based on the belief that elements of a system work best when they are specifically designed to complement rather than to compensate for each other. "When we started the design phase we consulted DNV GL, who were immediately enthusias-

SPECIAL FEATURES

The EcoShip is designed by the Spanish company Oliver Design around biophilic principles - based on the solutions nature has evolved. The aerodynamic hull is inspired by whales. This is how the design translates biology to shipbuilding technology:

- Solar farm - solar-panel-covered sails and a 6,000 m² top-deck solar farm will generate over 750 kW of power in low-wind conditions.
- Closed-loop water system - it ensures that waste water is reused, purified and re-purposed, along with rain and seawater, for irrigating the on-board garden.

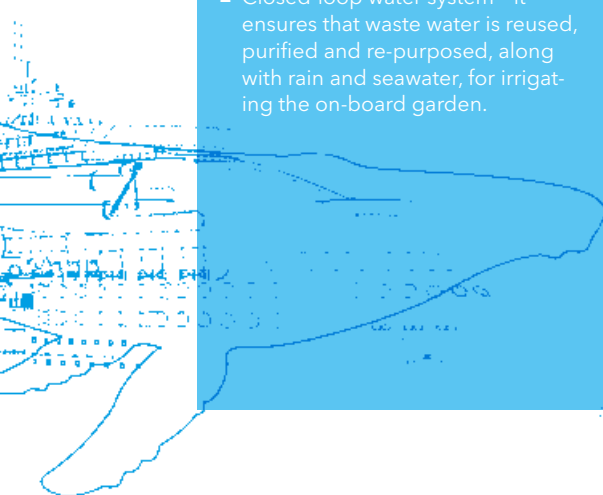
- Ten masts - under optimal conditions, the masts will harness wind energy to reduce propulsion fuel needs.
- On-board garden - an on-board garden serves as the heart and the lungs of the ship, featuring plants from around the world fed by rainwater and organic waste.
- Hull coating - plans are underway for a non-toxic, anti-fouling hull coating that mimics fish skin.
- Propulsion - the vessel is a dual engine LNG/MDO diesel electric podded ship with additional wind propulsion.
- Waste heat recovery - heat from the cooling systems will be used for water production and for

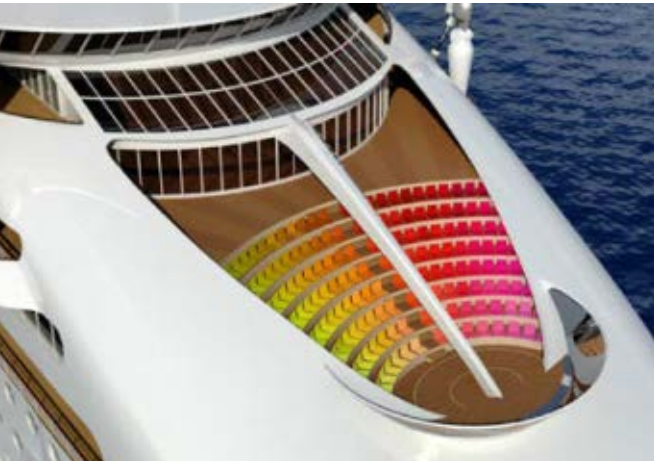
domestic applications; radical wasted-energy recovery with the goal of reusing 80 per cent of the energy normally lost in the air and in the water.

- Energy storage - managed by a combination of the latest technology for batteries and hot and ice storage tanks.
- Ballast water treatment - the most environmentally friendly solution is currently being researched.
- Research lab - a climate change and ocean research observatory is planned.
- Ice class - the plans call for a Type C vessel and IMO PC7 ice class with -10 °C design temperature.

MAIN DATA

- Gross tonnage: 55,000
- Total length: 224 m
- Beam: 31 m
- Draught: 8 m
- Top speed: 21 knots
- Optimised cruising speed: 17 knots
- Passenger capacity: 2,000
- Number of cabins: 750





The best view for passengers is from the arena in the bow section.



Sustainable luxury on board includes a multi-purpose auditorium for audiovisual presentations and other events.

tic about the project, attended our charrette and played an important role in the development," says Andres Molina, Project Director, Peace Boat. "We believe DNV GL has a great capacity to evaluate novel designs and is very agile in providing the proper answer to each new safety and technical challenge. Most importantly, we know that DNV GL, with its strong commitment to sustainable development goals, shares our vision for the Ecoship." One of the DNV GL experts who attended the charrette in Hamburg was Andreas Ullrich, Senior Principal Engineer. "Having worked with Peace Boat since they entrusted us with their vessel *SS Oceanic* in 2009 through to their current ship *Ocean Dream*, I was intrigued. For a classification society it is always great to be asked for technical support on such an innovative project because it reinforces our sense of working cooperatively to ensure the best solutions for the customer both commercially and in terms of



"We know that cruising is very visible to the public and it therefore has both great potential and great responsibility to make changes that will accelerate sustainable innovation."

Yoshioka Tatsuya, co-founder and Director of Peace Boat

class rules and international regulations. Also, having just released the new DNV GL rule set at the beginning of 2016, such a project is a great match for the flexibility and encompassing nature of the rules - which are designed to adapt to new technical challenges and modern design," Ullrich says.

Norbert Kray, DNV GL - Maritime Area Manager for Japan, agrees: "It is very special to work with a customer who is so in tune with the values of DNV GL. Their emphasis on sustainability, achieved through innovative approaches and the smarter use of technology, matches our own, and this project could be a great showcase for the industry. It is a great privilege to be part of this."

For Peace Boat, the Ecoship is not only important for its mission

but for the entire maritime industry: "As the cruise industry is growing so fast, particularly in East Asia, the need to mitigate the environmental impact is very important. Through its technical characteristics and the programmes that it carries out we hope it will encourage a model for 'green' cruising and further innovations in the cruise industry," says Yoshioka Tatsuya. ■ SA

MEMORANDUM OF UNDERSTANDING

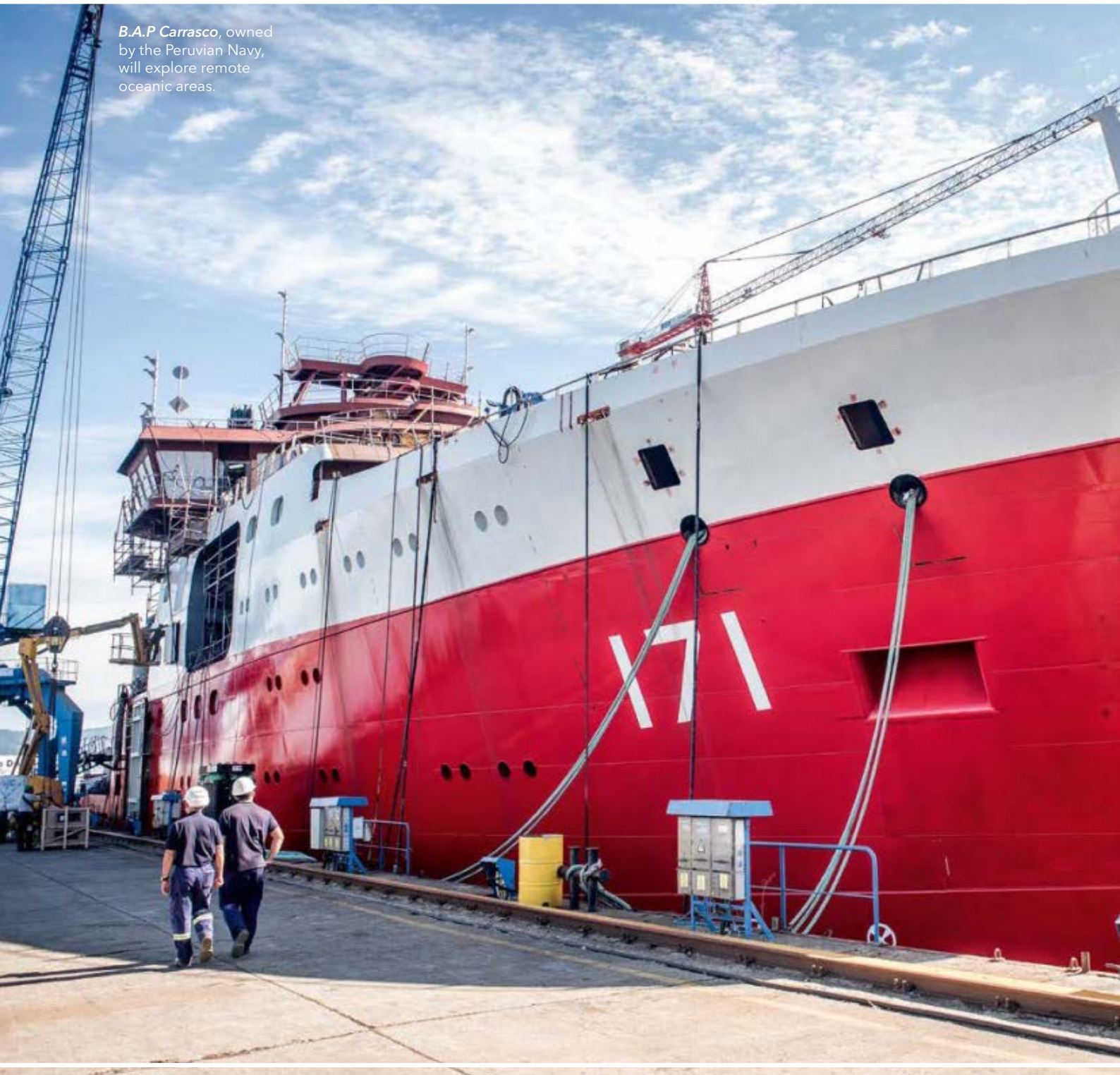
At the SMM 2016 trade fair and exhibition, Peace Boat and DNV GL will sign a Memorandum of Understanding on the design, construction and operation phases of Peace Boat's Ecoship and the promotion of the Ecoship as a flagship for climate action, the Sustainable Development Goals and sustainability in shipping.

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THE COMPLETE TOOLKIT FOR THE ANTARCTIC

B.A.P Carrasco, owned by the Peruvian Navy, will explore remote oceanic areas.



In Vigo, on the north-western coast of Spain, Freire Shipyard is constructing one of the world's most advanced polar oceanographic research vessels, classed by DNV GL. Freire's Director of Production Luis Santos gives a tour of the construction site.



More than 10,000 kilometres from where she will be deployed, *B.A.P Carrasco* is taking shape. With about 75 per cent of the 95-metre vessel completed, she is already afloat. Inside the hull sparks fly in every direction, and many rooms smell of freshly welded steel. "We are at the outfitting stage. About 150 people are currently routing 160 kilometres of cable and the piping, installing the panelling and fitting the consoles onto the bridge," says Luis Santos, Director of Production at Freire Shipyard, pulling a sheet of bubble wrap off a dynamic positioning (DP) console.

During DP manoeuvres, the DP operator will face towards the aft where most of the vessel's sensitive equipment will be located. "You need a very stable platform to carry out the array of surveys this vessel will perform, otherwise the data may become unreliable," Santos explains. After delivery, which is scheduled to happen before the end of 2016, *B.A.P. Carrasco* will be operated by the Peruvian Navy. "Her operating profile will range from hydrographic, biological, geological as well as physiochemical surveys to providing support with humanitarian operations and oil spills as well as search and rescue operations," says Walter Flores Servat, Head of the Department for Special Projects and Antarctic Matters at the Peruvian Navy. "We will also venture into Antarctic waters over the summer months, so the ship is built to withstand temperatures of minus 25 °C and can operate in up to one metre of ice coverage," he adds.

According to Freire's production manager Santos, the yard's biggest challenge was to integrate all the ship's systems and equipment into a very >



Photos: Fotografia Jelotí Comunicación

Sophisticated equipment is waiting to be installed on the bridge to support navigation under challenging conditions.

> limited space. The vessel is packed with state-of-the-art technology, including a meteorological office, six laboratories for different research purposes, a helicopter pad and a so-called bathymetry conductor system fitted on the flat bottom of the hull. It generates an array of acoustic beams with up to 10,000 metres of reach below the vessel to map the sea floor and feeds the data back to the vessel in real-time. The vessel will also carry a Falcon DR remotely operated vehicle (ROV), which can reach depths of up to 1,000 m, and two smaller, torpedo-shaped submarine vehicles by AUV Kongsberg.

A deck below the labs, the ship's two engine rooms are currently being installed. "The vessel will hold the DNV GL AP-3 notation, so the correct design of these spaces is critical," says Santos. AP stands for alternative propulsion, and the notation covers the eventuality of any single failure of the propulsion systems. "To meet this standard, the vessel needs two separate engine rooms and two propulsion rooms, which have to be watertight and insulated against fire. The piping systems for the propulsion can only be connected through valves in both sides of the bulkhead," explains Lucía Nogueira, Senior Surveyor at DNV GL's station in Vigo.

Clean operations

"This notation was very important to us because *B.A.P. Carrasco* will be venturing into restricted areas for very long periods of time, so we need to take all possible safety precautions. Certification to the AP-3 notation demonstrates that the propulsion system can continue operating at 50 per cent capacity in case of engine failure, ensuring a safe return to port," explains Walter Flores Servat.

