ClassNK

MAGAZINE

March 2016 - 75th Edition

- *Propulsion's composite future*
- *Stronger push for renewables*
- *Force the issue on collisions*
- *Getting tough on security*

Strides in innovation

Welcome to the 75th edition of the ClassNK Magazine

The maritime industry is in a state of constant improvement, and has been since the days of ancient navigation. Across the world, an incalculable amount of financial resources and man hours are being spent on optimizing ship designs, creating more efficient engines, and revising rules and regulations to help ensure the safety of seafarers and protect our seas. These are only some of the efforts being carried out across our industry. This edition will highlight a selection of projects supported by ClassNK and our partners.

One critical new development which is expected to improve maritime operations across the board is Big Data. Since teaming up with ClassNK in 2014 to help improve cyber security and other R&D projects, the United States Maritime Resource Center (USMRC) has been working to promote, encourage and develop open standards for data exchange among others.

Another organization working to improve operations for owners and operators is ClassNK subsidiary Helm Operations. Helm offers Helm CONNECT, an easy-to-use maintenance and compliance solution that has quickly proven to be the popular choice in the US inland barging sector. An article from Helm gives insight into why Helm CONNECT is fast becoming a household name in the industry.

57%
of crew are unaware of any cyber-safe policy or guidelines for personal web-browsing

41%
of boards don't understand supply chain risk

Find out why and more about ClassNK's partnership with USMRC on pages 20-22

With the looming introduction of Subchapter M regulations for the US inland sector, Safety Management Systems LLC (SMSLLC) has taken the initiative by providing regulatory advisement, risk management, and internal auditing services. In this edition SMSLLC explains how it is helping the industry prepare for the new regulations.

In terms of physical development ClassNK is supporting innovative technologies in shipbuilding. Details of the development and benefits of Nakashima Propeller's carbon fiber reinforced plastic (CFRP) propeller, the world's first CFRP propeller to be installed on a commercial vessel are included in this edition.

Another project supported by ClassNK is an innovative new material, Highly Ductile Steel, developed by Nippon Steel & Sumitomo Metal Corporation which has already been applied to a bulk carrier built by Imabari Shipbuilding. The key feature of this material is its ability to absorb greater impact than its conventional counterparts without rupturing, greatly limiting the chances of spillages in the event of a collision.

These are just some of the exciting new topics covered in this edition of the ClassNK Magazine.

ClassNK

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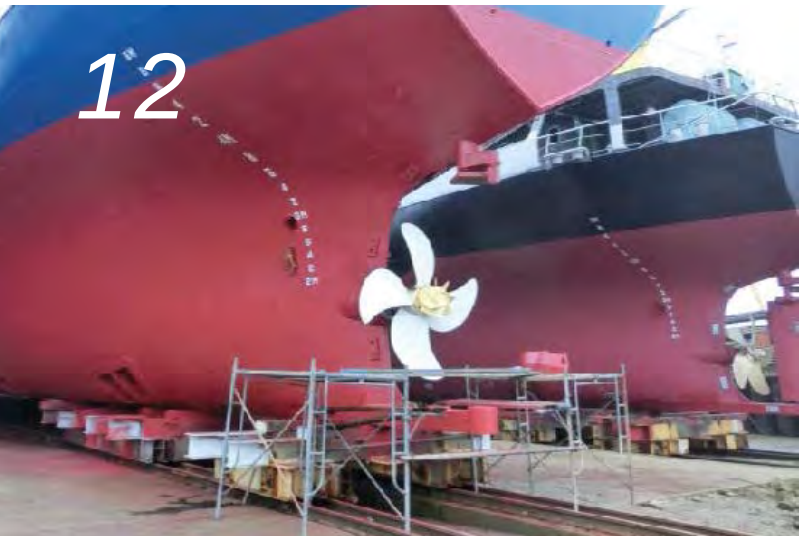


ClassNK

ClassNK news

AIP granted to LNG-fueled vessel

17 November 2015 - ClassNK granted Approval in Principle (AIP) to a 98,000 dwt LNG-fueled bulk carrier design developed by Maritime Innovation Japan Corporation (MIJAC). Utilizing its extensive knowledge and experience in R&D for LNG-fueled vessels, ClassNK carried out the safety evaluation of the vessel and approved the concept design based on the International Code of Safety for Ships using Gases or other Low flashpoint Fuels (IGF Code), which will come into effect from 1 January 2017, and ClassNK's Guidelines for Gas Fueled Ships. The vessel will be fitted with a 2,000m^3 capacity LNG tank (IMO Type B) and an LNG fuel supply system. The main engine and main generator engines will operate on dual fuel. ClassNK has the world's top share of bulk carriers on its register and through granting AIP to this LNG-fueled bulk carrier, it is contributing to the spread of environmentally-friendly shipping practices.

Guidelines for Floating Offshore Facilities

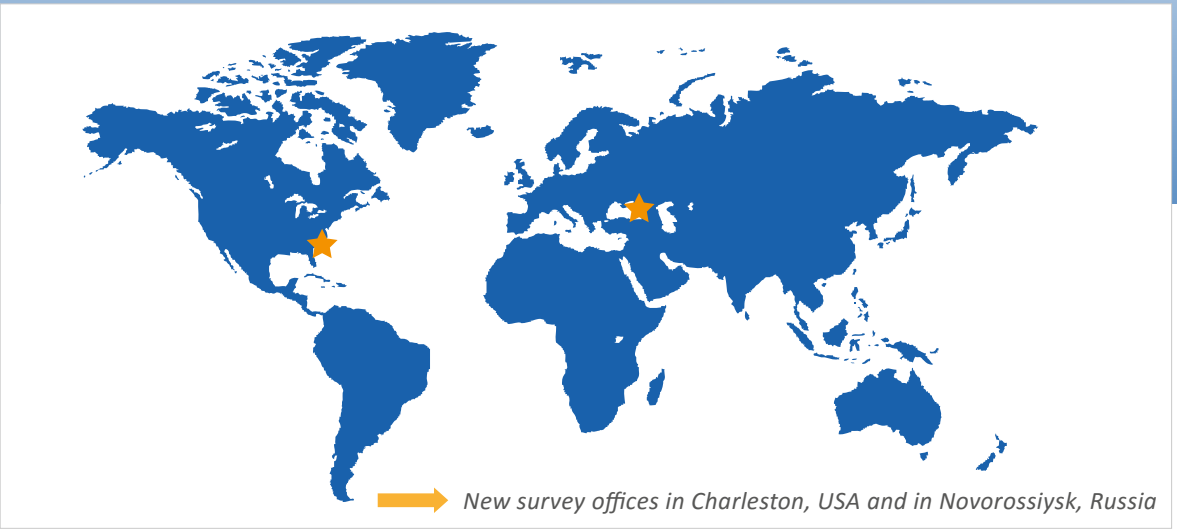
3 December 2015 - ClassNK released its Guidelines for Floating Offshore Facilities for LNG/LPG Production, Storage Offloading and Regasification (Third Edition). The first edition of the guidelines laid out specific technical requirements for gas FPSOs and was released in 2011. In February 2015, the guidelines were revised and the second edition was released to clarify the application to FSRUs. Key industry players, as well as ClassNK and Japan's Ministry of Land, Infrastructure, Transport and Tourism recently gathered to discuss how to further enhance the safe design of FLNG. Based on the outcomes of this discussion, ClassNK has developed the third edition of its guidelines. Updates include specific requirements of mooring analysis of single-point mooring systems, such as turret mooring systems. The combination of environmental conditions to be considered and statistical analysis methods using tension evaluation are set out in detail in the guidelines.

IT Solutions award for ClassNK-PEERLESS

18 November 2015 - ClassNK received the IT Solutions Award for its 3D modeling software ClassNK-PEERLESS at the International Bulk Journal (IBJ) Awards in Antwerp on 16 November. The Award's independent panel of judges selected ClassNK-PEERLESS from a number of nominations for the IT Solutions Award which recognizes a new innovation that increases efficiency in a bulk cargo operation. ClassNK-PEERLESS provides a solution to the ballast water management (BWM) system retrofit bottleneck following the anticipated entry into force of the BWM Convention. Whereas before it was necessary to enter the engine room and measure every structure manually, ClassNK-PEERLESS streamlines the process and eliminates the need for direct contact by using high-precision 3D laser scanners. This marks the second consecutive year that ClassNK has won the IT Solutions Award. Last year it received the award for its jointly developed vessel performance monitoring and optimization solution ClassNK-NAPA GREEN.

ClassNK establishes Ship Data Center

7 December 2015 - ClassNK announced the establishment of the Ship Data Center Co., Ltd. in Tokyo, Japan, a wholly owned subsidiary that aims to support the utilization of data gathered from ship operations. The Data Center will be headed by ClassNK Executive Vice President Yasushi Nakamura. To make larger gains, an effective platform capable of centralizing and managing such diverse data is essential. However, creating and maintaining this kind of platform is costly, time-consuming and unrealistic for some organizations. The Data Center consists of a secured shipping operations database which will serve as an information hub to independently manage the utilization of big data in the maritime industry. Through the Center's integrated data, the industry can maximize the benefits of big data with minimum cost and burden. Trials of the Data Center will commence on a container vessel in February 2016 in cooperation with a Japanese shipping company. Various information including data from the ship's voyage data recorder and data logger will be gathered from the vessel.