The vessel will also be certified to the DNV GL CLEAN notation, which covers emissions to air from energy producers, cargo-handling systems and service systems on board, and DNV GL BWM-T, which prepares it for compliance with the Ballast Water Management Convention. "The vessel will have a Hyde Guardian ballast water treatment system using UV-light technology. In addition, a selective catalytic reduction system, which treats nitrogen oxide (NO_x) emissions with urea, ensures exhaust gases are reduced safely below particular emission limits," explains Santos. The Silent-A notation makes sure survey readings are not distorted by noise and vibrations from on-board systems.

Heading back up from the engine rooms to the main deck, Luis Santos passes one of his favourite features. "It doesn't look like much now, but this room will contain a so-called moon pool, an open shaft in the bottom of the hull that rises up to the centre of the ship to allow sensitive equipment to



"The vessel will have a Hyde Guardian ballast water treatment system using UV-light technology. In addition, a selective catalytic reduction system ensures exhaust gases are reduced safely below particular emissions limits."

Luis Santos, Director of Production at Freire Shipyard



The research vessel is being classed by DNV GL.



With a few months to go until her maiden voyage, work on *B.A.P. Carrasco* is progressing at a fast pace.

be lowered into the sea in all weather conditions," he explains. On the starboard side of the vessel, a hangar containing a conductivity, temperature and depth (CTD) instrument allows scientists to take seawater samples at different depths. The steel-clad data cable used for lowering this instrument into the water is 5,000 metres long.

Proven cooperation

Freire Shipyard specializes in building technically advanced vessels such as military patrol and training vessels and research ships. "The cooperation with DNV GL and Freire is going very well. The shipyard is experienced in building research vessels, and having DNV GL as a classification partner will ensure the ship and its systems meet the highest safety standards," says Flores Servat.

"*B.A.P. Carrasco* represents the highest standards in research vessels. We are very pleased to be classifying such an impressive newbuild and look forward

to continuing this close cooperation with Freire and the Peruvian Navy in the future," says Christian von Oldershausen, Segment Director Navy at DNV GL - Maritime.

Freire's Luis Santos has a few months before *B.A.P. Carrasco* has to be ready for her maiden voyage.

"We still have a lot to do until then, but the project is going very well. Thanks to the support from DNV GL we feel fully in control and are confident there won't be any surprises which could delay delivery. In recent years, about 50 per cent of all vessels Freire has built are DNV GL-classed, so we have a long history of working closely together, and it continues to be a good fit." ■ **AJO**

DNV GL Expert

Christian von Oldershausen, Segment Director Navy

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MAIN PARTICULARS

- Length overall: 95.30 m
- Beam: 18 m
- Depth to main deck: 9.20 m
- Draught: 5.95 m
- Number of crew and passengers: 110 (50 crew, 60 scientists)
- DNV GL class notations: DNV 1A1, E0, PC-7, CLEAN, BIS, SPS, AP-3 (50%), DPS2, BWM-T, COMF-C(3)V(3), SILENT-A

POWER AND SPEED

- Azimuth propulsion: 2 x 3,000 kW Rolls Royce AZP 120 CP
- Generating sets: 4 x Caterpillar 3516C x 2,250 kW
- Max. speed: 16 knots
- Bow thrusters: 2 x Rolls Royce TT1850 DPN CP x 800 kW
- Winches: 4 x scientific winches Ibercisa
- Frames: Ferri 3 x scientific frames
- Main crane: Ferri 14 tonnes at 13 m



MY
DNV GL

A CLICK AWAY

DNV GL has developed a series of new web applications to offer easy access to a number of DNVGL services and provide information about a wide range of topics.

DNV GL's digital channels are redefining the way customers can work with and benefit from DNV GL. The customer portal My DNV GL is a key part of this. It currently provides access to 34 DNV GL services, including a growing number of web applications. "We are very pleased to see that user numbers have increased and we have received positive feedback from them. One of the most popular services we host is Direct Access to Technical Experts (DATE)," says Kay Dausendschön, Programme Manager My DNV GL.

DNV GL's new web applications include a cybersecurity self-assessment tool, a business intelligence portal for LNG as ship fuel, a tool to assess the energy efficiency of specific vessels and an app that supports MRV compliance. MARITIME IMPACT takes a closer look at what the new apps have to offer. ■ KD



Kay Dausendschön presents the different applications of My DNV GL.

DNV GL Expert

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ABOUT MY DNV GL

DNV GL's customer portal My DNV GL acts as a single entry point for all relevant applications and exclusive information. With a new, intuitive interface and customized accounts, users can easily access the services they need in order to successfully advance their business - whether they are shipowners, managers, yards, designers, manufacturers, or flag states.

DATE

In brief

This app offers direct access to our most competent and up-to-date experts on every maritime topic through the DATE application. All owners and operators of DNV GL-classed vessels may use DATE.

Features

More than 400 experts cover all technical disciplines in five centres around the world and are ready to answer questions, independent of the time zone. Some of the subjects they offer support for include certificate issues, postponements, survey requirements, evaluation of repair proposals, class and statutory rule interpretations, and minor alterations. In an update, which will

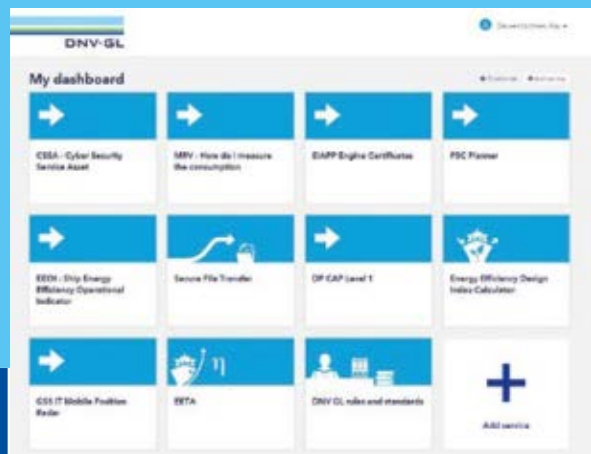
be implemented soon, we will also provide answers to frequently asked questions as an additional information source for customers.

Benefit

All relevant vessel data is stored and accessible via My DNV GL. Using the web application therefore avoids the need for iterative clarifications, which means better answers are provided faster. Queries

are automatically passed on to the most competent and up-to-date expert in a particular field. In urgent cases responses take only a few hours.

Photos: DNV GL



EETA

In brief

The Efficiency Evaluation Tool for Assets (EETA) is used to benchmark vessels against a comparable peer group, in order to identify and quantify retrofit potentials and costs.

Features

EETA uses publicly available information on ship design and real operating profiles based on AIS data. Using this input, it provides an indication of a vessel's energy

efficiency from a design perspective and benchmarks this value against its peer group. In addition to the assessment of the vessel in its current state, EETA looks at up to seven commonly known energy efficiency retrofitting measures and estimates how they could improve a vessel's performance.

Benefit

DNV GL Maritime Advisory has developed the Efficiency Evaluation Tool for Assets for shipping companies, ship financing banks, and other stakeholders. EETA is used frequently by those who need a fact sheet on their own or offered vessels for various business decisions, e.g. to:

- Market a vessel's advantages to charterers and buyers

- Check how a vessel which could be chartered or purchased compares to peers
- Identify and quantify retrofit potential and costs



MRV READINESS

In brief

The MRV Readiness application provides a fast gap analysis between a customer's monitoring and reporting system and the requirements according to the new EU regulation on monitoring, reporting, and verification (MRV).

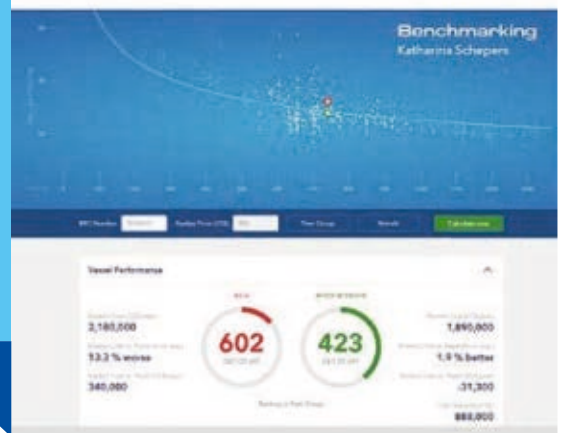
Features

According to the new EU MRV regulation, by 2018 all vessels calling at EU ports will have to monitor and report their CO₂ emissions. The MRV Readiness app provides a comprehensive checklist for all the data that must be monitored on EU-related voyages and that must be reported to the European Commission. For each kind of data, a full explanation is given so that owners and operators can learn

more about MRV in general and check for compliance with MRV. Furthermore, the MRV process and its timeline are illustrated. Users can check for updates on MRV in the app's news section. The app also includes a section for frequently asked questions and provides direct access to experts if required.

Benefit

The MRV Readiness app supports environmental compliance officers and fleet performance departments in identifying any gaps between their current monitoring and reporting systems and the requirements of the MRV regulation.



CYBERSECURITY SELF-ASSESSMENT

In brief

The application helps users to assess relevant questions regarding cybersecurity in a maritime environment (shipping companies, vessels). The quick check covers the following questions:

- Does a company/vessel have a cybersecurity weakness that could be exploited?
- How well is a company/vessel protected against a cyberattack?
- What could the consequences of a cyberattack be for the vessel/business?

nesses and improve resilience against cyberattacks.

Using a questionnaire, users can assess the cybersecurity risk for each process or system. This includes the loss of data and the availability of software for example. The application also includes a general overview on cybersecurity.

Features

The application offers a straightforward way for customers to carry out a self-assessment of their cybersecurity measures, providing an overview of high risk-items and the general risk status of maritime assets. It also creates awareness and provides general recommendations on how to eliminate weak-

Benefit

The app provides customers with regular updates on the latest discoveries in the field of cybersecurity and offers an opportunity to assess the status quo of a company or vessel, identify common weaknesses, and plan the next steps ahead.



LNGi

In brief

The application hosts LNGi, DNV GL's business intelligence portal for the LNG industry, and aims to support and accelerate the uptake of LNG as ship fuel.

Features

In addition to detailed statistics on LNG-fuelled ships, shipowners, charterers, LNG suppliers, and equipment manufacturers have access to an interactive LNG bunkering map. It provides worldwide and continuously updated data and information on the entire LNG ship fuel value chain.

Benefit

LNGi combines market intelligence provided by LNG

suppliers, infrastructure owners and DNV GL to create a comprehensive platform for the industry. LNGi allows members to:

- Assess the availability and attractiveness of LNG fuel for specific routes and newbuilds
- Save time and the cost of mapping LNG availability themselves
- Understand current market

developments and evaluate the uptake of LNG fuel and competing technologies in their segment

- Get up-to-date, accurate information regarding potential LNG suppliers for specific projects
- Use an efficient source of information for business development and planning



Photos: DNV GL



CON-GREEN 2000 – THE BANGKOK-MAX

The largest container vessels are designed for the greatest possible efficiency – maximum intake, minimum fuel consumption. Their smaller cousins, however, have not received the same level of attention – but this is beginning to change.

For the last few years, the titans of the container world have stolen the headlines; 18,000, 19,000 and even 20,000 TEU giants have arrived and reshaped the way goods are transported around the world. This has resulted in a need for more feeder services to keep these giants filled and reap the efficiency benefits of their size.

For the Korean shipbuilder Hyundai Mipo Dockyard (HMD) this was a good reason to look into the designs of feeder vessels and identify energy savings potential for this ship type as well. “With the Con-Green 2000 project we wanted to define the next generation of feeder vessels with maximum fuel efficiency, high quality, reliability and lower maintenance costs,” says C. G. Lim, Team Leader and Deputy General Manager of the ECO Hull Form Development Team at HMD. The yard asked several partners to participate in the project, including MAN Diesel & Turbo, Becker Marine Systems, and DNV GL.

The hull form, propeller, general arrangement, midship section and scantling have been designed and optimized by HMD using their own proprietary software Hull Form Optimizer of Mipo (HOM) and Propeller Optimizer of Mipo (POM). The hull design of this Bangkok-max vessel was based on the new

DNV GL rule set and the new IACS S11A and S34 requirements, and given approval in principle by DNV GL.

Efforts to optimize the hull and propeller have led to power savings of approximately 7.5 per cent. Cargo capacity was maximized by minimizing the weight of the vessel and optimizing the structural arrangements. A further capacity increase could be achieved through a tailored Intra Asian Service loading plan under the DNV GL RSCS (Route Specific Container Stowage)

	Original design (ORI)	Revised design (REV)
Length between perpendiculars	163.0m	163.55m
Beam	27.5m	27.4m
Draught	8.75m	8.75m
Normal continuous rating	9,500kW	8,517kW
Sea margin	15.0%	15.0%
Service speed	19.0kts	19.0kts
Nominal capacity	1,785TEU	1,801TEU
14 tonnes homo. capacity	1,210TEU	1,240TEU
Energy saving device	Applied	Applied

Comparison of main particulars.