New survey offices in Charleston, USA and in Novorossiysk, Russia

New survey office in Charleston

4 January 2016 - ClassNK opened a new exclusive survey office in Charleston, USA with operations beginning 1 January 2016. Charleston is a major port city located in South Carolina and home to one of the fastest growing ports in the USA. It has the deepest channels in the southeast region and plans are underway to increase its depth to 52 feet by 2019 to accommodate the ever-increasing size of containerships. Once the project is complete, Charleston will become the deepest harbor on the east coast. The Charleston office joins an expanding network of ClassNK survey offices along the coast including in New York, Norfolk and Miami.

New survey office in Novorossiysk

4 January 2016 - ClassNK opened a new exclusive survey office in Novorossiysk, Russia with operations beginning 1 January 2016. Novorossiysk is a port city in southwest Russia facing the Black Sea. It is the country's main port on the Black Sea and a leading Russian port for trade with Asia, the Middle East, the Mediterranean region, Africa and South America. The Novorossiysk office joins an existing network of survey offices throughout the region including in Constanta (Romania) and Istanbul (Turkey). The strategic positioning of the Novorossiysk office will allow ClassNK to respond swiftly to the recent increase in clients' needs across the Black Sea and dispatch surveyors without delay.

ClassNK 2015 annual Technical Bulletin

22 December 2015 - ClassNK released a summary of the latest industry developments in its annual Technical Bulletin (Vol. 33, 2015). This year's edition covers a wide variety of topics including marine energy usage, research on fatigue strength and R&D project outcomes. The opening paper explores the possibilities and challenges of tidal power, offshore wind power, and wave power, and outlines tidal power generation systems around the world. A technical report then takes a broad look at the trend of ocean energy development in Japan and ClassNK's initiatives related to the certification of renewable ocean energy power generation devices. This Bulletin presents studies on fatigue strength in welded joints and the thickness effect of fatigue strength in large-scale-welded models as well as a proposal for a simplified high frequency fatigue damage assessment method for a ship's welded parts. This year's edition also includes outcomes from several R&D projects. Available for download through the My Page service at *www.classnk.com*.

Guidelines for Use of Structural Adhesives

14 January 2016 - ClassNK released its Guidelines for Use of Structural Adhesives for the shipbuilding industry. Compared with other joining methods such as welding, structural adhesives are easy to construct and control. In addition, because they can be used without the need for hot work, they are used in a wide variety of fields including the railway and automobile industries. The application of structural adhesives is anticipated to streamline workflow, increase workplace safety at shipyards, and reduce vessel weight. In light of these anticipated benefits, industry requests were made for guidelines to facilitate their wider use. In response to these requests, ClassNK established the Committee of the Development of Guidelines for Use of Structural Adhesives in cooperation with relevant institutions and organizations to discuss the necessary requirements. These requirements were compiled and the Guidelines for Use of Structural Adhesives were developed.

SoC issued to Indian facilities

15 December 2015 - ClassNK issued Statements of Compliance (SoC) to two ship recycling facilities in Gujarat, India, Shree Ram Vessel Scrap Pvt. Ltd and Leela Ship Recycling Pvt. Ltd, verifying that the facilities are in line with the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (HKC). Although the HKC has yet to enter into force, Shree Ram and Leela have both carried out substantial improvements to their facilities in a bid toward safer and greener ship recycling as well as developed the Ship Recycling Facility Plans (SRFPs) required for a competent authority's certification according to the HKC. ClassNK reviewed the SRFPs prepared by Shree Ram and Leela, which comply with requirements of the HKC, and confirmed that their ship recycling processes follow their respective SRFPs. ClassNK conducted a full set of on-site inspections to verify that both yards met the required standard before issuing the SoC.

Updates on ship recycling

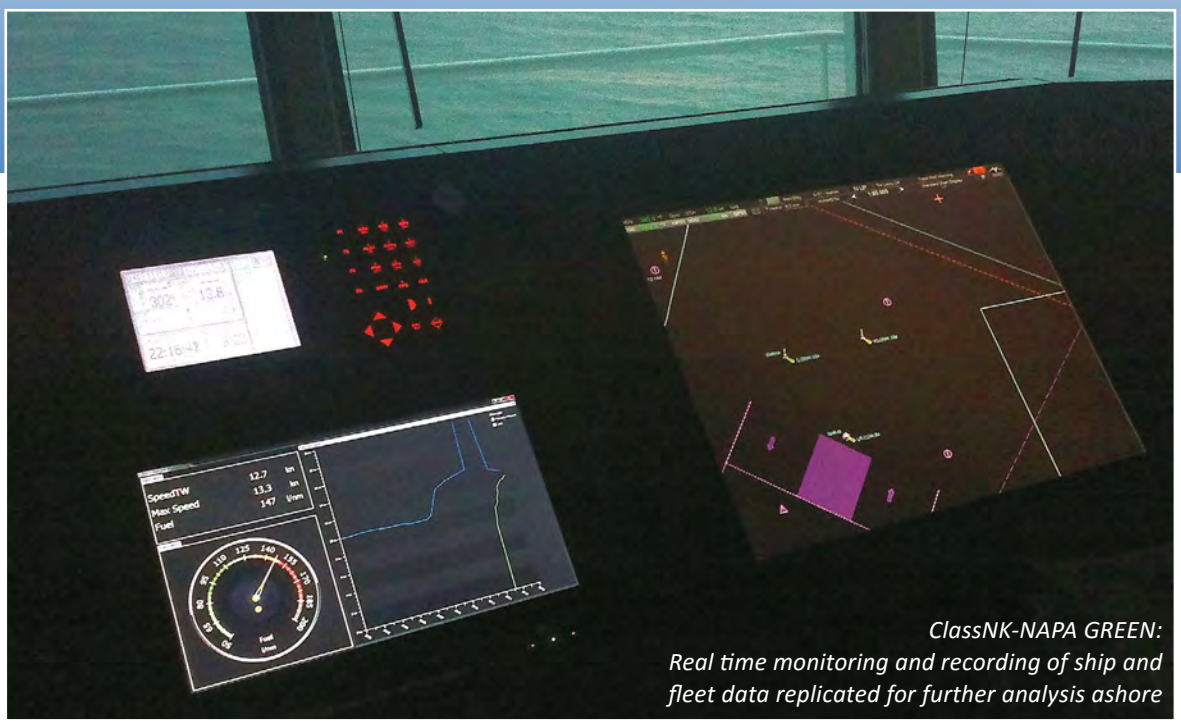
29 January 2016 - ClassNK released the latest updates on ship recycling on its website. The updates include information on ship recycling facilities that ClassNK has issued Statements of Compliance (SoC) to so far in line with the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (HKC). In response to the growing demand for verification, ClassNK reviewed HKC-compliant SRFPs prepared by ship recycling facilities from Japan, China and India and confirmed that their ship recycling processes follow their respective SRFPs. The society also conducted thorough on-site inspections before issuing Statements of Compliance (SoC) based purely on technical verifications of the facilities. ClassNK was invited to discuss better ship recycling practices at the 'Ship Recycling Seminar: Towards sustainable ship recycling', held in London on 3 February and organized by Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in cooperation with the IMO Secretariat.

Amendments to class rules

5 January 2016 - ClassNK announced that it released amendments to its Rules and Guidance for the Survey and Construction of Steel Ships on 25 December 2015, including structural strength requirements of container carriers. In response to a large container ship casualty in June 2013, ClassNK established The Investigative Panel on Large Container Ship Safety to investigate the possibility of casualty occurrence and the structural safety of large container carriers. The results from the investigation and ClassNK's action plan were released in the Investigation Report on Structural Safety of Large Container Ships in September 2014. In line with its action plan for rule amendments and the recommendations by the Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Committee Large Container Ship Safety, ClassNK has updated its independent longitudinal strength requirements in consideration of the effects of whipping, and the effects of sea water pressure and container loads. The amendments also reflect the new IACS Unified Requirements (UR) S11A and S34.

PrimeShip-HULL for container carriers

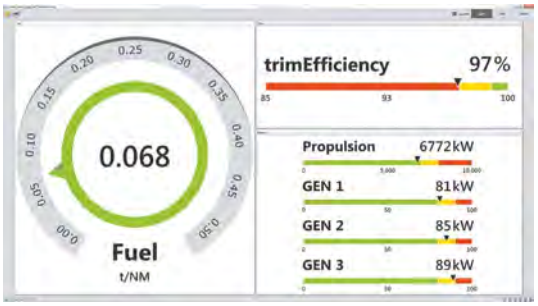
18 January 2016 - ClassNK announced the release of its new structural design support system PrimeShip-HULL for Container Carriers to correspond with its latest rule amendments. To promote container carrier safety, ClassNK released amendments to its Rules and Guidance for the Survey and Construction of Steel Ships on 25 December 2015. The amendments, based on findings from ClassNK's investigation into a large container carrier casualty, include updates to independent longitudinal strength requirements and reflect the new International Association of Class Societies (IACS) Unified Requirements (UR) S11A and S34. These amendments will apply to container carriers contracted for construction on or after 1 April 2016, three months before the application of the IACS UR S11A and S34. In a further demonstration of its unwavering commitment to safety and the steps taken to enhance methodology, ClassNK developed PrimeShip-HULL for Container Carriers to correspond with its latest rule amendments.



ClassNK-NAPA GREEN: Real time monitoring and recording of ship and fleet data replicated for further analysis ashore

Namura Shipbuilding introduces ClassNK-NAPA GREEN

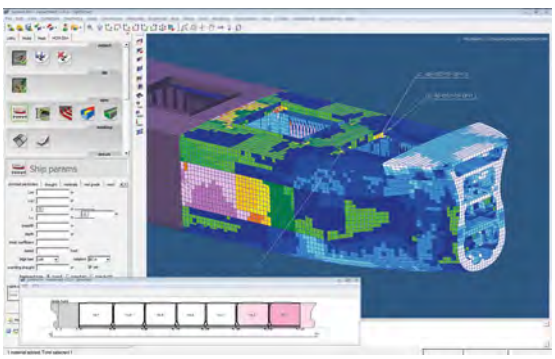
26 January 2016 - The fleet performance management and optimization system ClassNK-NAPA GREEN jointly developed by ClassNK and maritime-software, services and data analysis company NAPA has been introduced to a newbuilding by Namura Shipbuilding. The move was spearheaded by Namura Shipbuilding based on the shipowner's acceptance. Namura Shipbuilding's introduction of ClassNK-NAPA GREEN aims to use voyage data and performance analysis of actual voyage speed, draft and full cargo load performance to provide feedback for optimized ship design. For example, voyage data collected from ClassNK-NAPA GREEN can be used by the shipyard to indicate optimized hull shape and engine specifications for newbuildings. Namura Shipbuilding anticipates a further increase in demand for voyage support systems and is strengthening its competitiveness by proactively installing the award-winning software on a newbuilding and providing its clients with added value.



ClassNK-NAPA GREEN performance monitoring

ClassNK PrimeShip-HULL(HCSR) system upgrade

16 February 2016 - PrimeShip-HULL(HCSR) has long been the go-to design support system for ship designers worldwide. To date, over 800 licenses have been provided to more than 90 shipyards. In response to the latest amendments to the IACS Common Structural Rules for Bulk Carriers and Oil Tankers (CSR BC & OT), ClassNK has just released its latest version, PrimeShip-HULL(HCSR) Ver. 3.0.0. The new version builds on the success of ClassNK's existing system with some useful tweaks and new capabilities. As always with PrimeShip-HULL(HCSR) upgrades, ver. 3.0.0. is up to speed on all the latest rules and is fully compliant with the February 2016 corrections (Corrigenda 1) made to CSR BC & OT. The prescriptive calculation software includes enhanced data linkage with popular commercial CAD systems, which further streamlines the design process.



ClassNK PrimeShip-HULL(HCSR)

Helm CONNECT:
The appeal of simple software

Helm CONNECT helps the industry face maintenance challenges

In July of 2014, ClassNK acquired Victoria, Canada-based maritime software developer Helm Operations. One of the main reasons for the acquisition was the promise of Helm CONNECT – a maintenance and compliance software solution that was being developed for the workboat industry. The appeal of Helm CONNECT was the user interface, which was different from every other software provider. Helm had taken the complexity of maintenance and compliance functionality and designed it in such a way that it was simple and intuitive to use.

Helm's core market is the US inland barging market, and ClassNK believes that the development of Helm CONNECT is a great way for Helm to further penetrate this potentially lucrative market with its maintenance and compliance software. One thing ClassNK did not anticipate was the broad appeal of software usability. Early estimates predicted widespread use of Helm CONNECT in the inland barging industry. However, the ease of use of the software has opened up other markets that both ClassNK and Helm had not considered before.

The results are in

After eight months of marketing Helm CONNECT, the results are in. The inland barging industry has started using Helm's new solution, but other markets, such as fishing, research vessels, passenger vessels (i.e. ferries), pilot vessels and offshore vessels have taken notice of how easy it is to use Helm CONNECT, and have started buying the solution for their industries as well. In fact, over 30 companies have already bought Helm CONNECT to address their maintenance challenges. The reason? There isn't a

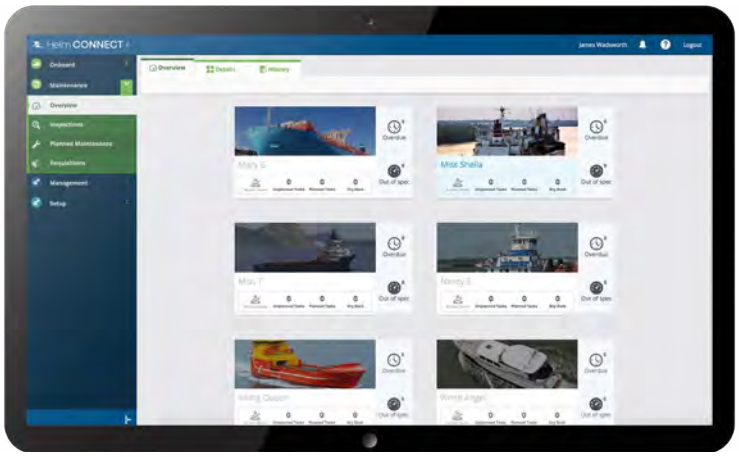
maintenance and compliance solution today that addresses the commercial maritime industry's needs better than Helm CONNECT.

Commercial Maritime Industry Needs

"It seems like our competitors are working against the industry instead of for the industry," says Rodger Banister, VP Marketing for Helm Operations. "So when we developed Helm CONNECT, we wanted to address their needs (instead of ours) as much as possible." Banister says that the core of those needs is about giving power back to the customer.

"We want to make Helm CONNECT easy-to-use, easy-to-buy and easy-to-configure," says Mr Banister. Users always try to do less with software that's difficult to use, and in an era where better information saves companies time and money, the place to start is with software that's easy-to-use. With respect to pricing, Helm makes it easy because it published the prices of Helm CONNECT, something its competitors definitely do not do. And yet another difference between Helm and its competitors is that it gives power back to its customers in the area of configuration. Most software companies charge their customers to 'set up' the software to match their processes and routines. But Helm lets its customers do it all themselves. Helm's customers appear to be satisfied with their approach, too. Anthony Roberts from Louisiana International Marine says; "We chose Helm CONNECT because they [Helm] made it easy to do business with them. First off, their maintenance and compliance software is the easiest we've ever seen, and secondly we didn't have to wait weeks to get a price quote from them. They've been transparent and responsive throughout the entire process."

> *"We chose Helm CONNECT because they made it easy to do business with them"*



Helm is making easy-to-use software and making it easy to do business with them too.

SMS reflects on US inland safety standards

SMSLLC is holding up a mirror to US inland operators and asking if they like what they see

Change is coming to the governance of vessel safety along US inland waterways, as the US Coast Guard's 'Subchapter M' regulation brings a new inspection, standards and safety management systems regime.

While this is a step change for an industry that has hitherto been self-regulating, the critical distinction between self-regulating and unregulated needs to be acknowledged. Many inland service providers pride themselves on their safety records, while industry body the American Waterways Operators makes strenuous efforts to coordinate standards.

Safety Management Systems LLC Director Bill Mahoney points out that internal auditing plays a central role in maintaining safety standards in shipping as a whole. "With ISM, the international shipping community shifted its focus somewhat towards a climate of 'self-regulation' meaning that operators were trusted by the regulator to identify the risks particular to their operations and to establish suitable mitigation strategies," he observes.

"The job of the regulator involved verifying that the operator had sufficiently identified and addressed the risks accordingly. The internal audit function plays a critical role to assist the operator in taking a very close look at itself in the mirror."

However, Mr. Mahoney says that the voluntary governance of tugboat and towboat safety along US waterways makes the design and implementation of internal audit programs that offer a mirror to operating practices "a potentially foreign concept".

"Our experience is showing us that many operators are either using a mirror that's too small or that distorts the image," he says.