Optimizing the hull form based on wave patterns to minimize resistance is an important step towards achieving high operational efficiency.



The Cross Over Rudder by Becker Marine Systems reduces power requirements, contributing to ship efficiency over a wide range of operating conditions.

class notation, allowing the deck containers' VCG (vertical centre of gravity) to be raised by 13.5 per cent compared to the standard North Atlantic route. As a result of optimizing the loading condition and LCB position (longitudinal center of buoyancy), the fore and aft peak tanks were removed.

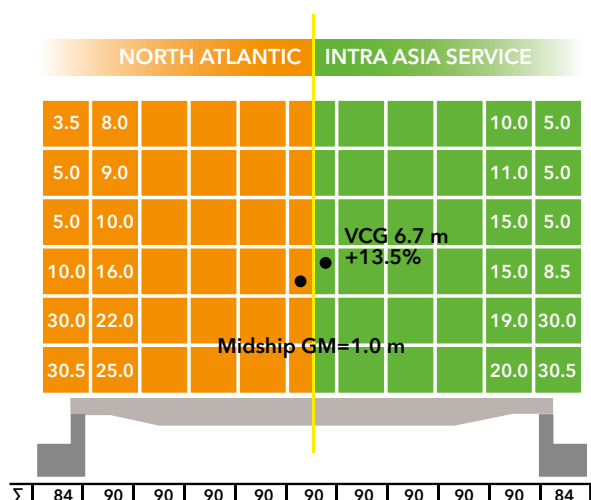
Innovative rudder design

"Reducing fuel consumption is the most effective way to improve the emissions profile of a vessel, while, at the same time, improving competitiveness. The design includes a Cross Over Rudder (COR) developed by Becker Marine Systems (BMS), which will provide efficiency benefits over a wide range of loading conditions, speeds and real sea conditions with waves, winds and current," says Lim.

The COR is a new design from BMS that includes a new fairing hub cap and a new rudder bulb design. The flow efficient hub cap (FEHC) and the rudder

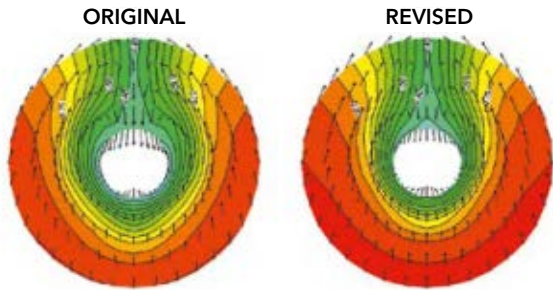
bulb are designed to reduce the required power and prevent propeller hub cavitation with no loss of manoeuvrability. The addition of the COR reduced the power requirement by another 2.8 per cent.

"BMS has a long history of cooperation with HMD and we were very pleased to have been asked to take part in this interesting project," says >

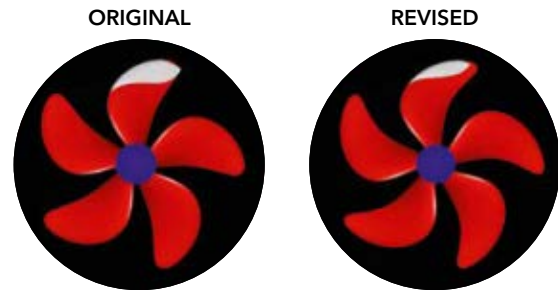


Route-specific stowage allows for a higher vertical centre of gravity (VCG) and more advantageous loading.

Photos: Becker Marine Systems, DNV GL, Hyundai Mipo Dockyard



Hull and rudder optimization improves the wake pattern, an indicator of the efficient use of power.



Cavitation patterns caused by vibration-induced erosion are a key concern for propeller designers.

> Henning Steffen, Naval Architect and Sales Manager from BMS. "We took the data provided by HMD and undertook CFD calculations to find the ideal COR rudder design for maximum efficiency. After seeing the model testing results, we are especially pleased with the power savings added by the COR over the whole range of operational speeds."

Model tests confirm better performance

The design also incorporates the latest version of the MAN B&W 6S60ME-C10.5 main engine from MAN Diesel & Turbo (MDT). "At MDT, we are always interested in projects which can contribute to the development of innovative designs that benefit builders, owners and operators," says Sang Bae Cha, Sales Promotion, MAN Diesel & Turbo Korea. "The Con-Green project was an excellent opportunity to feature the new MAN B&W 6S60ME-C10.5, which has increased power, improved fuel efficiency and reduced weight and dimensions, and also features new technologies like our fuel booster injection valve and top-controlled exhaust valve." Model tests carried out in June at Force Technology in Denmark and witnessed by a DNV GL expert confirmed the added performance, with the speed at NCR (nominal continuous rating) power with 15 per cent sea margin improved by about 0.55 knots in comparison to the original design. Daily fuel oil consumption was improved by 12 to 16 per cent, depending on the vessel speed.

DNV GL will work with HMD on obtaining an approval in principle for the design, verify the performance of the design and assess the compliance of the design with environmental requirements including the EEDI. DNV GL will also provide technical sup-

"We wanted to define the next generation of feeder vessels, with maximum fuel efficiency, high quality, reliability and lower maintenance costs."

C. G. Lim, Team Leader and Deputy General Manager, ECO Hull Form Development Team at HMD

port on the basic design in terms of stability, cargo loading/unloading, and the machinery arrangement concept and placement.

"The feeder market is gaining in importance, especially in the intra-Asian sector, and we are seeing a wave of innovation in this area as yards and designers look to maximize efficiency and reduce environmental impacts," says Jai Oh Sun, responsible engineer for the Con-Green project at DNV GL - Maritime. "We are very pleased that HMD has chosen us to participate in the project and trusts our expertise in the container sector. We look forward to the future development of the design and its success in the market."

HMD Con-Green 2500 and HMD Con-Green 3000 are now under development and will be released soon. ■ SA

DNV GL Expert

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12.09.16

Revised ISO Standards 9001:2015 and 14001:2015 for Shipping Companies
Delhi, IN

13. - 14.09.16

Energy Efficient Operation of Ships - Masterclass
Piraeus, GR

15.09.16

Complying with the MLC 2006
Antwerp, BE

15. - 16.09.16

Practical Incident Investigation and Root Cause Analysis - Methods and Tools
Hamburg, DE

19.09.16

Offshore Service Modules
Dubai, AE

19.09.16

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Pasay City, PH

19. - 21.09.16

Company/Ship Security Officer (CSO/SSO) Training Course
Leer, DE

21.09.16

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Mumbai, IN

21. - 22.09.16

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21. - 23.09.16

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Rotterdam, NL

22. - 23.09.16

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23.09.16

Vessel General Permit
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26. - 27.09.16

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Pasay City, PH

26. - 27.09.16

Vetting Inspections
Singapore, SG

26. - 28.09.16

Planning and Managing a Drydocking for Superintendents
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27.09.16

HSE Leadership for Managers Course
Piraeus, GR

27. - 28.09.16

Maritime Risk Management and Incident Investigation
Gdynia, PL

27. - 28.09.16

Machinery Piping and Statutory Design
Shanghai, CN

27. - 28.09.16

NORSOK Standard - Material
Busan, KR

28.09.16

Navigational Audits
Piraeus, GR

28. - 29.09.16

Designated Person Ashore (DPA) Training Course
Madrid, ES

28. - 29.09.16

Vetting Inspections for Bulk Carriers
Istanbul, TR

04.10.16

Hull Inspection Course
Høvik, NO

04.10.16

Optimizing Waste Management on Board - Operational and Technical Management Issues
Piraeus, GR

04. - 05.10.16

NORSOK Standard - Safety/Working Environment
Busan, KR

04. - 06.10.16

Drydocking - Survey Simulator Workshop
Gdynia, PL

04. - 06.10.16

Internal Auditor ISM
Houston, US

05.10.16

STCW for Crewing Managers
Barendrecht, NL

05. - 06.10.16

Internal Auditor ISM-ISPS-MLC for Shipping Companies
Istanbul, TR

06. - 07.10.16

LPG Hull (available in South Korea)
Busan, KR

06. - 08.10.16

Train the Trainer for Shipping Companies
Delhi, IN

09. - 12.10.16

Port Facility Security Officer Training Course
Dubai, AE

10. - 12.10.16

HAZOP Leader Course
Barendrecht, NL

10. - 13.10.16

Approved HazMat Expert
Shanghai, CN

SUPERSIZING CAR CARRIERS

Similar to container vessels, bulk carriers and cruise ships, car carriers are rapidly growing in size. A new series of the world's largest pure car and truck carriers sets a new standard for this segment.

July 2016, Xiamen, China: Berthed along the 1.5-kilometre coast side of the Xiamen Shipbuilding Industry yard, the final two vessels in a series of six New Horizon Class pure car and truck carriers (PCTC) are nearing completion. While one of them has just undergone sea trials, the last of these gigantic post-Panamax vessels is still in the outfitting stage and will be delivered by the end of the year. Ordered by Norwegian shipping company Höegh Autoliners, the

New Horizon Class vessels have a carrying capacity of 8,500 units, and are able to accommodate nearly 15 per cent more cars than ships of same size and type. The 200 m long and 36.5 m wide vessels have a deck area of 71,400 m², divided over 14 decks. This makes them some of the world's largest PCTCs by capacity.

"We worked very closely with Deltamarin OY, the Finnish designer, Xiamen Shipbuilding Industry, as



Höegh Target, delivered in 2015, was the first of six New Horizon Class pure car and truck carriers.

The last of the six New Horizon Class pure car and truck carriers in the dock of Xiamen Shipbuilding Industry will be delivered by the end of the year.

well as DNV GL concerning class approval," says Jan Rune Mørken, Head of Newbuilding - Höegh Autoliners. "There are several reasons why we wanted to give these vessels a wider beam rather than increasing the length. For example, the expansion of the Panama Canal gave us more freedom to increase capacity. In addition, we aim to reduce the carbon footprint of each vehicle we transport. Creating a new vessel standard with a capacity for 8,500 vehicles makes a big difference," he explains. Making the vessels longer was not an option. "A maximum length of 200 metres is common for many PCTC berths," says Mørken.

Small carbon footprint

The final design was fully optimized to make these vessels as green as possible, with a new hull shape and a very efficient propeller. "These PCTCs only emit half the amount of CO₂ per car transported compared to standard car carriers, and they consume a lot less fuel oil per day. Certification to the DNV GL CLEAN and BWM-T (Ballast Water Management) notations demonstrates the sustainability of the design and its preparedness for future requirements," says Li Zhenjun, Chairman of Xiamen Shipbuilding Industry (XSI). "We are proud to be working on this vessel series. We are committed to developing our expertise in the car carrier segment; through these projects and our cooperation with shipowners and DNV GL, we have grown to be a leading yard in this field."



"Through these projects and our cooperation with DNV GL, we have grown to be a leading yard in this field."

Li Zhenjun, Chairman of Xiamen Shipbuilding Industry (XSI)



record and competence with this type of design," Mørken explains. "Installing the complex ro-ro system including the doors, hoistable decks, stern ramp and side ramps was also a challenge we had to overcome," says Li.

The new vessels have 14 cargo decks and five liftable car decks, and a higher door opening than Höegh Autoliners' current vessels, enabling cargo up to 6.5 metres high and twelve metres wide to be loaded. Extra ramp strength allows for cargo weighing up to 375 tonnes to be loaded over the stern ramp and 22 tonnes over the side ramp.

"It is fascinating for us to be involved in such an ambitious project," says Chi Shaoguang, DNV GL Newbuilding Manager for Area South China. "The cooperation between all the partners has been excellent and the progress on the construction site

is a testament to the high level of expertise XSI holds in building these complex vessels."

"Indeed this is a milestone for our company," says Mørken. "It is a very proud moment and it is great to see that we have had very positive feedback from those who work on and operate these vessels." ■ HH/CZ

A milestone for Höegh

Increasing the beam presented significant design challenges. Höegh and DNV GL carried out extensive studies looking at the impact of the wider beam on stability. "Our fleet uses the 'two pillar support principle'. This means the deck is like a football pitch and we can utilize the entire deck from port to starboard. DNV GL was the first classification society to approve such a flexible design with an open deck, so we knew it had a good track

Photo: Höegh Autoliners

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HANDS FREE


The growing size of container vessels has forced ports around the world to maximize the efficiency of their cargo handling operations. One of the terminals at the Port of Hamburg is being upgraded with automated container storage systems - with support from DNV GL.

At Hamburg's Burchardkai Terminal the first block of cranes has already been mounted. "We're currently preparing them for testing and in a few months we plan to finish four more automated storage blocks," says Antonio Schmidt, Lifting Machinery Manager at the Hamburger Hafen und Logistik AG (HHLA). Once the automated yard storage blocks go into operation in the first half of 2017, they will improve container handling efficiency significantly, while further increasing the level of occupational safety in the port. The project brought together HHLA, DNV GL, the crane manufacturer Hans Künz, and the electronics supplier ABB.