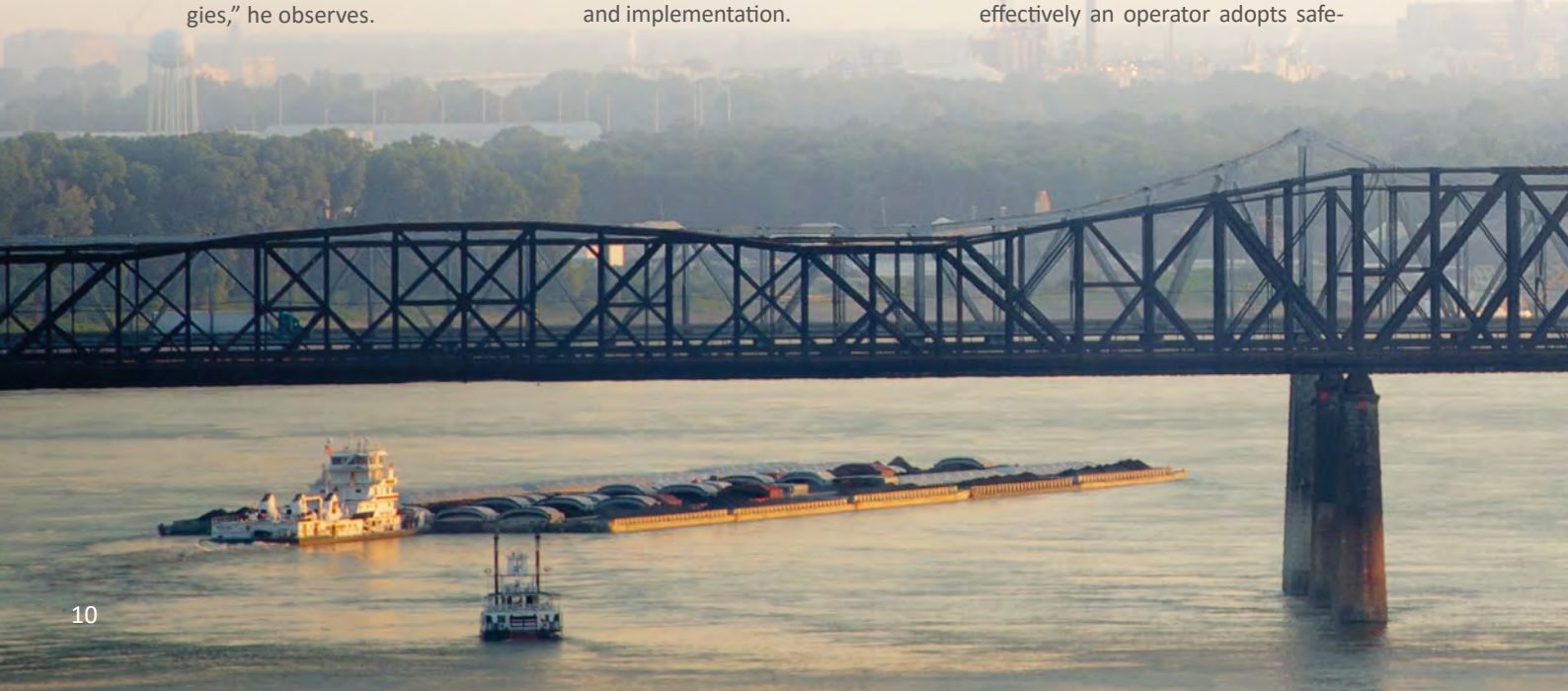
Consultancy SMSLLC was acquired by ClassNK in 2014, as part of the Society's long-term commitment to the US and beyond. The Maine-based company has a strong reputation for professionalism and attention to detail in providing regulatory advisement, risk management, internal auditing and management systems design and implementation.

"A safety management system evolves over time and our goal is to track the progress of its evolution in a positive direction," says Mr. Mahoney. "Where we observe matters trending in an opposing direction, we make recommendations to inform a course correction."

Often, though, SMSLLC will be called in to offer guidance at times of profound change for industry, with its advice and systems design providing the basis for participants to respond to developing regulation or new expectations from charterers/shippers.

The new and developing relationship between SMSLLC and Starr Marine has been exemplary. Starr is responsible for insuring the majority of vessels within the US domestic tugboat and towboat industry.

"Both underwriters and owners understand that our area of expertise is safety and operational management," Mr. Mahoney observes. "As such, we focus on the system rather than the organization - regardless of its type. Our role is to capture how effectively an operator adopts safe-



> *Our role is to capture how effectively an operator adopts safety management during a baseline assessment, benchmarking against future reviews*

ty management during a baseline assessment, benchmarking against future reviews."

The step change in US inland safety governance has also seen SMSLLC called in by some of the industry's largest individual operators. Major inland, coastal and oceangoing bulk liquid transportation service provider Kirby, for example, recently asked the consultant to assist with the operational assessment of its SMS throughout various fleets.

Kirby defines safety as a 'core value', supporting its training commitments with quality management that includes ongoing ISO 9002 accreditation, its own Quality Steering Committee, and regular customer and employee surveys.

"There is a strong internal auditing culture at Kirby that delivers measurable results," says Mr. Mahoney. "However, Kirby is keen to determine how effectively its expectations are actually put into practice onboard its vessels. It's one thing to have an audit or TMSA2 review; it's quite another to custom-tailor an assessment to support a deeper analysis of how actively and effectively policy and procedures are put into practice."

SMSLLC is being given a free and objective hand in the scope of the review, but historical experience has informed some areas for a more intensive focus, Mr. Mahoney says. "Kirby recognizes that to achieve a meaningful understanding of the dynamic between the safety management system and personnel onboard, SMSLLC consultants will need to review operations onboard. We need a sufficient sample of offshore and inland vessels for multiple days to experience the integration of safety management into operational routines at various locations.

"This level of assessment is not achievable via conventional audits that explore a relatively broad scope at a more superficial level," adds Mr. Mahoney.

Providing assistance to owners overhauling their internal auditing systems is a key SMSLLC service offering, and its recent work with diversified inland and offshore operator Genesis Marine Transportation is a great example.

"Genesis is taking a leading role in sponsoring the development of an internal auditing program that parallels its safety management program by supporting detailed and thorough self-examination," explains Mr. Mahoney.

"We sought ways to better our internal audit practice," says Samuel C. Robinson, Director Marine Operations at Genesis Energy. "The revised checklist provided improved topic and time balance, with more emphasis on vessel process. It allows for focus by design. SMSLLC gave us exactly what we wanted."

"The robust internal audit function achieves operational improvement and eliminates any potentially troublesome lapses in compliance," adds Mr. Mahoney. "Through Genesis we've acquired a deeper appreciation for the value of internal auditing and what may be a related disconnect in the domestic towing industry.

"It is not uncommon for the scope of our services to expand with any client as a function of time and our role as a trusted advisor and team member. What they will see in the mirror will be reflective of a true measure against their own requirements."

Propulsion's composite future

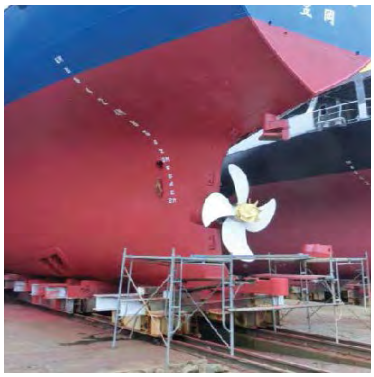
Developing innovative technologies to contribute to a safer and greener maritime industry

The driving force behind shipping can be attributed to many factors, but the driving force behind the ships themselves is arguably their propellers. Research into improving this vital component has been virtually constant since its inception. While their size and shape may have changed over the years, NAB (Nickel Aluminum Bronze) is still by far the material of choice.

The use of NAB as a material provides many advantages in terms of strength, however there are other factors to consider. Copper itself is an exhaustible mineral, and the reserve-production ratio for copper that is available in the mining industry is estimated to reach its limit over the next few decades. Demand from increased construction in emerging countries and futures trading of the material have also driven up the price of copper worldwide. The economic aspect alone provides enough of an impetus to search for a new raw material that can provide a substitute.

At the same time, the industry is also looking at ways to improve operational efficiency. Although owners are now enjoying lower oil prices, they are faced with increasingly stringent environmental regulations that require substantial reductions in emissions. Cutting fuel consumption through improved efficiency continues to be the most sustainable option for the industry.

Composite materials are increasingly being used for their strength and corrosion resistant properties, proving to be a feasible alternative to NAB. In particular, glass fiber



CFRP propeller installations

> *By taking advantage of CFRP's strength and light weight, it is possible to produce thinner propellers with smaller blade areas, potentially increasing the propeller's efficiency*

reinforced plastic (GFRP) and carbon fiber reinforced plastic (CFRP), both of which are composite materials, have already been used in fields such as aerospace, automobiles and wind power generation, and their scope of application has been further expanded due to their advantages.

Fiber reinforced plastics offer another key advantage: their lower mass make them significantly lighter than their conventional metal counterparts. On the face, the benefits seem fairly obvious, lighter materials are cheaper to transport and assemble. Most importantly however, if this material could be applied to propellers, would its lower mass produce any reductions in operational costs? Are there any other benefits that could be gained using this material? The first question can be easily answered. Lightweight composition allows for larger blades which increase propulsive efficiency and consequently save fuel.

ClassNK has been at the heart of efforts to see if the advantages of fiber reinforced plastics could be transformed into a workable reality for commercial shipping, as part of its overall research and development program. Within its *Joint R&D for Industry Program* Nakashima Propeller Co., Ltd. led a project with partners including the University of Tokyo, Japan's National Maritime Research Institute (NMRI), Imabari Shipbuilding Co., Ltd., NYK Line, and Monohakobi Technology Institute (MTI), to develop a propeller using CFRP as its main blade material. After a variety of tests on a newly proposed design, the CFRP propeller was approved for use on commercial vessels.