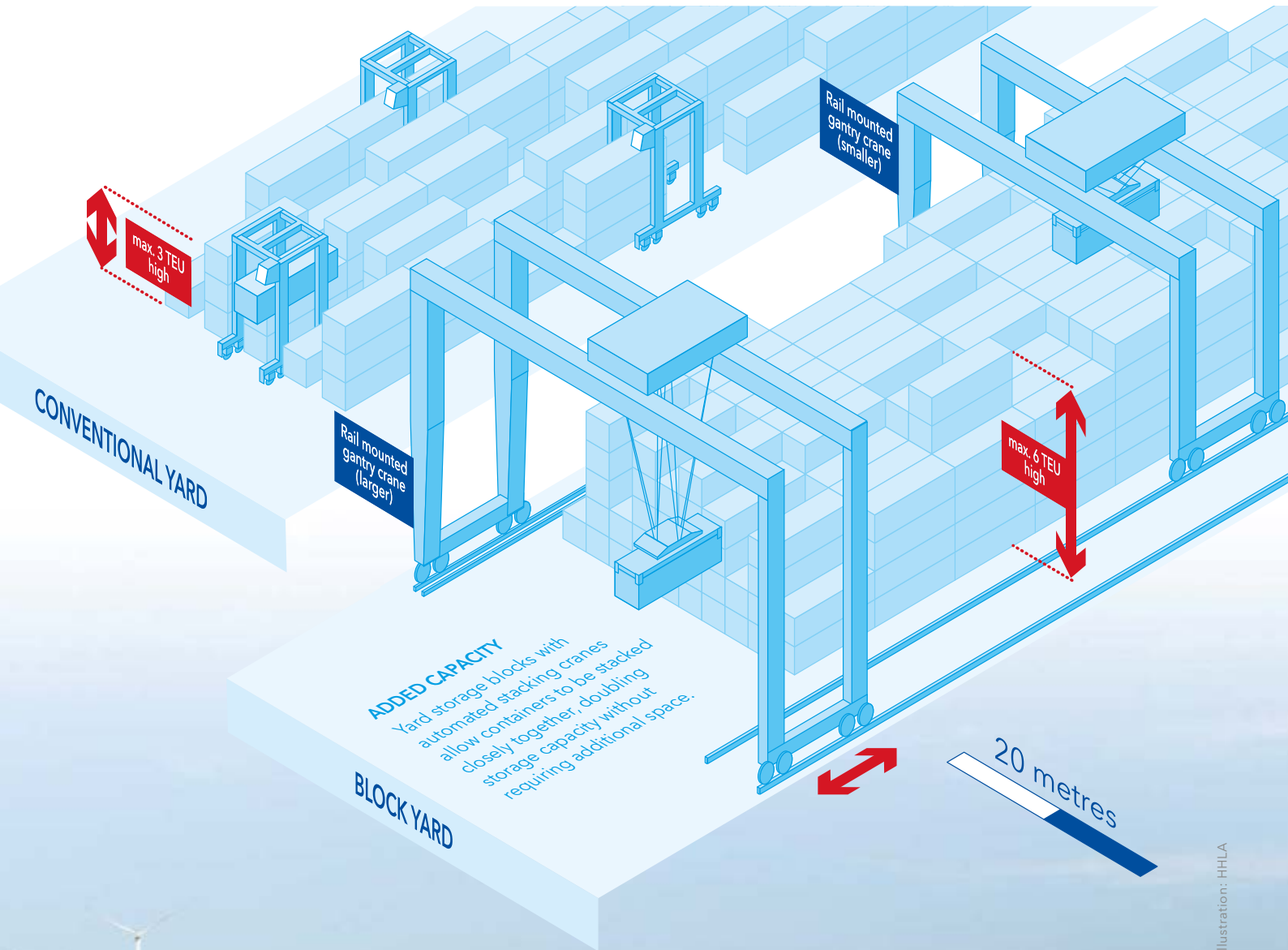
"Our collaboration with DNV GL has been very smooth and DNV GL has demonstrated a high level of professionalism in terms of project execu-

tion," says Schmidt. His team is responsible for the acquisition of cargo handling equipment, such as quay cranes and yard cranes. For each of the four new yard storage blocks being set up at Burchardkai there will be three automated stacking cranes (ASCs). "In projects like this, we are in charge of organizing project execution and overseeing the manufacturing process. DNV GL is responsible for quality assurance. Their experts help us scrutinize areas such as steel construction, welding technology or mechanical engineering for potential deficiencies," he adds.

DNV GL has also inspected the cranes and checked the risk analysis for the overall system, detailing what each project partner needs to do to ensure compliance with the overall safety requirements of the European Machinery Directive. According >



Burchardkai container terminal is getting ready to accommodate tomorrow's 20,000 TEU carriers.



Photo/Illustration: HHLA





HHLA Terminal Burchardkai handles one in three of all containers in the Port of Hamburg.

> to Thorsten Rolfs, Principal Engineer - Infrastructure, Marine Infrastructure & Cranes at DNV GL, crane automation creates significant challenges for the overall system: "Unmanned gantries require entirely different control systems than manually operated stacking cranes to ensure the efficiency of their automated processes and enable staff to intercept operations remotely in case of an incident. Automated yard storage systems require extensive safety procedures to ensure the same overall level of safety as for manually operated systems."

Same footprint, doubled capacity

In a conventional container yard, manned container loaders, so-called straddle carriers, simply unload the boxes by placing them in marked zones. This solution requires a relatively large amount of surface area because containers must be placed about one metre apart from each other so the straddle carriers can pick them up. In addition, straddle carriers are unable to stack more than three containers, which can weigh up to 36 tons. Block storage allows containers to be stacked faster, higher and more closely together. "Each storage block is 380 metres long, ten container rows wide and six boxes high, and can store just under 2,100 standard container units (TEU). Compared with the old yard arrangements we are able to accommodate twice as many containers in the same space," says Schmidt.

The new technology also reduces CO₂ and noise emissions as well as power consumption, adds HHLA spokesperson Karl Olaf Petters: "Unlike diesel-powered straddle carriers, the rail-mounted cranes

are electrically operated. And with our new LED yard lights, which light up faster and are only switched on when needed, we save some two million kWh of energy - the power consumption of a village with 1,200 people."

Once the cranes for the first storage blocks have been fully commissioned this autumn, final tests will be carried out. "Before granting approval for the cranes, every element of the system undergoes a final inspection and we run error simulations to ensure the cranes respond properly, to make certain that any potential flaws have been identified and removed," explains Rolfs. According to the DNV GL expert, the project has gone very smoothly. "Working on this project at HHLA has been a pleasure. Automation solutions are growing in number throughout the industry and are rapidly advancing in terms of complexity. Cooperation between HHLA and the other project partners has been excellent. We are progressing very well, and the first unit should be commissioned in the autumn," he adds.

"The expansion of our storage capacity will set an example for the industry," says HHLA's Karl Olaf Petters, "and prepare us for handling some of today's biggest container vessels, which can carry up to 20,000 containers." ■ DD

"Our collaboration with DNV GL has been very smooth and DNV GL has demonstrated a high level of professionalism in terms of project execution."

Antonio Schmidt, Lifting Machinery Manager, HHLA



HHLA headquarters in Hamburg's historic Speicherstadt district.

DNV GL Expert

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EVENTS & EXHIBITIONS



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

14. - 15.09.16

OSV Chartering Contract Management Seminar
London, UK

15. - 16.09.16

Global Liner Shipping Asia Conference
Singapore, SG

21. - 23.09.16

Seatrade Cruise Med
Santa Cruz de Tenerife, ES

26.09 - 27.09.16

Liquefaction of Bulk Cargoes Seminar
London, UK

04. - 06.10.16

Arctic Shipping Forum North America
Montreal, CA

04. - 06.10.16

International Marine Technician Symposium
Bergen, NO

04. - 07.10.16

Offshore Marintec Russia
St Petersburg, RU

15. - 19.10.16

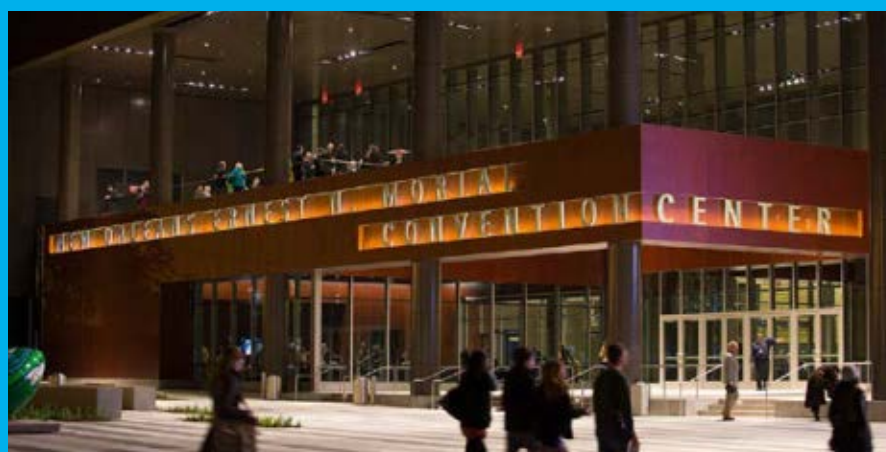
Interferry Annual Conference
Manila, PH

18. - 20.10.16

Marine Vietnam
Vung Tau City, VN

24. - 26.10.16

Arctic Technology Conference 2016
St John's, CA



The International Workboat Show is being held from 30 November to 2 December 2016 in New Orleans.

25. - 28.10.16

Shiptec China 2016
Dalian, CN

31.10. - 02.11.16

Seatrade Middle East Maritime 2016
Dubai, AE

09. - 10.11.16

16th Ballast Water Management Conference
Antwerp, BE

10.11.16

20th HANSA-Forum Shipping & Financing
Hamburg, DE

14. - 16.11.16

EAGC - European Autumn Gas Conference 2016
The Hague, NL

14. - 17.11.16

Green Ship Technology North America Conference
Washington, US

15. - 16.11.16

Tanker Shipping & Trade Conference
London, UK

16. - 18.11.16

7th Gas Fuelled Ships Conference
Hamburg, DE

28. - 30.11.16

6th International Maritime Conference on Design for Safety
Hamburg, DE

29.11. - 01.12.16

Seawork Asia
Shanghai, CN

30.11. - 02.12.16

The International Workboat Show 2016
New Orleans, US

05. - 07.12.2016

BWMTech
London, UK

07. - 08.12.16

19th Salvage & Wreck Removal Conference
London, UK

24. - 25.01.17

MARENER 2017
Malmö, SE

31.01. - 02.02.17

Euromaritime 2017
Paris, FR

15. - 16.02.17

FPSO Europe Congress 2017
London, UK

13. - 16.03.17

Seatrade Cruise Global
Fort Lauderdale, US

21. - 24.03.17

14th Annual Green Ship Technology
Copenhagen, DK

VIRTUAL SISTER SHIP

In a challenging economic environment, shipping companies are looking for innovative technology to drive efficiency and reduce operational costs. The digital twin of a ship provides a platform for powerful analyses, insights and diagnostics.

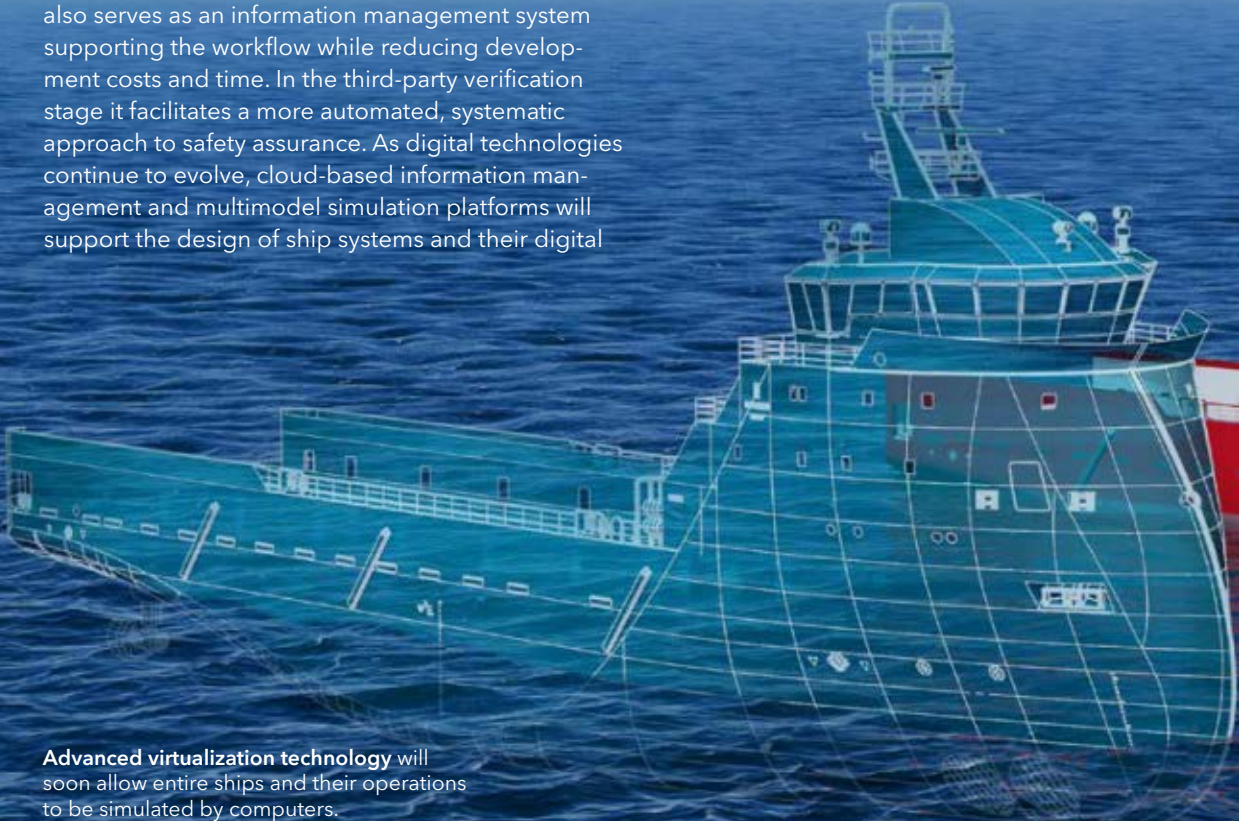
A digital twin is a digital copy of a real ship which synthesizes the information available about the ship in the digital world, virtualizing all of its systems. A digital twin allows any aspect of an asset to be explored through a digital interface, including its layout, design specifications, simulation models, data analytics, and so on. It is easy to see that there are countless uses for a vessel's digital twin throughout its life cycle.

Virtual companion for the ship life cycle

During the design phase the digital twin is used as a virtual test bench to improve system performance. It also serves as an information management system supporting the workflow while reducing development costs and time. In the third-party verification stage it facilitates a more automated, systematic approach to safety assurance. As digital technologies continue to evolve, cloud-based information management and multimodel simulation platforms will support the design of ship systems and their digital

twins, allowing various stakeholders to populate the digital twin of an asset with modules and evaluate in advance how the system will operate as a whole.

Once a ship is in service, its digital twin offers various possibilities for evaluating performance and criticalities in near real time and suggesting corrective action, especially when coupled with operational data from sensor-instrumented equipment. Over time, increasingly detailed virtual models will be continuously populated with information collected on board, accelerating the development of industrial big data and smart analytics platforms.



Advanced virtualization technology will soon allow entire ships and their operations to be simulated by computers.

The concept of digital modelling has already been implemented successfully in the DNV GL COSSMOS tool, which can simulate and optimize complex and integrated ship machinery systems - leading the way toward a "digital twin" for ship machinery. "In essence, we use COSSMOS to build virtual engine rooms, digital twins of the vessel machinery either to be built or operated. The virtual engine room is then coupled with the entire operational profile of the ship together with cost data to perform advanced techno-economic analyses of practical use," says Nikolaos Kakalis, Manager R&D, Region East Med, Black & Caspian Seas at DNV GL.

Pathway to a new era of shipping

Another example which illustrates the practical use of digital twins is the DNV GL application Nauticus Twinity. It is based on Marine Cybernetic's Hardware-In-the-Loop (HIL) testing technology. "HIL testing

is an efficient black-box method for testing and verification of control system software. HIL has been proven for more than 150 offshore vessels and units. Instead of being connected to the actual equipment on the vessel, the control system is connected to a digital twin (HIL simulator), with sophisticated models of the vessel and its equipment," describes Arne Kjørsvik, Manager Digital Services, Marine Cybernetics services, Offshore Class, DNV GL. This technology can be easily adapted for gas carriers and other ship types. The experience gained during the tests conducted so far is continuously analysed and utilized to further enhance the test technology for all ship types.

Virtual ship platforms will lead to several new ways of operating and maintaining ships and fleets. Indeed, the digital approach may eventually be the preferred method for stakeholders in the shipping industry. For the time being, however, it is still in its infancy, and smart ways of organizing and making the vast amount of information accessible need to be explored. New technologies leveraging ontology-based reasoning, functional modelling, multiphysics simulation, machine learning, and big data are currently being investigated by both the industry and academia. By 2025, the results of these investigations should provide the basis for new standards and best practices for ship and operational management in the new digital-industrial age of shipping. ■ AKJ

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Photo: DNV GL



PUTTING A STOP TO CYBER EXPLOITS

Marine Cybernetics, a DNV GL service line, works to identify maritime and offshore cybersecurity vulnerabilities. The experts give an in-depth look into one of their most recent cases.

“This was a vulnerability that could have allowed a hacker to remotely shut down the drilling control system, a blowout preventer, power management systems, or an emergency shutdown system,” says Mate J. Csorba, Principal Specialist Cybersecurity, Marine Cybernetics (MC). In January 2016, Csorba’s MC team and partners at the Norwegian University of Science and Technology (NTNU) contacted Siemens about a denial of service (DoS) vulnerability in a series of their programmable logic controllers (PLCs). Designed for discrete and continuous control in industrial environments worldwide, these PLCs are among the most widely deployed Siemens controllers. Many critical applications are built on top of this family of PLCs.

“We engaged with ProductCERT, the central Siemens team for responding to potential security incidents and vulnerabilities,” continues Csorba. “Through a coordinated disclosure procedure, we sent an encrypted proof of concept showing how the vulnerability could be exploited.” The resulting

dialogue between Marine Cybernetics services and Siemens produced a firmware update that addressed the issue.

“This most recent finding has been the result of our collaboration with the Department of Telematics at NTNU. The investigation relied on state-of-the-art security testing methodologies, in particular fuzzy testing and negative testing of industrial communications,” Csorba adds. “The proof of concept developed by MC only required TCP/IP packets to be sent to the PLC. By doing this we could disable a PLC in such a way that only a cold restart would bring it back to normal operation.”

High-severity vulnerability

The issue detected received a base rating of 7.5 out of 10 based on the industry standard for assessing the severity of computer system security vulnerabilities (CVSS) - which meant it was a high-severity vulnerability. Most control systems are designed assuming a secure PLC operating environment.

But in practice, industrial systems are often connected to other networks, allowing remote access through the Internet. “This vulnerability could have been exploited by an attacker gaining access to the control system network. This is why the verification and testing of deployed barriers, such as network segregation, and secure remote connectivity is so

The inventiveness and viciousness of hackers should not be underestimated.

essential to ensuring system security," says Csorba. While the vulnerability identified by Marine Cybernetics services and NTNU was, on this occasion, in a Siemens PLC, serious vulnerabilities have also been reported in similar products from other vendors. "The ProductCERT team from Siemens was excellent. They handled the finding and disclosure process professionally and swiftly. The major control system vendors take such findings very seriously and are continually working to maintain and improve their development cycles."

But at the same time, he states, owners in the maritime and offshore industries should seriously contemplate third-party verification of their assets' cybersecurity. "The current practices to mitigate cybersecurity risks, especially in the industrial environments where these controllers are used, are not always best suited for addressing such issues," Csorba explains.

Customized tools and methods

This is just one example of how DNV GL works to identify and prevent cybersecurity vulnerabilities that can impact critical maritime and offshore control systems. As part of DNV GL - Maritime, Csorba works in one of the test labs in Trondheim, Norway, where

Photo: Carabay-Fotolia



Modern ship systems are vulnerable to cyberattacks and computer viruses.

"Maintaining the integrity and resilience of cyber-physical systems, including critical control systems, requires a holistic approach to safety and security."

Mate J. Csorba, Principal Specialist Cybersecurity, Marine Cybernetics services

the focus is on addressing cybersecurity in on-board control and various auxiliary systems.

The DNV GL - Maritime labs can host replicas of a variety of control systems, including power management systems, blowout preventers, drilling control systems, steering and propulsion systems. Cybersecurity threats are entering the maritime domain, but the testing of systems for cyber vulnerabilities is still relatively new to the maritime and offshore industries. Proprietary and closed-source solutions require novel and often customized tools and methods to address these concerns.

"Cybersecurity regulations and guidelines are for the most part still under development," says Csorba. "But maintaining the integrity and resilience of cyber-physical systems, including critical control systems, requires a holistic approach to safety and security. This is an area where we foresee increased demand over the next few years the industry becomes more aware of the potential vulnerabilities in these complex, software-dependent systems." ■ SA

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AN INDUSTRY FIRST

The IMO NO_x Tier III limits took effect in North American and US Caribbean emission control areas (ECAs) at the beginning of the year and apply to vessels with an engine output of ≥ 130 kW built after 1 January 2016. Previously, shipowners were required to separately install selective catalytic reduction systems or exhaust gas recirculation systems to achieve compliance. A recently developed MAN engine offers an integrated solution to NO_x Tier III compliance. DNV GL has now certified the first engine of this type, the MAN B&W 6S50ME-C8.2. It can switch between Tier III operation in NO_x ECAs and Tier II operations in other waters, and this is how it works. ■ AK

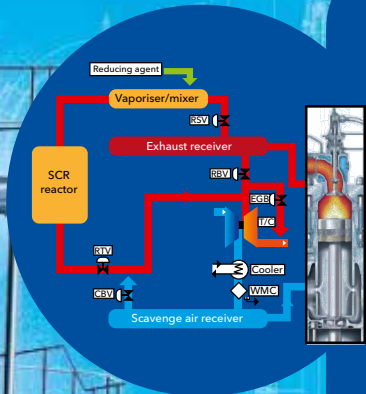


Innovative engine

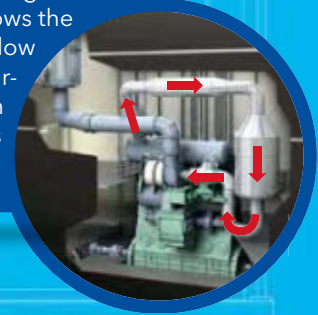
The MAN B&W 6S50ME-C8.2 is an electronically controlled six-cylinder, super-long stroke, two-cycle engine with an output power of 6,780 kW at 111 rpm. It is equipped with an integrated high-pressure SCR exhaust gas treatment system which ensures compliance with the Tier III nitrogen oxide (NO_x) limits and can use heavy fuel oil (HFO). The Hitachi Zosen SCR reactor converts NO_x to diatomic nitrogen and water in the presence of urea and a catalyst.



Flexible Solution



A high-pressure SCR system is more compact. The SCR reactor is located close to the engine. The exhaust gas flows from the reactor to the turbocharger (T/C). The specific arrangements are flexible and can be chosen as required to fit the engine room design. A turbine bypass allows the exhaust gas to flow directly to the turbocharger when SCR operation is not needed.



Type-approved by DNV GL

The MAN B&W 6S50ME-C8.2A, type-approved by DNV GL, has been certified by Hyundai Heavy Industries as a "parent engine", which means it is the **first in a series of identical engines** and complies with the NO_x limits of MARPOL Annex VI Reg. 13.



New vessel

Built by Hyundai Mipo Dockyard Co. and owned by F. Laeisz, the LPG carrier *Yara Kara* is the first ship powered by an **MAN B&W 6S50ME-C8.2** engine. The vessel sails with DNV GL class.



Photos: MAN Diesel & Turbo, F. Laeisz

PUTTING PASSENGER SAFETY FIRST

A new EMSA study recommends amending the damage stability requirements for passenger ships to account for new insights and improve ship survivability.

The damage stability of passenger ships is subject to the rules of the International Convention for the Safety of Life at Sea (SOLAS), which has been amended over the years to incorporate lessons learned and account for the availability of new technologies. The 1990 amendments introduced a probability concept for determining the damage stability of cargo ships, which was expanded to include passenger ships in the 2005/2006 amendments, commonly called SOLAS 2009.

A provision for the change to a probabilistic method was that it should not lead to stricter requirements. However, a number of sea incidents in recent years have raised questions about whether the requirements of SOLAS 2009 are sufficient to ensure the safety of passenger vessels, and several research projects supported by the EU have resulted in new recommendations for passenger ships. As part of these efforts, the European Maritime Safety Agency (EMSA) issued an invitation to tender a third study into possible enhancements of the survivability of passenger ships through improved damage stability ("EMSA III"). "A consortium coordinated by DNV GL was established," reports Odd Karsten Olufsen, Senior Principal Engineer, Hydrodynamics and Stability at DNVGL.

To incorporate the invaluable knowledge of the shipowning community and ensure broad support

across the industry, the consortium included leading European passenger ship builders and designers, cruise and ferry operators, software developers, and academics (see infobox to the right). The consortium provided expertise in the fields of ship design, ship operation, risk modelling, formal safety assessments (FSA), accident data analysis, and software development. Design teams were formed to study ship survivability under flooding conditions, using specific sample ships chosen by the shipbuilders and operators. The engineering consultancy Safety at Sea (SaS) headed the investigations of risks from watertight doors, and NAPA Group, headquartered in Finland,



Making ships safer by learning from experience is the gist of the new EMSA study on ship survivability.