The CFRP propeller was first fitted as part of the side thruster installation on the 499 gt chemical tanker Taiko Maru in 2012. Based on the successful performance of the CFRP propellers installed on the vessel, shipowner Sowa Kaiun YK decided to extend the use of the CFRP propeller technology to its main propulsion system, making the vessel the first merchant ship in the world to use a CFRP propeller for its main propulsion system.

Taiko Maru's new CFRP main propeller features an enlarged diameter (2.12m in place of 1.95m diameter of the original NAB propeller) thanks to its ultra-lightweight composition (60 percent less than conventional NAB propellers), providing the chemical tanker with higher propulsion efficiency.

While the use of CFRP propellers as a solution for the very largest of ships remains to be seen, the early signs are promising. Sea trials on *Taiko Maru* confirmed that the shaft power required by a merchant ship featuring a CFRP propeller was reduced by 9 percent compared to conventional metal propellers at the same cruising speed. It was also reported that the use of the propeller resulted in a noticeable decrease of onboard noise caused by hull vibration, most likely attributable to the greater flexibility of the propeller blades which distribute flow pressure evenly across their surface to greatly lower the occurrence of cavitation.

Based on the knowledge obtained through this joint R&D project, ClassNK also summarized the requirements for the approval of the manufacturing process for composite propellers and the testing/ inspections in the world's first *Guidelines on Composite Propellers* (Part on Manufacturing/ Product Inspection).

With further research and data on how the propeller works in real operations, the uses of CFRP propellers could be extended to larger vessels in the future. While no assumptions can be made yet, the future is bright for CFRP propellers.

Strong push for renewables

ClassNK is taking necessary steps to support the development of marine renewable energy

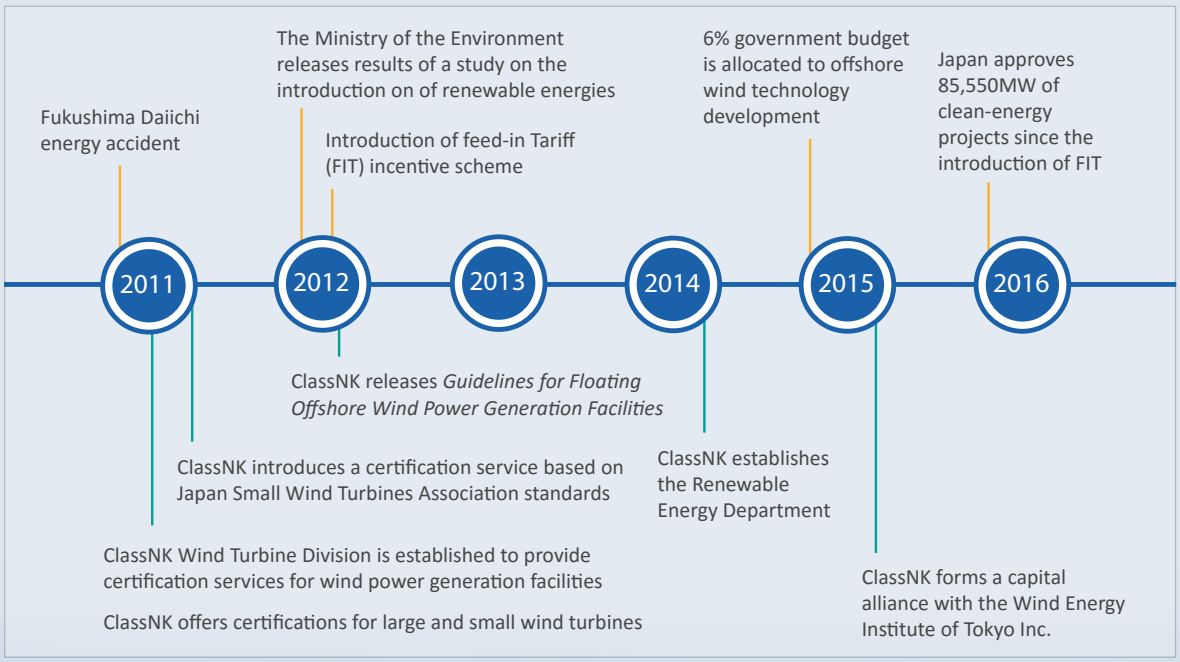
Growing worldwide concern over global warming is increasing demand for cleaner forms of energy that do not emit greenhouse gases. Renewable energy platforms that utilize alternative sources that are available offshore require extensive ingenuity, but also risk management.

With 8,771 megawatts (MW) of electricity generated by global offshore wind resources in 2014, wind remains the most developed offshore renewable energy source. While electricity from onshore wind farms is already cheaper than conventional power in an increasing number of markets, relatively high costs remain the biggest challenge for offshore wind development.

However, according to a study commissioned by the European Wind Energy Association (EWEA) in 2015, offshore wind costs could be reduced to EUR 90/MWh (USD 94) by 2030. In line with the report, the sector will have reduced the cost of energy to close to EUR100 per MWh by 2020, by which time cumulative installed capacity in European waters is expected to have tripled to 23.5 GW.

At present, more than 91% (8,045 MW) of all offshore wind installations can be found in European waters; in the North Sea (5,094.2 MW: 63.3%), Atlantic Ocean (1,808.6 MW: 22.5%) and in the Baltic Sea (1,142.5 MW: 14.2%).

Nevertheless, governments outside of Europe have set ambitious



6 years of renewable energy in Japan

targets for offshore wind and development is starting to take off in South Korea, Taiwan and China where 61 offshore wind units have been added in the past three years with a total capacity of 229.3 MW in 2014. The target is to reach 30 GW of installations off the Chinese coasts by 2020.

As Japan possesses the world's sixth largest exclusive economic zone, expectations are high that the nation will develop as a mainstream source for renewable energy.

To date, wind power generation facilities in Japan have mainly been established onshore, with total capacity reaching approximately 2.6 GW by the end of 2012. However, due to the increased costs of establishing larger facilities onshore and land scarcity, wind energy recovery opportunities have been explored along the Japanese coast line.

The feed-in Tariff (FIT) incentive scheme for purchasing all renewable energies at a fixed tariff introduced in July 2012 confirmed the strong commitment of the Japanese government to solar and wind energy sources.

Last year, Prime Minister Shinzo Abe announced that JPY 131 ($ 1.1) billion - of the JPY 96.3 trillion 2015 budget – had been assigned to renewable technologies with 6% of the budget for offshore wind technology development.

The go-ahead for clean-energy projects set to generate 85,550 MW since the introduction of FIT in 2012 followed at the beginning of the year. Of the approvals, 23,650 MW, or about 28%, had gone online as of the end of September 2015, according to the Ministry of Economy, Trade and Industry. That is more than equal to the 20,600 MW of clean energy capacity Japan had before the FIT program began.

Offshore platforms take advantage of stronger winds than onshore structures, which is one of the main factors attracting the development of floating type and fixed-foundation wind turbine installations offshore.

Fixed offshore wind turbine systems are more common in Europe, where extensive shoals around the coastal areas provide optimal conditions for harnessing renewable energies. Despite the scarcity of linear landforms in Japan, as part of the government's initiative demonstration projects are supporting the aim to test the viability of fixed-foundation type and floating type structures off the coasts of Fukushima, Nagasaki Goto, Kitakyushu and Choshi.

With its vast background in marine energy and offshore research, combined with extensive research assessing both marine and offshore structures, ClassNK support is pivotal to the viable development of Japan's wind power generation facilities of the future.

In accordance to Japan's Ship Safety Act, which applies to floating offshore wind turbines constructed on or after April 2012, ClassNK has offered certification services for large and small wind turbine systems and classification surveys for related offshore support structures through its Wind Turbine Division, which has now taken on an expanded role as the Renewable Energy Department. Ever since the establishment of this division in 2011, ClassNK has been making multiple efforts to help facilitate the spread of offshore wind power generation in Japan. Conducting classification surveys as an "authorized organization" under the Ship Safety Act, the Society published the *Guidelines for Floating Offshore Wind Power Generation Facilities* in July 2012.

Using its ships and marine structures expertise, ClassNK carried out class registration inspection for the Fukushima Project (phase I) for the Ministry of Economy, Trade and Industry, and the Nagasaki Project for the Ministry of Environment, as well as issuing certificates for both in the spring of 2014.

ClassNK is also authorized to issue type certification for small wind turbines with an output of less than 20kW to confirm that these meet the public safety standard required by FIT to be eligible for the scheme, with 13 small wind turbines certified so far.

As part of its certification and design evaluation activities for large wind turbines, in accordance with IEC and JIS, ClassNK issued a "Design Evaluation Conformity Statement" to Mitsubishi Heavy Industries covering a 2.4MW wind turbine. In addition, the Society issued "Prototype Certification" to the wind turbines destined for the Fukushima Offshore Wind Turbine Project "Fukushima FORWARD", one MHI-built 7MW installation.