THE EMSA III CONSORTIUM

Passenger Ship Builders: Members of the EUROYARDS interest group

- Meyer Werft
- Meyer Werft Turku
- Fincantieri
- STX France

Ship Design Consultancy

- Knud E. Hansen

Classification

- DNV GL

Engineering Consultancy

- Safety at Sea (SaS)

Cruise Operators

- RCCL
- Carnival

Ferry Operators

- Stena Line
- Color Line

Universities

- The National Technical University of Athens (NTUA)
- University of Trieste (UNITS)
- University of Strathclyde, Ship Stability Research Centre (SSRC)

Maritime Software Developer

- NAPA OY

developed the software for grounding calculations. The University of Trieste and the National Technical University of Athens carried out groundbreaking work on developing a new methodology for the assessment of groundings.

Proven methodology

The joint EMSA III project studied risks resulting from collision, watertight doors, and grounding, and performed assessments of these categories as well as combinations of all three. An impact assessment based on EU guidelines was also part of the project. The study applied the methodology defined by the IMO guidelines for Formal Safety Assessment (FSA), which include hazard identification, risk analysis, the identification of risk control options, a cost versus benefit assessment, and the formulation of recommendations for decision-making.

After evaluating accident records and risk escalation information from databases, the study groups defined a series of variants, or "Risk Control Options" (RCOs), for each of the six sampled ships to investigate the consequences of improved survivability in terms of cost. The study was limited to passenger vessels carrying a minimum of 400 persons. It was found that design variants with improved survivability in the case of collision accidents generally showed

improved survivability in the case of grounding and contact accidents as well. The cost versus benefit analysis revealed that the cost of averting a fatality value (CAF) drops significantly when a combined assessment of collision and grounding is performed.

The EMSA III research work resulted in a better understanding of the risks related to watertight doors and in software tools for grounding assessments. Based on the findings, a set of recommendations for updated damage stability requirements were drafted and forwarded to the IMO Sub-Committee on Ship Design and Construction (IMO SDC 3) for further consideration. After reconciling the levels suggested by the EMSA III study with alternative proposals from other flag states related in particular to smaller ships carrying up to 400 persons, SDC 3 developed a proposal which was submitted to the IMO Maritime Safety Committee (MSC) for approval.

Raising safety standards

The proposal implies stricter requirements regarding the survivability of passenger ships in the event of collision, raising the safety standards from current levels to reduce the risk involved in passenger transport at sea. Newbuilding and operational costs may increase somewhat as a result; however, this is justified by the cost versus benefit assessments performed by the EMSA III study, which is also a key element of the IMO FSA process. The impact assessment made in accordance with EU guidelines confirmed the conclusions of the study.

"MSC96 approved the compromise draft amendments to SOLAS regulation II-1/6 in May 2016, and adoption will be discussed at the next MSC meeting (97) in November 2016," says Olufsen. "At this point in time, the final outcome is still unclear, as some flag states may be in favour of changes, particularly regarding smaller ships."

The concerted effort of the industry consortium, which carried out the EMSA III study, has resulted in a proposal that is founded on the IMO FSA guidelines for use in the rule-making process and which was favourably reviewed by the IMO FSA Expert Group. "In addition to meeting the formal requirements, the expertise and knowledge of the leading ship designers/yards and operators that have contributed provide a solid basis for the decision-making at IMO," says Olufsen. ■ AK

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Salvage experts from SMIT on board *Modern Express* attempting to attach tow lines.

UNDER PRESSURE

When accidents happen and the DNV GL Emergency Response Service (ERS) team is called in, every minute counts, and close cooperation with salvage services is essential for a good outcome. One of the team's most recent cases was *Modern Express*.

On 29 January 2016, the ro-ro carrier *Modern Express*, a Panama-registered ship transporting 3,600 tonnes of wood and construction machinery from Gabon to France, was caught in as severe storm in the Bay of Biscay. Battered by huge waves, the vessel developed a severe list and lost engine power. The captain sent out a distress signal, and the vessel's 22 crew members were airlifted to safety by two Spanish helicopters, leaving *Modern Express* to founder in heavy seas without crew or power.

Rapid response team

SMIT Salvage, a Dutch salvage and towing company that specializes in emergency operations, was called to handle the case, and the DNVGL ERS team was activated.

Within hours, SMIT had chartered two heavy tug boats to secure the vessel and had a ten-man salvage crew on the scene. DNV GL put three technical experts on the case to provide advice on stability and structural strength issues based on the original vessel drawings and a predefined 3D computer model.

Aware that the wind and sea conditions were pushing *Modern Express* towards the south-western coast of France, the SMIT team

attempted to attach a tow line to the stricken vessel. Rough seas made this impossible, but on 1 February, four SMIT salvage experts were lowered onto the deck of *Modern Express* by a helicopter, where they were able to attach towlines. This allowed a tug to turn the vessel and steer it away from immediate danger. While no personnel were injured during the operation and the loss of the vessel was no longer an immediate threat, the job was far from over, and the focus of the operation shifted to guiding the vessel to a safe port.

Safe harbour

"Our first priority in a crisis situation is to carry out the necessary calculations to assess the condition of the vessel and to advise personnel on-site how best to manage the crisis," says Øyvind Træthaug, Principal Engineer Emergency Response Service at DNV GL. >





“Our first priority in a crisis situation is to carry out the necessary calculations to assess the condition of the vessel and to advise personnel on-site how best to manage the crisis.”

Øyvind Træthaug, Principal Engineer Emergency Response Service at DNV GL

> “Together, our duty teams in Oslo and Hamburg handle about 40 cases a year. Not all require salvage operations, but when they do, we try to support the efforts of the salvors. We have worked extensively with SMIT in the past, and have developed a good, cooperative relationship with them.”

According to Richard Janssen, Commercial Director of SMIT Salvage, the greatest challenge in any salvage operation is gaining timely access to reliable information. “Until we get people on board to assess the condition of the vessel itself, it is difficult to get an accurate picture of what we are dealing with,” he says. “The stability calculations we receive from the class of the vessel, combined with analysis from our own team, can make a big difference in how we approach salvage operations.”

Challenging conditions

Janssen says that the greatest challenge in any emergency salvage operation is coordinating the flow of information between various stakeholders. “In a

case like this, we work with the owner, local maritime authorities, lawyers and underwriters to coordinate our response. We received excellent support from DNV GL in this situation,” says Janssen, adding that the hands-on assessment of the vessel’s condition was difficult. “The vessel was listing at 40 degrees, with some decks partially submerged, making it difficult for our experts to assess structural damage. However, DNV GL’s calculations helped confirm our own analysis of the vessel’s condition and we agreed the ship was seaworthy enough to be towed.”

Righting the ship

After having applied for a place of refuge in accordance with the new EU Operational Guidelines, the Spanish authorities gave their approval by 2 February for *Modern Express* to head for the harbour entrance in the Port of Bilbao in Spain, where a boarding team of eight SMIT salvors were put onto the vessel to connect up additional tugs for berthing. The vessel was secured to the dock with specialized

Calculations by the DNV GL ERS team confirmed the vessel had sufficient stability for towing.





Modern Express listing in the Port of Bilbao, viewed across a water puddle on the quay.

shore-tension equipment after the necessary inspections could be carried out.

The next challenge was how to right the ship. "We discussed using counterweights to bring the ship upright, but as the SMIT team was able to assess the vessel more thoroughly, we verified and helped SMIT to improve a nine-step dewatering sequence using pumps and ballast tanks to gradually right the ship,"

says Træthaug, who was very happy with the result. Work began on 6 February and the team managed to reduce the vessel's list from 51 degrees to zero.

"We measure the quality of our service in how quickly we can produce and deliver useful information and recommendations for decision support in critical situations," adds Rossen Panev, a DNV GL Principal Engineer who collaborated on the case with Træthaug. "Working closely with salvors like SMIT gives us the opportunity to enhance each other's skill sets and provide the customer with the best possible advice when the pressure is on and they need to make fast decisions." ■ **AW**

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ERS: GOOD ADVICE WHEN YOU NEED IT

With over 4,000 vessels registered, the DNV GL Emergency Response Service (ERS) is the largest service of its kind in the industry, covering:

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



Safety depends on proper training, which requires constant adaptation to new technologies and operating conditions.

QUALITY ASSURANCE FOR MARITIME TRAINING

Competence is a crucial factor in the shipping business. Through its SeaSkill certification services DNV GL helps owners and operators, maritime training providers and test centres to advance crew training and ensure the highest levels of safety on board.

The most sophisticated technologies are of limited use if not operated by people who command the appropriate skills. As maritime technology advances so do the demands on crews. Complex on-board systems, shorter turnover times in ports and the ambition to operate vessels as efficiently as possible, requires highly skilled seafarers. "Enhancing crew competence and establishing a strong safety culture is a key concern for many operators in the maritime and offshore sectors. Competence management is therefore at the heart of the SeaSkill programme," says Nils Gunnar Bøe, Head of SeaSkill and Area Manager Norway East, Mid & North at DNV GL.

Overcoming reactive competence management

Seafarer training is subject to the rules of the IMO "Convention on Standards of Training Certification and Watchkeeping for Seafarers" (STCW). The amended 2012 version of the STCW sets forth new standards and requires all seafarers to be certified

accordingly by 2017. Training organizations and their equipment also require certification under the STCW. The DNV GL SeaSkill programme with its standard for providers of maritime training was the first competence-related initiative by a classification society and is widely recognized and valued by the industry. "SeaSkill certification ensures high-quality, well-structured maritime education programmes using appropriate resources and equipment, and proper competence assessments which increase the value of licences and certificates," says Bøe. Going beyond the basic requirements of STCW, SeaSkill certification is designed to make sure that "ships are operated by people who are fit for purpose."

DNV GL SeaSkill certification to applicable national or international standards is available for maritime training providers, learning programmes and test centres, simulators used for training and qualification, assessment centres and competence management systems.

DNV GL SeaSkill also assists training organizations in developing competence standards and recommended practices for areas such as ice navigation, the use of LNG as a fuel or Dynamic Positioning (DP). "Our experts have also developed a voluminous library of skill standards, which have been adopted by many training providers and assessment centres," says Bøe.

SeaSkill assessment systematics have been formally recognized by the London-based International Marine Contractors Association (IMCA), the Norwegian government and practically all relevant flag states. The German Maritime and Hydrographic Agency (BSH) has recently acknowledged the equivalence of the DNV GL standard GL-ST- 0029 with the ISO 9001 quality management standards.

Facilitating simulator certification

Numerous companies have embraced the DNV GL SeaSkill standards and activities as a reference or source for their own activities, or use voluntary SeaSkill certification to verify the quality of their maritime-training-related products and processes. For example, over 200 DP operator certificates have been issued based on SeaSkill certification.

Kongsberg Digital, a leading manufacturer of simulators, and DNV GL have formed a partnership enabling Kongsberg to assist operators in meeting the STCW requirements. For training organizations, achieving compliance has been a challenge, says Nils Gunnar Bøe. "There have been several misunderstandings regarding the STCW requirements, which have resulted in additional costs for training providers seeking approval for their simulators."

In future DNV GL will issue product certificates based on an evaluation of documentation provided by Kongsberg and a report of the on-site acceptance test conducted by Kongsberg according to approved testing programmes. DNV GL will also perform annual tests of the training provider's equipment to ensure continued compliance. "We are very satisfied to work with DNV GL to reduce the complexities and challenges maritime training providers face when obtaining product certificates for their simulator installations," says Erik Hovland, General Manager in Maritime Simulation, Kongsberg Digital.

Safety culture inspired by airlines

DNV GL SeaSkill has certified three DP test centres in Norway, including Kongsberg's Ship Modelling and Simulation Centre (SMSC) in Trondheim, the Simsea centre in Haugesund, and Kongsberg Digital's test centre. "These centres will follow industry best practices when awarding DP operator certificates to candidates who have passed their mandatory theory



The latest engine room simulators meet present and future needs in the maritime and offshore industry.

"We are proud that DNV GL selected Kongsberg as the first manufacturer to make this simplified procedure happen."

Erik Hovland, General Manager in Maritime Simulation, Kongsberg Digital

and practical exams," says DNV GL project manager Lars Markusson. More test centres will follow soon.

In the Netherlands, SeaSkill is certifying Carnival Corporation's training facility CSMART in Almere. "CSMART is one of 150 education and learning providers worldwide certified by DNV GL SeaSkill according to the DNV GL ST-0029 standard for Maritime Training Providers," says SeaSkill's Nils-Gunnar Bøe.

Carnival Corporation has modelled its safety culture after an approach adopted by the airline industry as early as the 1980s. To ensure the same or higher safety standards, all technical officers from each of Carnival's brands attend one week of training at CSMART every year. Captain David Christie, SVP, Maritime Quality Assurance at Carnival Corporation, explains: "Modern cruise ship management demands the highest level of safety, and, within all of the Carnival brands, we strive to meet or exceed the applicable safety standards." ■ AK

DNV GL Expert

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BREAKING THE MOULD

With the increasing popularity of the cruise market and as superyacht owners seek the next thrill, the private submersible sector is expected to grow substantially over the next few years. MARITIME IMPACT looks at one of the latest DNV GL projects in this field.

At the U-Boat Worx production facility in the Netherlands, a group of engineers have gathered around the three-metre-long submersible *Super Yacht Sub 3* for its factory acceptance test. Once it passes a visual inspection and dry tests on the propulsion, electric and hydraulic systems, the submersible is taken for harbour and sea trials.

The *Super Yacht Sub 3* is one of the most popular models produced by U-Boat Worx in Breda. The Dutch manufacturer specializes in submersibles for the pleasure boat and research sectors. "Our aim is to make our submersibles as safe, manoeuvrable and comfortable as possible. To ensure they meet the highest quality and safety standards, we have been cooperating closely with DNV GL for a number of years," explains Erik Hasselman, Commercial Director at U-Boat Worx.

3,600 tonnes of pressure

"Submersibles can reach depths of up to 300 metres and open up a whole new world for cruise passengers to explore, including areas that divers cannot reach," says

Andreas Fischer, DNV GL Inspection Engineer – Pressure & Underwater Technology. "Every new model is tailor made for the customer, and all calculations have to be made against pressure considerations to check whether the sub can withstand these kinds of depths," he adds. At 300 metres the submersibles' acrylic viewpoint has to resist a total force of 3,600 tonnes.

DNV GL works closely with U-Boat Worx from the design to the production phase to ensure new models achieve compliance.

"Designing these subs is a challenge because we develop submersibles that

Photos: U-Boat Worx/Rob Aarsen

can be fitted on board vessels such as superyachts. This means that the design has to be very compact while still being able to accommodate three passengers and dive to depths of 300 metres. Working with experienced staff from DNV GL has helped speed up the design process significantly," says Stefan Franken, U-Boat Worx Manager – Classification & Quality.

Tight fit

Fitting models such as the *Super Yacht Sub 3* on board a vessel requires a freeboard extender so the submersible can handle sea state three and wave heights of up to 1.5 metres. In addition, the freeboard must not be fixed permanently otherwise the craft won't fit on the superyacht.

To ensure the highest safety standards, the submersible's 200-cell lithium-ion battery propulsion system is equipped with a specially developed cell monitoring system to stop the batteries from overheating or discharging hazardous material.

The submersible has a 96-hour life support system to provide passengers with sufficient breathing air in case of an incident.

The pilot also needs to press a so-called "dead man's handle" every ten minutes otherwise an alarm system is triggered, which immediately takes the submersible safely back to the surface. As an additional safety feature, the submersible can also be operated remotely from the support vessel. >



Super Yacht Sub 3
Capable of diving 300 m deep, it can withstand a pressure equivalent to 3,600 tonnes.



The *Crystal Esprit* makeover

> One of the manufacturer's recent projects for the Los Angeles-based company Crystal Cruises, owned by the Genting Group, presented both the U-Boat Worx team and DNV GL classification experts with a particular challenge: fitting a *C-Explorer 3* submersible on the seasoned cruise ship *Crystal Esprit*.

"The *C-Explorer 3* was part of a larger upgrade programme for the *Crystal Esprit*, and it required very close cooperation between all parties involved, starting from the approval of drawings, planning for surveys and follow-up in the yard. The main tasks were to prepare the foundations for the sub and fit the retractable telescopic crane and the 'access hatch' where passengers board the sub," explains Jamel Eddine Barhoumi, DNV GL Principal Surveyor and Lead Auditor, Fleet in Service Maritime, who worked on the *Crystal Esprit* project at the Sembawang Shipyard in Singapore.

"Making space for the submersible was a challenge and required precise measurements. Quite a few things had to be relocated, for example ventilation ducts and mooring bollards, and pipes had to be rerouted," he adds. DNV GL also worked closely with the superintendent regarding the lifting procedures for the six-tonne submersible. After about three months, the *C-Explorer 3* was lifted and stowed on board *Crystal Esprit* in Penang, Malaysia, and officially launched and tried out in the Seychelles. The classification society has worked with



C-Explorer 3

Designed to be carried on board a cruise ship, the craft enables breathtaking dives for cruise passengers.



the owners for more than 20 years. "We know each other's teams very well, there is very good cooperation from top management to the surveyors in the field," says Barhoumi.

According to Captain Gustaf Gronberg, SVP Marine Operations & Newbuilding for Genting and one of the group's five certified submersible pilots, *C-Explorer 3* was received very well on the *Crystal Esprit*. "The sub has been in operation for more than a year, and we have taken her to the Seychelles and now she is in Croatia. Often people imagine a cigar-shaped submarine with a tiny window, but this model gives an incredible 360-degree view."

Crystal Esprit has been a success story for U-Boat Worx's production team as well. The Genting Group has gone on to order four more submersibles from the Dutch manufacturer. In October, two five-seater submersibles will be delivered for the installation on its newbuild *Genting Dream*. U-Boat Worx is also working on several new concepts, including a seven and a nine-seater as well as a faster sports model. DNV GL will continue to support U-Boat Worx in its ambitious plans and ensure new ideas can be taken from the concept to the manufacturing stage as smoothly as possible. ■ HH



"To ensure our submersibles meet the highest quality and safety standards, we have been cooperating closely with DNV GL for a number of years."

Erik Hasselman, Commercial Director U-Boat Worx



A look inside the manufacturing facility of U-Boat Worx in Breda, The Netherlands.

DNV GL Expert

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Ideal X, a converted tanker, was the first commercially successful container ship.

60 YEARS OF CONTAINER SHIPPING

In 1956 the modern container trade was born, when the *Ideal X* carried 58 containers from Houston to Newark in the United States. Since the delivery of the first purpose-built containerized ships in the 1960s, DNV GL's container fleet has grown into the largest in the world. To mark the anniversary of 60 years of "the box that changed the world", we take a look at some of DNV GL's most notable contributions to this sector.



MSC Oscar, classed by DNV GL, set a world record for size when she was delivered to MSC in 2015.

For many years, German owners have contributed to the innovation of the container segment, placing some of the industry's biggest players right on DNV GL's Hamburg doorstep. "Our experiences in this field were closely connected to those shipowners and the first shipyards to build these vessels. We learned from each other and worked closely together on many technological and operational advances," says Marcus Ihms, Ship Type Expert Container Vessels at DNV GL. Today, almost 40 per cent of the global container ship fleet sails under DNV GL class.

"It's staggering to see the rate at which boxships have grown in size and capacity. From 1972 to 1976 alone vessels more than doubled in capacity, from 1,600 TEU to 3,400 TEU. The 3,400 TEU vessels already had the principal dimensions of Panamax size. By the early 1990s, Panamax-size vessels were carrying 5,400 TEU," he explains. This created a number of design challenges, such as deleting the longitudinal hatch girder to allow eleven-row container stowage in the cargo hold or increasing the number of tiers on the hatch cover. "DNV GL's pioneering work in the field of structural design and our rules and regulations for container ships helped make these developments possible," he adds. For example, DNV GL implemented improved methods of modelling and calculating hull structures for this design, such as the finite element method (FEM). "Today, FEM is the industry standard," says Ihms.

Twin island concept enables ULCS

DNV GL has been closely involved in the evolution of container ship sizes - from Panamax, Post-Panamax, through to the new ultra-large container ships (ULCS) that hold close to 20,000 boxes. The feasibility study for the groundbreaking 6,200 TEU Post-Panamax project, which was the starting point for the rapid growth of Post-Panamax container ships, was guided by DNV GL experts, as were many other Post-Panamax container ship projects ranging from 8,500, 9,500 and 11,000 TEU supported and classed by DNV GL.

Most modern large container ships are based around the so-called twin island concept, where the accommodation block is located at the forward area and the engine room is located at the semi-aft. This idea emerged from the development of the 13,000 TEU design led by DNV GL and Hyundai Heavy Industries in 2005. Moving the deckhouse towards the midship section resulted in an increased nominal container intake, as well as improved hull girder strength and visibility for navigation. In addition, shifting the fuel tanks to below the accommodation block further improved the hull girder strength, trim capabilities and environmental protection. >

HISTORY OF CONTAINER VESSELS

1950


Pioneer of containerization: US businessman Malcolm McLean.


26 April 1956

The *Ideal X* departs from the Port of Newark and docks in Houston five days later with 58 containers on board.

1960
6 May 1966

Sea-Land's *Fairland* is the first container vessel to call at a German port, bringing 255 containers to Bremen.


12 January 1968

The first German fully containerized ship *Bärbel Bolten* is delivered to the tramp owner Bolten.


12 July 1968

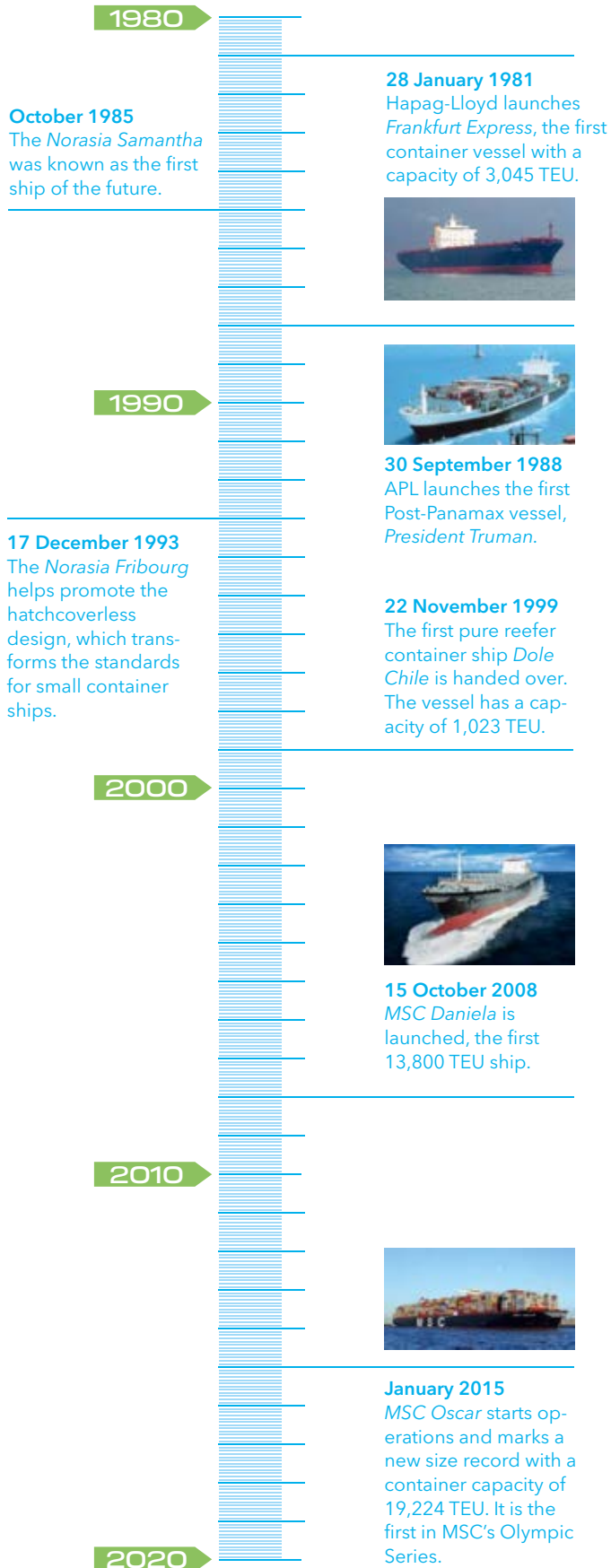
The 750 TEU *Elbe Express* is delivered.

1970

17 April 1971

Columbus New Zealand is launched. The first in a series of three, she is the world's largest reefer container ship at the time.

1980



Sajir, the first LNG-ready ultra-large container vessel, set a precedent for the use of alternative fuels in the 15,000 TEU segment.

> These innovations culminated in the rise of the ULCS class. Launched in 2015, the DNV GL-classed *MSC Oscar* and her sister vessels, with capacities of over 19,000 TEU, are the world's biggest container vessels. With a length of almost 400 m, a breadth of 59 m, a height of 30 m, a draught of 16 m and a deadweight of 199,000 t, they are not only the largest container ships but also among the world's longest vessels.

Rapid growth of reefers

In the late 1990s, the amount of refrigerated cargo carried in containers significantly increased, boosting the demand for vessels with a higher reefer capacity. DNV GL worked with the industry to develop rules for the reliable transportation of reefer cargo, covering such vital factors as the required electrical power supply, ventilation and the space required to carry out repairs. In close cooperation with Hamburg Süd and Hapag-Lloyd, DNV GL also developed rules for the efficient and safe carriage of large numbers of reefer containers, summarized in the class notation RCP, which was first published in 2000 and recently revised.

As part of this trend DNV GL developed the first requirements for medium voltage (MV) equipment, such as MV switchboards and transformers, and the installation of MV cables on board container vessels. "Today every vessel above 8,000 TEU is automatically equipped with a medium voltage system," says Ihms.