> *ClassNK continues to make multiple efforts to expand the deployment of marine renewable energies*

ClassNK is also part of a National R&D project overseen by the New Energy and Industrial Technology Development Organization (NEDO), Japan's largest public R&D management organization, and has developed the certification guidelines for Condition Monitoring System (CMS) for wind turbine certification. This project aims to improve efficiency of domestic installed wind turbines from the current average level of below 20% to over 23% by enhancing maintenance strategy and conducting demonstration tests on actual wind turbines.

Large-scale offshore wind farm projects are planned in East Asia, and recent weather and seismic events in the region dictate close risk management when considering the construction of offshore platforms and the laying of power cables. In Europe, where offshore wind farms are longer established, insurance claims involving offshore installations have been extensive, despite more predictable conditions. As a result, there has already been an increasing demand of a specific Marine Warranty Survey (MWS) from the view point of insurance. A Marine Warranty Survey (MWS) supervised by a third-party inspires confidence that a given installation will comply with technical requirements for marine operations. ClassNK is cooperating with experienced Marine Warranty Surveyors to provide customized MWS to meet different site conditions, with its initial emphasis on Asia. ClassNK is also developing guidelines that cater for specific site conditions, running desk top studies to simulate high risk marine operations as well as developing software tools to support efficient and smooth project management.

Ocean Thermal Energy Conversion (OTEC) takes advantage of the differences between the temperatures on the ocean's surface and in deep water to convert thermal activity into turbine rotation. Although this system has been associated most closely with specific southerly seas, the method is gaining attention in Japan due to the sharp increase in water depths relatively close to the Japanese shoreline. In summer 2013, an OTEC demonstration test plant was installed on Kumejima island in the Okinawa Prefecture. ClassNK have issued the AIP (Approval in Principle) for the concept design of a 10MW class floating offshore OTEC.

Given the relatively stable energy secured from wave power, wave power generators that convert kinetic wave energy into electricity are already commercialized off Japan. NEDO has organized an R&D project to convert vertical wave movements into rotational motions using the rack and pinion method, and flywheel rotation. The first system of this type will undergo demonstration trial on the seas off Japan in the near future.

Tidal power generator systems are also being commercialized off Japan. Here studies are underway on a system that utilizes not only tidal flow, but predictable ocean currents flowing near Japan, such as the Kuroshio Current.

Established in October 2015, the ClassNK Renewable Energy Department manages diverse activities which were previously the responsibility of the Society's Wind Turbine Division. The department not only provides certification services for wind turbine generation system verification and offshore farm installation, but is also responsible for the developments in wind

power, tidal power and ocean thermal energy conversion.

In line with these diverse responsibilities, ClassNK is compiling Guidelines for marine renewable energy installations that utilized wave, tidal, ocean current and ocean thermal energy conversion expected to be released in the near future. In doing so, it is capitalizing on the experience and knowledge accumulated over the years through R&D, certification and inspection of ships and marine structures in an effort to promote safety and environmental protection.

"Given the high potential of the ocean as an alternative energy source and the ever-growing demand for renewable sources to reduce CO^2 emissions, the need for high-quality technical services to support the practical development of these new technologies has increased over the years", says Hirofumi Takano, Operating Officer and General Manager of ClassNK's Renewable Energy Department.

"By actively participating in the creation of international standards and rules, as well as developing certification services and R&D projects for wind turbines, wave power and tidal generators, ClassNK continues to make multiple efforts to expand the deployment of marine renewable energies".

Force the issue on collisions

Energy-absorbing highly ductile steel offers higher rupture limits

While retaining the same yield and tensile strength and weldability as conventional steels, highly ductile steel (HDS) is distinguished by greater ductility. The consequence is that HDS plate has been shown to be able to absorb significantly more energy than its conventional counterpart without rupturing, should it be involved in a 90 deg collision.

This is clearly significant for ship structures, and HDS is already available in this application from Nippon Steel & Sumitomo Metal Corporation under the NSafe™-Hull brand and has been used in the construction of a Mitsui O.S.K. Lines bulk carrier built by Imabari Shipbuilding Co Ltd.

The characteristics of HDS would appear to be especially significant in the case of tankers, however, where the regulatory response to historical oil spills has been the enforcement of double-hulled vessels where conventional steel plate is used.

A collision or incident at sea involving an impact at right angles to the hull's steel plate would be the most probable occurrence indeed and is supposed to cause the most severe damage to the struck ship. In reality however, the crashworthiness of hull structures needs to be considered in relation to oblique collisions as well.

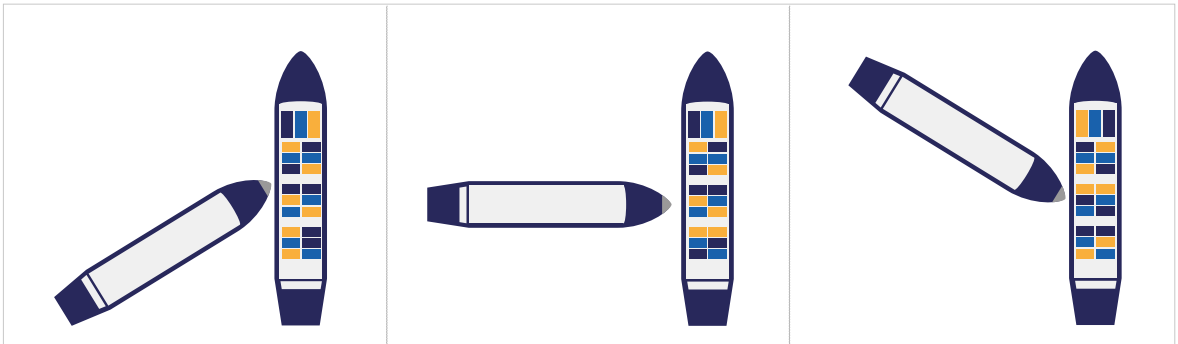
The infamous 2001 Baltic Sea collision between the stem of the vessel *Tern* and starboard tank No.6 of *Baltic Carrier*, which contained 2,700 tons of fuel oil, involved a hull built of conventional steel struck at an angle of incidence of around 50 deg. Although a double hull vessel, *Baltic Carrier* was holed, with the main part of the 2,700 tons of oil discharged into the sea.

Currents carried the oil spill towards the Danish islands Moen and Falster, and into the narrow Groensund waters between the two. The pollution along the coastline was the most severe ever experienced off the coast of Denmark.

While such consequences are mercifully rare, oblique collisions are not. For this reason ClassNK has supported work as part of its Joint R&D for Industry Program on a new series of three-dimensional, non-linear ship-to-ship collision simulations. The Society is working together with the National Maritime Research Institute, Nippon Steel & Sumitomo Metal Corporation, and Imabari Shipbuilding Co Ltd to quantify the extent to which ships featuring HDS would offer better protection against shell rupture.

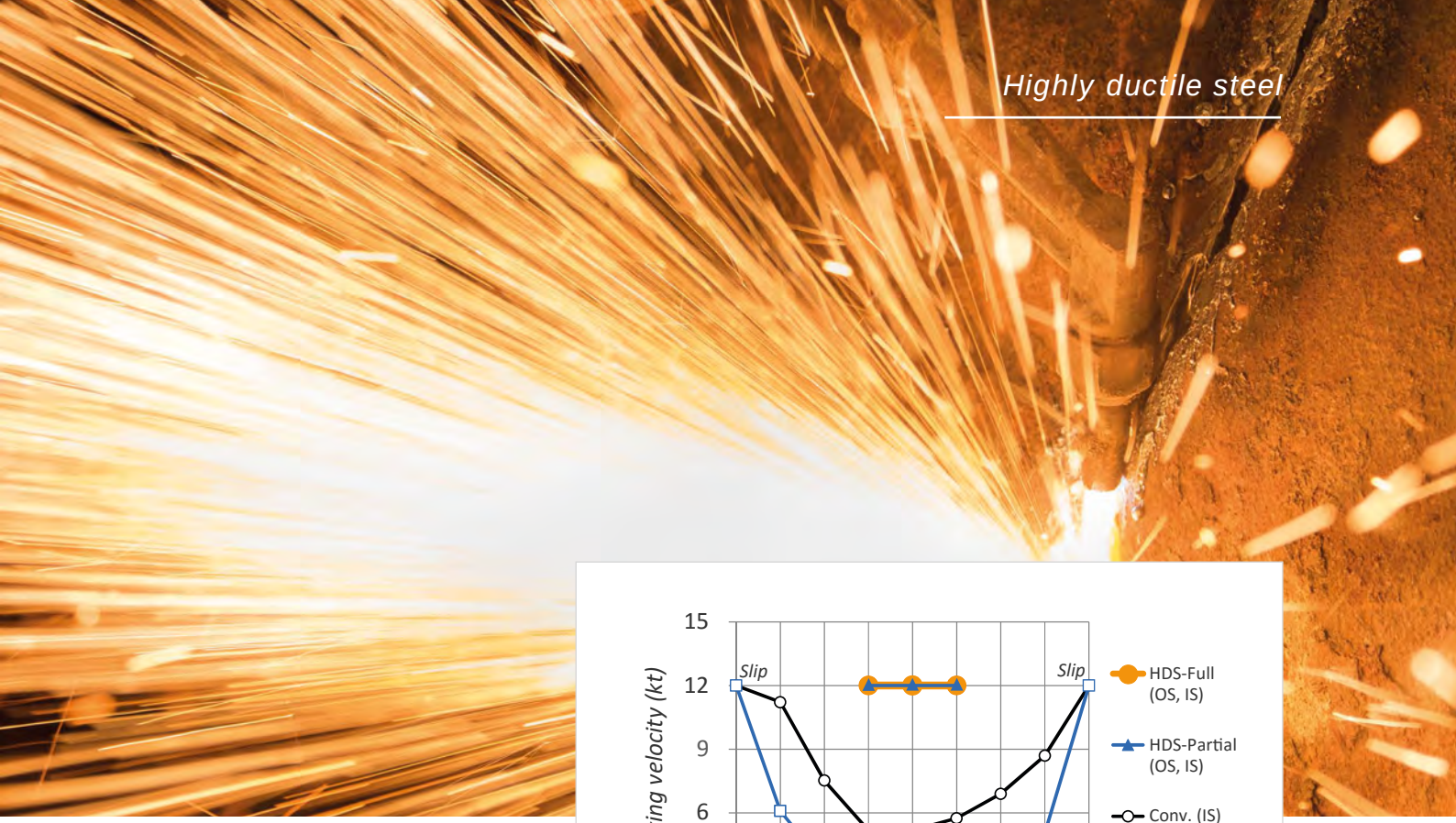
A series of finite element simulations was carried out between two 333m LOA very large crude carriers (VLCCs) where a comparison was made covering the same incident scenarios between ships constructed using conventional steel plate and HDS. Both the striking ship's speed and the angle of collision were varied.