Route Specific Container Stowage

In 2013, DNV GL launched another innovation that would help its customers in what had become a very tight market. The new Route Specific Container Stowage (RSCS) notation, developed in cooperation with major German owners like Reederei Claus-Peter Offen and the Rickmers Group, was designed to help boxship owners and operators boost their vessel's utilization rates by offering more flexible container stowage. Traditionally, vessel lashing system rules and layouts are based on the harsh conditions of the

North Atlantic. DNV GL recognized that this represented a significant opportunity for vessels that operated in regions with more benign conditions.

Taking advantage of long-term statistical data on wave conditions, the RSCS notation for the first time allowed container stowage schemes that would take into account the variance in sea conditions on particular sea lanes. This meant that depending on the route and vessel, ship operators could stow heavier containers in higher positions on deck, increasing the centre of gravity of shielded stacks by up to 21 per cent. In addition, in-hold stack weight for 20-foot stowage could be increased by up to 25 per cent, as well as nominal capacity through the addition of an additional tier, where the line of sight is not affected. "The DNV GL class notation RSCS has become an industry standard. Since it became available in May 2013, DNV GL has approved lashing computers and stowage plans for more than 600 ships," says Ihms.

Alternative fuels

The implementation of green propulsion concepts using alternative fuels such as LNG is also a field which DNV GL has been involved in for many years. The DNV GL-classed 15,000 TEU ship *Sajir*, owned by UASC, was the first ever LNG-ready ultra-large container vessel, setting a precedent for the use of alternative fuels in this segment. In the US, the first DNV GL-classed, LNG-powered container vessels are currently under construction, with Crowley Maritime's two new LNG-powered con-ro ships at VT Halter Marine in Pascagoula as well as Matson's two

new Aloha-class 3,600 TEU container ships at Philly Shipyard.

Over the years DNV GL has teamed up with all the major container ship builders and designers to push the limits of design and construction. In a recent project, DNV GL carried out a technical and feasibility study for a new mega-boxship with GTT and CMA CGM (and its subsidiary CMA Ships). The Piston Engine Room Free Efficient Containership (PERFECT) concept vessel is LNG-fuelled, powered by a combined gas and steam turbine, and is electrically driven.

The development of the new DNV GL rule set, which entered into force at the beginning of this year, marks yet another milestone for DNV GL. "One of the key pillars of the new rules is the innovative concept to assess the structural strength of the hull. The introduction of so-called equivalent design waves marks a significant change in the way dynamic loads are calculated. The new advanced load approach is a major step towards a more realistic and accurate representation of the environmental loads," says Ihms.

"At DNV GL we are always looking for new ideas that will help build the next wave of innovations in the maritime world. The rules are easy to work with, industry-driven, efficient and ready for the future," he concludes. ■ SA/SG

DNV GL Expert

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The Quantum concept was developed by DNV GL and presented in 2010 as a revolutionary new design. It features improved stability and container capacity.

DNV GL IN

A heavyweight in the global maritime industry, Germany is also a very important location for DNV GL, and a centre of excellence in terms of expertise and services.

The maritime community in Germany has for a long time sat at shipping's top table. As owners, builders, financiers, and innovators, German companies and individuals have had a notable impact on almost every aspect of the industry. Today, the German-owned fleet maintains its prominent position among the world's top five shipowning countries. Many of the world's top managing owners and shipping lines call Germany, the premier container-ship-owning nation, their home.

This German maritime heritage is built into the very fabric of DNV GL, whose roots stretch back to 1867, the year Germanischer Lloyd was established in Hamburg. Today, DNV GL classes about 60 per cent of the German-owned fleet. The heart of the





GERMANY

country's maritime industry, Hamburg has continued to be the centre for the DNV GL maritime operations after the merger between DNV and GL, and is home to its global maritime headquarters.

"More than 1,000 DNV GL experts based in Hamburg and in the field are working hard to support our customers and their fleets," says Matthias Ritters, Regional Manager Germany at DNV GL. Many of DNV GL's experts have gained experience in German yards, manufacturers, shipping lines, and ship-management companies and can draw on a wealth of local knowledge and contacts. Local customers find an unparalleled range of services at their Hamburg doorstep.

Photos: DNV GL, HS-Photos/Depositphotos

Superior technical and service range

"When it comes to annual surveys or port state control, class matters a lot. At DNV GL, we strive to minimize deficiencies and avoid detentions for our customers. Our database of nearly 13,000 ships delivers a unique collection of operational insights helping us to keep our customers' vessels afloat," says Hagen Kruse, Regional Chief Surveyor at DNV GL. >

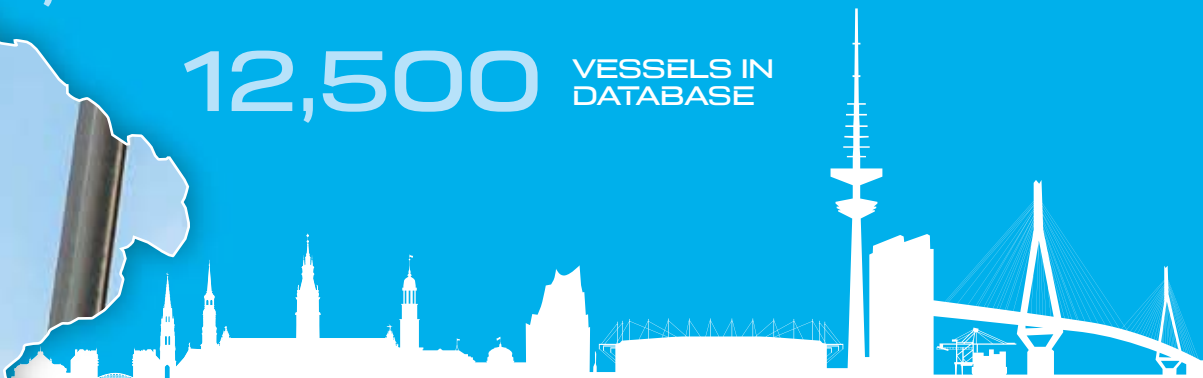
18 LOCATIONS
IN GERMANY

250 PLAN APPROVAL
TEAM MEMBERS

1,000 MARITIME
EMPLOYEES

800 MARITIME EXPERTS
BASED IN HAMBURG

12,500 VESSELS IN
DATABASE





> The Hamburg office is also where the 250 member DNV GL plan approval team works on newbuilding and retrofit projects from Germany and around the world. Relying on the new DNV GL rule set, the most modern and future proof worldwide, they ensure that DNV GL customers get the most out of every tonne of steel.

In an operational crisis the DNV GL Emergency Response Service (ERS) team stands ready to support owners and operators. More than 4,000 vessels rely on the global DNV GL ERS. The team consists of 17 people, with seven based in Hamburg and the rest in Høvik. The ERS team worked to refloat the *Hoegh Osaka* in 2015 and supported the Dutch company SMIT Salvage in bringing the ro-ro carrier *Modern Express*, which lost engine power and developed a severe list in the Bay of Biscay, safely back to port (see page 40).

With specialists for every ship type, DNV GL has highly skilled and experienced experts to cover every niche. The German DNV GL offices have dedicated ship-type experts for bulkers, container ships, MPVs, gas carriers, naval vessels, LNG as ship fuel and inland water vessels as well as teams specializing in underwater vehicles, submarines, cruise vessels, yachts and many other fields.

Maximizing efficiency

The maritime advisory team in Germany comprises some of the leading experts in shipping efficiency and optimization. A dedicated fluid dynamics team based in Potsdam is able to generate and evaluate hundreds of thousands of hull forms systematically, modeling, varying and analyzing ship designs, based on a unique parametric approach. This allows the team to optimize hull performance as well as the performance

of appendages, resulting in a hull shape and vessel design that offer the highest standards in efficiency and performance. For example, the hull line optimization of a 20,000 TEU container vessel series resulted in a reduced power demand of more than five per cent compared to the initial design and conventional lines, saving the owner up to one million US dollars annually per vessel.

The Hamburg headquarters are also the base for the award winning ECO Solutions team, whose ECO Insight tool has become the most widely used fleet performance solution worldwide, with more than 700 registered users. ECO Insight provides a comprehensive and easily accessible way to manage the performance of a fleet, including voyage, hull, propeller, engine and systems performance. ECO Insight is continuously adding new features to the portal. For example, a new cooperation with Veritas Petroleum Services has resulted in the new Fuel Analytics tool, which for the first time enables systematic assessment of the impact of fuel quality on vessel performance.

To perform the calculations underpinning these modern solutions, DNV GL utilizes one of the most powerful computing clusters available to the ship-

“Drawing on our tradition of service and our innovative vision, we are ready to meet the challenges of the market now and in the future.”

Matthias Ritters, Regional Manager Germany at DNV GL

DNV GL's Leadership

Team for Region Germany (from left to right): Matthias Ritters, Regional Manager, Sergey Gribanov, Team Leader Technical Service Management, Jörg Langkabel, Business Development Manager, Sönke Pohl, Key Account Manager Regional Business Development, Hagen Kruse, Regional Production & QHSE Manager, Principal Surveyor.



The ro-ro carrier *Modern Express* was caught in a severe storm in the Bay of Biscay in January 2016. The DNV GL ERS team supported the salvage operation.

ping industry, with some 8,000 processor cores operating in parallel enabling nearly 70 teraflops of computing capacity. Developed in-house, the simulation software running on this supercomputer is among the best in the world, as international validation contests have shown.

Hamburg is one of five hubs for DNV GL's Direct Access to Technical Experts (DATE) service. DATE is spread across all major time zones and has the capability to handle more than 4,000 questions or cases a month. The set-up allows DATE experts to address urgent requests within just a few hours. The other support hubs are located in Oslo, Piraeus, Singapore and Houston.

Hamburg is also home to a team of nine dedicated local technical support managers, providing personalized service to German shipowners and managers. "The combination of DATE and the dedicated local technical service enables DNV GL to provide tailor-made and quick support to our customers," says Sergey Gribanov, Team Leader Technical Service Management for Germany. "A team of dedicated key account managers is in constant exchange with customers in the region. Their insights into day to day questions and issues as well as the expertise provided by our Technical Support Unit (TSM) enables us to offer the best possible service to our customers", says Jörg Langkabel, Business Development Manager Region Germany, DNV GL - Maritime.

DNV GL has also established a number of ship type specific working groups and forums to discuss common operational or regulatory challenges with customers and share best practices. "These events are very important to us and we have received very positive feedback from customers. Our most recently estab-

lished fixture is the Bulk Carrier Working Group, which had its first meeting in June 2016," adds Langkabel.

Driving innovation

DNV GL is constantly searching for innovations which will take classification and the maritime industry further. Among the numerous DNV GL projects, both cooperative and in-house, that have helped advance shipping are joint industry projects (JIPs) to promote the use of LNG as ship fuel, AIPs and classification projects for the latest generations of ultra-large boxships, new survey techniques to enhance transparency, a calculator enabling smooth low-sulphur operations, and ship simulations to optimize efficiency.

Digitalization is a key area for the industry's future. The new digital solutions and innovation team located in Hamburg is working on many projects, from applications helping owners assess their exposure to cyber-attacks to a new calculation tool and survey techniques to support DNV GL class services, through to data-enhanced services to boost operational efficiency, crew performance and safety.

"Drawing on our tradition of service and our innovative vision, we are ready to meet the challenges of the market now and in the future," says Matthias Ritters. ■ SA

DNV GL Expert

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THE POWER OF INFORMATION

The maritime world is constantly in motion. New approaches to ship design, operation and management are being developed, tested, implemented and superseded. At DNV GL, too, we are always working to provide you with services and information that can help your business adapt to changing markets, regulations and advancements.



ECO INSIGHT

By making fleet performance visible, ECO Insight guides owners, managers and operators towards taking the right actions for improvement. Browse our new ECO Insight portal to see how you can increase your operational efficiency.

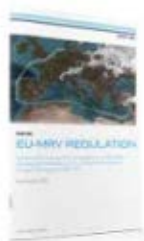
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MARITIME CONTACTS

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Our research studies and white papers demonstrate insights of the maritime industry with long-term impact. They provide you with a broader view of our services and current maritime topics.

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UPDATE - A NEW SIDE OF YOUR SHIP TYPE

Sharing our knowledge and experience to benefit our customers and the industry - our Updates offer an in-depth focused look at the issues, news and technologies of a specific ship type.

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TECHNICAL AND REGULATORY NEWS

Whether it is about incident causality information, new requirements released by the IMO/ILO or other authorities and bodies, guidance and advice on specific issues or Port State Control results: DNV GL keeps customers and business partners up to date.

dnvgl.com/tecreg



THE APP

The DNV GL - Maritime app is packed with features and information, including NEWS & EVENTS, CONTACTS, VESSELS, MARKET INSIGHTS and TRAINING COURSES. There have never been so many ways to interact with us

and stay informed about the latest developments at DNV GL.

To download the app for your Android or iOS device, scan the QR code or visit Apple's App Store or Google Play and search for "DNV GL - Maritime".



DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries.

Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. With origins stretching back to 1864, DNV GL's reach today is global. Operating in more than 100 countries, our professionals are dedicated to helping customers make the world safer, smarter and greener.

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100
Countries

15,000
Employees

350
Offices

13,000
Ships and MOUs in class