The collision scenario assumes that the striking ship collides with the midship section of the struck ship where damage is the most severe for the struck ship. The output offers a comparison of energy absorbed at a variety of angles of incidence, and the way the 'critical striking velocity' changes. The critical striking velocity is defined as the maximum impact that could be sustained without the ship's inner shell being ruptured.



60 deg	90 deg	120 deg

Analysis condition in various collision angles



Rupture Limit Curve (OS +IS)

In order to encompass a higher level of real world factors into the investigation, consideration has been given to the use of three types of conventional steel (one mild steel for the bow and side stringer, HT32 (High Tensile Strength Steel 32kn/mm^2) for the outer and inner shell, and HT36 for the upper deck and bottom shell). The simulation makes a direct comparison across different collision scenarios between these steels and their corresponding HDS (HDS, HDS32, and HDS36).

An example of the normalized nominal stress-strain relationships between the two steel types has been offered for HT32 – as noted the main material for the outer and inner shells – and HDS32. In this case, HDS is shown to offer elongation one and a half times that offered by high tensile strength steel. This elasticity has a significant bearing on energy absorption.

To investigate critical striking velocity in the case of an oblique collision, a series of finite element simulations establish the rupture limit curve for both the outer and inner shells of the VLCC that has been struck.

In the case of HDS, although the precise value of the 'critical striking velocity' will be the subject for a later study, the model shows that rupture of the outer shell and the inner shell does not take place if the impact speed is up to and including 12 knots, even if the collision occurs at a 90 deg angle.

In the case of conventional steels, the 'rupture limit curve' modelled suggests that a 90 degree collision at as little as 3 knots would penetrate the outer shell, with the inner shell being penetrated if the impact velocity was just under 6 knots. If the angle of incidence were 60 deg, a striking velocity of 7.5 knots would still represent an impact large enough to breach both skins.

The study's findings are that if the collision angle is 30 deg or 150deg, the striking ship will slip against the struck ship and the two ships float apart from each other, consequently avoiding severe penetration, but if the angle of incidence is 45 deg or above no such 'slip condition' occurs in the present study. For the ship built using high tensile strength steel, then, the critical collision angle is therefore somewhere between the two. For the ship built using HDS struck by another with a velocity of 12knots, there would be no critical collision angle at all.

With the practical application of HDS in vessel designs, expectations are high for helping shape a safer future.

Interview with USMRC: Getting tough on security

USMRC spells out what needs to be done for organizations to ensure their data is secure

What is USMRC's view on the growth of Big Data in shipping and what is the potential for this phenomenon for the maritime community? Where do you see the main opportunities and challenges?

The growth of Big Data in international shipping presents tangible opportunities to significantly improve and optimize numerous functions in operations and ship management. These include aspects of remote access monitoring, data analytics, and forecasting. However, innovating without prioritizing security of business information and IT-dependent systems presents unique risks not seen before in maritime business. Massive amounts of transmitted and consolidated data can be an extremely attractive target for malicious actors, offering the opportunity to seize proprietary company data, customer data, voyage and operations data, and confidential industry information. Perhaps the greatest challenge presented by Big Data is understanding the interconnectedness of all shipboard and shore-based systems, and the design vulnerabilities therein.

Every ship is different, even ships within the same class. As ships continue to feature more automation and connections to shore-side operations, the industry must ensure it takes proactive measures to understand and protect itself from cyber threats and disruptions. The growth of Big Data within the maritime industry is one of many reasons why USMRC has been so focused on conducting evidence-based cyber research on board ships and in marine terminals.

Brian T. Holden - USMRC President (left) and Captain Alexander N. Soukhanov, AFNI - Vice President, International Shipping and Maritime Operations (right)

Where does USMRC believe responsibility lies in developing the necessary 'open standards' for data exchange – with shipping companies, class, equipment suppliers? With all three? What is USMRC doing to promote, encourage and develop open standards?

The responsibility in the development of "open standards", or "open source", is the responsibility of all three, and they should all be synchronized. Shipping companies must be cognizant of the networks they own and consider security and safety when driving innovation and procuring innovative technologies. Class societies must seek independent methods of testing and proving these standards and equipment prior to fitting out vessels and placing these systems in operation, similar to the aviation industry. Equipment suppliers have a responsibility to the shipowner to provide only the equipment that is industry-approved to operate on those open standards. The shipowner and builders must be adequately informed so as to understand a change in cost consistent with increased security and resilience features.

USMRC encourages the use of open standards for many reasons. Open standards architecture could be more cost effective for the shipowner and management, and can be safer if the proper physical security and cyber security measures are implemented and regularly maintained (such as intrusion detection). Open source is also more interoperable than proprietary systems, can be maintained with limited resources, and easier to incorporate more efficiency strategies. In this industry, interoperability is crucial, because of the wide variety of technologies and vendors. While our current research identifies cyber vulnerabilities, determines business impacts, and scores risk, we see the industry evolving to open standards as an opportunity to implement a greater cyber risk management strategy that makes sense for both business and security concerns.

57%
of crew are unaware of any cyber-safe policy or guidelines for personal web-browsing

41%
of boards don't understand supply chain risk

Our Maritime Cyber AssuranceSM research has definitively demonstrated to industry stakeholders that there are significant cyber vulnerabilities aboard ships. Any move to create open standards must consider this from the very beginning of the process. USMRC and our strategic partners - ClassNK, BIMCO, and the Liberian Registry - are working closely with shipowners, management, and the IMO to ensure a thoughtful, well-informed, and meaningful approach is made to dealing with this incredibly important issue. We also believe the mariner should not be left in the dark as to what these technologies are and how they are installed and perform on board.

Will developing more open standards and sharing more data compromise security as shipping evolves into a "big data" industry? In your opinion, what are the main cyber security vulnerabilities the maritime community is currently facing and how can these be managed to avoid cyber threats becoming a systematic risk? How 'Cyber Aware' and prepared is the maritime industry against attack?

Development and implementation of open standards could actually help to provide a better understanding of vulnerabilities to software and technologies. Conversely, proprietary systems are only secure until the source code is stolen or the software is compromised. With the drive for the IMO eNavigation concept to be developed and implemented, an open architecture will be required for harmonized information exchange across technologies. Lessons learned from current adoption of maritime big data and information exchange must be incorporated. Without validated anomaly data, research will be even more critical.

Vulnerabilities range from outdated and unpatched operating systems, very poor architecture design, improper user accesses, poor file transfer procedures, and lack of cyber awareness by the mariners and marine terminal employees. Cyber security as a strategic policy discussion is comparatively recent, and is not even discussed in the new standards for ECDIS to be implemented on 1 September 2016.

We're still not sure how well prepared the industry is to deal with a "cyber-attack", so our research must continue. Mariners and terminal operators will most likely not recognize an actual "attack", but more of a disruption in IT-dependent equipment operation. Mariners have been taught from day one to operate their vessels and onboard systems in manual modes, from navigation to engineering, so we have confidence that safe operations can be maintained. However, as automation, and the natural human dependency on that automation, becomes more common, the effects of a cyber disruption could be far more pronounced and dangerous. The equipment that is currently installed on vessels, particularly that equipment which is mandated for carriage (AIS, ECDIS, etc.), is expected to operate. Immense trust is placed in this equipment, particularly in collision avoidance and navigation. When disrupted, doubt as to one's navigation or collision avoidance disposition could develop. Specific and long-existing Rules (COLREGS) apply to doubt already, and specific actions are required. It's important that situational awareness in long proven navigation and seamanship practices now include measures to enhance cyber awareness. USMRC and its business partners have a strategic plan for this.

According to a recent industry survey, only 43% of crew is aware of any cyber-safe policy or guidelines provided by their company for personal web-browsing or use of removable media. How can owners ensure that staff are aware of cyber security threats and how can they develop a cyber aware culture on board?

These findings highlight exactly why USMRC is working closely with its partners to develop a comprehensive and easy-to-understand "Shipmaster's Guide to Cybersecurity" - so that owners and Masters can make smart, well-informed, decisions on how to best educate and train ship's crews. However, ship management should follow the new BIMCO Guidelines to Cyber Security on Board Ships in developing a policy from the corporate executive and senior management levels, and fully understand the networks on board their ships. This is no longer an "IT problem" - it's everyone's concern from top to bottom, shoreside and shipboard staffs alike. Our hope is that the aggregate database of cyber vulnerabilities we have built from our research over the past 14 months will allow us to help our partners create a simple, straightforward, and effective set of best practices that can be easily understood and executed by industry personnel.

How can the use of maritime simulation help develop the consciousness

of mariners to threats in the new age of maritime cyber risks?

Maritime simulation might be a very effective means to conduct risk-free research and awareness enhancement on cyber safety, security, and resilience for the shipping industry. USMRC has a strategy to incorporate simulation and testing as part of our research.

How can classification societies support cyber security and help address the needs of data protection?

Class societies already have a critical role in ensuring safe shipboard operations and seaworthiness. While cyber security is a relatively new issue to the industry, its importance should be addressed in the same manner as all other issues facing the industry - proactively and with sufficient research to determine the facts and develop relevant standards and certification. Data protection is protecting business. It's a real issue to all other industries, and should not be ignored in maritime.

ClassNK has been supporting USMRC in accelerating and advancing our research to better understand current and evolving cyber threats.

In order to accelerate the use of Big Data in the maritime industry, ClassNK has recently established the Ship Data Center in Tokyo. In your opinion, what benefits do you think the Center will bring to the maritime industry?

There are many benefits, from condition-based monitoring, to optimization requirements. Efficiencies in recording data of machinery, fuel consumption, and performance also alleviate the ever-growing administrative burdens on ships' officers. We also believe that with greater emphasis on environmental protection will come the need for ensuring more accurate and readily available records and data.

As shipping is rapidly changing to become a more digitalized industry, what will be the role of class in the next 20 years? Should class lead or follow on Big Data? If lead, how?

> *"USMRC is already developing a way forward with ClassNK as a derivative of industry-recognized evidence-based research"*

Class should take a leading role in the implementation of cyber security standards, which will serve not only to protect big data usage, but also critical IT-dependent marine engineering, cargo management, and navigation systems. This would include certifying professional training, as well as providing a means of assessing cyber safety readiness for the ship owners and operators. Most importantly, class should develop audit standards, or "train the cyber auditor", based on real research, to effectively assist the industry with a transformation of culture and awareness. Not any auditor is suitable for this task, and a level of competency in cyber must be demonstrated to a class standard first, and acceptable to the industry. USMRC is already developing a way forward with ClassNK as a derivative of industry-recognized evidence-based research.

ClassNK events in 2016

- **ASIA PACIFIC MARITIME, SINGAPORE, 16TH - 18TH MARCH**

  Please visit ClassNK at booth B-L16

- **CMA SHIPPING, STAMFORD, USA, 21ST - 23RD MARCH**

  Please visit ClassNK at booth 101 & 102

- **OTC ASIA, KUALA LUMPUR, MALAYSIA, 22ND - 25TH MARCH**

  Please visit ClassNK at booth D702

- **LNG 18, PERTH, AUSTRALIA, 11TH -15TH APRIL**

  Please visit ClassNK at booth 1034

- **SEA JAPAN, TOKYO, 13TH - 15TH APRIL 2016**

  Please visit ClassNK in the Japanese Pavilion (JPN-56)

- **OTC, HOUSTON, USA, 2ND - 5TH MAY**

  Please visit ClassNK in the Japanese Pavilion (11825)

- **INLAND MARINE EXPO, ST. LOUIS, USA, 10TH - 12TH MAY**

  Please visit ClassNK at booth 218 & 220

- **POSIDONIA, ATHENS, GREECE, 6TH - 10TH JUNE**

  Please visit ClassNK at booth 2.102

- **ONS, STAVANGER, NORWAY, 29TH AUGUST - 1ST SEPTEMBER**

  Please visit ClassNK at booth 511

- **SMM, HAMBURG, GERMANY, 6TH - 9TH SEPTEMBER**

  Please visit ClassNK at booth B2.EG.208

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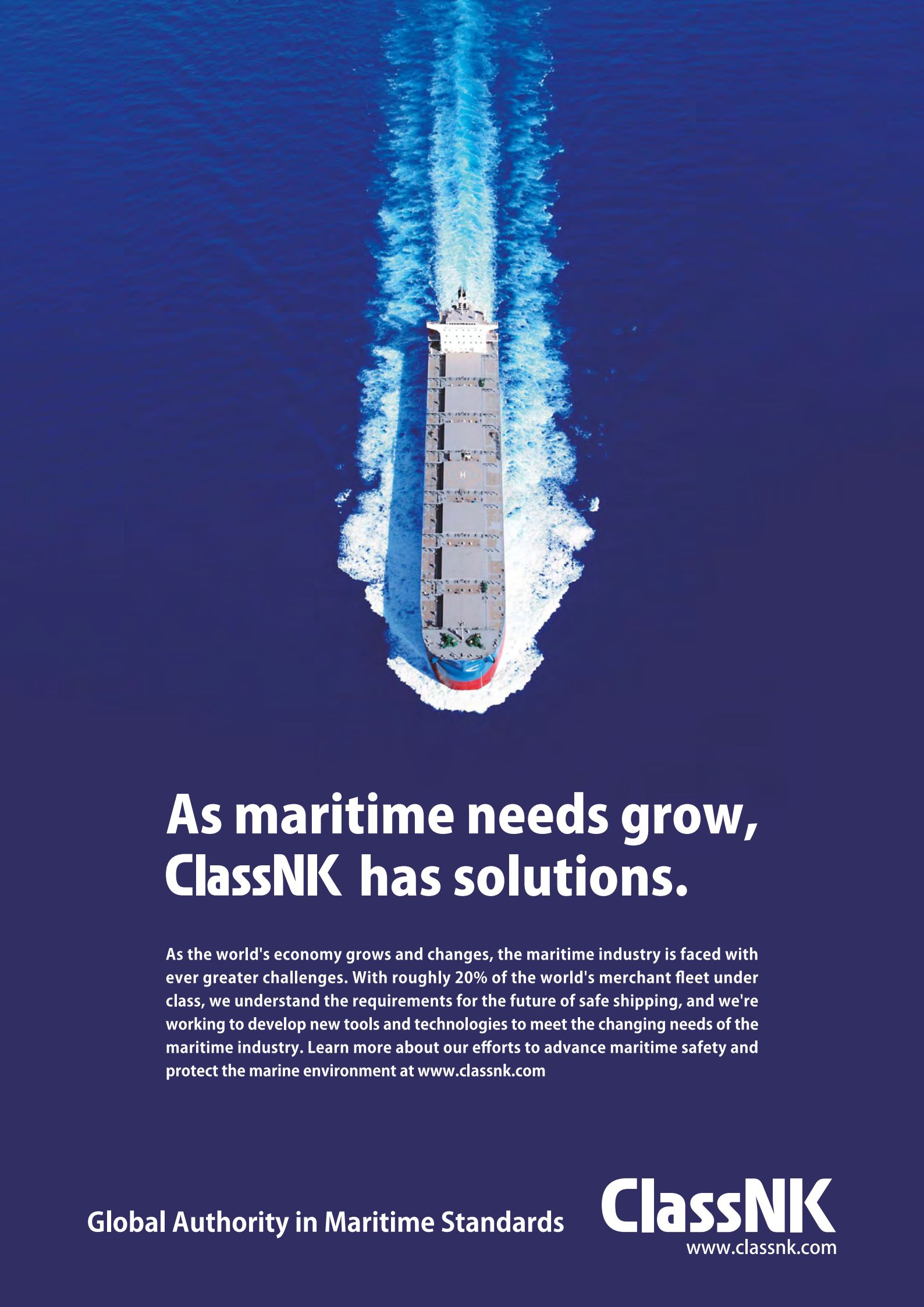

As maritime needs grow, ClassNK has solutions.

As the world's economy grows and changes, the maritime industry is faced with ever greater challenges. With roughly 20% of the world's merchant fleet under class, we understand the requirements for the future of safe shipping, and we're working to develop new tools and technologies to meet the changing needs of the maritime industry. Learn more about our efforts to advance maritime safety and protect the marine environment at www.classnk.com

Global Authority in Maritime Standards

ClassNK

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