DNV·GL

OFFSHORE UPDATE

02-2017

Offshore wind market

Smarter operations

Transfer of class

DNV GL's digital journey

CONTENT

Cover photo: Courtesy of PGS

Photo: DNV GL, Marianne Wennesland

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DEAR READER,

When the downturn in offshore exploration and production investments became a reality in 2014, the first reaction from many was: "After so many years of growth, a correction is only healthy and natural." Today, more than three years later, instead of a correction we see the contour of an industry transformation.

As the competition is getting fiercer, stoked by the oversupply of rigs, drilling ships and offshore service vessels, the number of units being laid up seems to have stabilized. The coming six months are predicted by many to be the most challenging time; during the winter season, few will be performing field maintenance work before the demand tide turns in spring. Vessels collecting seismic data, as the advanced *Ramform Hyperion* on the cover, delivered March 2017, are likely to be first movers in a turning market.

In the article "Partnering to win" you can read how Vantage Drilling International, after restructuring in 2016, have kept their focus on thinking lean and efficient to reduce operating costs while maintaining their operational performance. DNV GL has contributed to this transformation by providing expertise and processes.

There are natural limits to the cost savings a company can achieve by streamlining operations. Sometimes the solution lies in smarter industry-wide cooperation to establish new ways of working for the benefit of all. This was the key motivation for DNV GL to invite the industry to participate in the D-Class project workshops arranged in 2017. By embracing the opportunities provided by modern technology and connecting them digitally on board and remotely, we can adapt and transform the way we build confidence through advanced validation of DP-systems without compromising safety.

The offshore wind industry is growing fast and has provided new opportunities to OSV operators traditionally serving oil and gas activities. We have included two articles to highlight the fact that this is still a fast-growing industry in spite of diminishing or absent economical subsidies in Europe, and that the industry is now picking up speed in US waters as well. Aiming for "Zero Emissions" is an update on current investments in renewables and the role alternative fuels and battery technology will play as the energy industry transforms.

Enjoy reading!

OFFSHORE UPDATE

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FRESH BREEZE FOR OFFSHORE WIND FARMS

Forecasts are predicting a grand future for offshore wind farms, and the maritime industry is going to benefit as well. Major opportunities are arising across the entire supply chain, from installation to maintenance through to crew vessels.

The cost of wind energy has fallen sharply across Europe in recent years, in part because of larger turbines, economies of scale, increased competition, lower capital costs, a steep learning curve and competitive auctions. The price per megawatt-hour has dropped up to 50 per cent within as little as three years. This year for the first time two offshore wind projects were awarded in Germany without entailing any government subsidies – underscoring the maturity of the technology as it competes with other energy sources. And while prices for all renewables are expected to fall, the drop in the case of a technology as young as wind energy is likely to be even more pronounced.

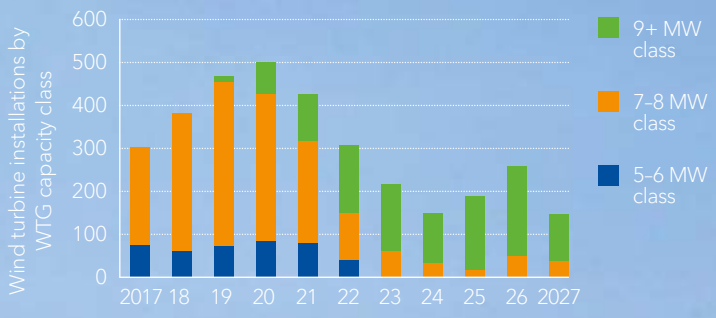
Pacific Osprey is a six-legged DP2 wind farm installation vessel (WIV) with a 1,200 t main hoist capacity in dual mode.

Dynamic market development

The operational forecast for the European offshore wind sector predicts an increase in megawatt output of more than 50 per cent in the year 2020 compared to 2016. About 40 new sites will be available, equivalent to a 33 per cent increase in the number of turbines.

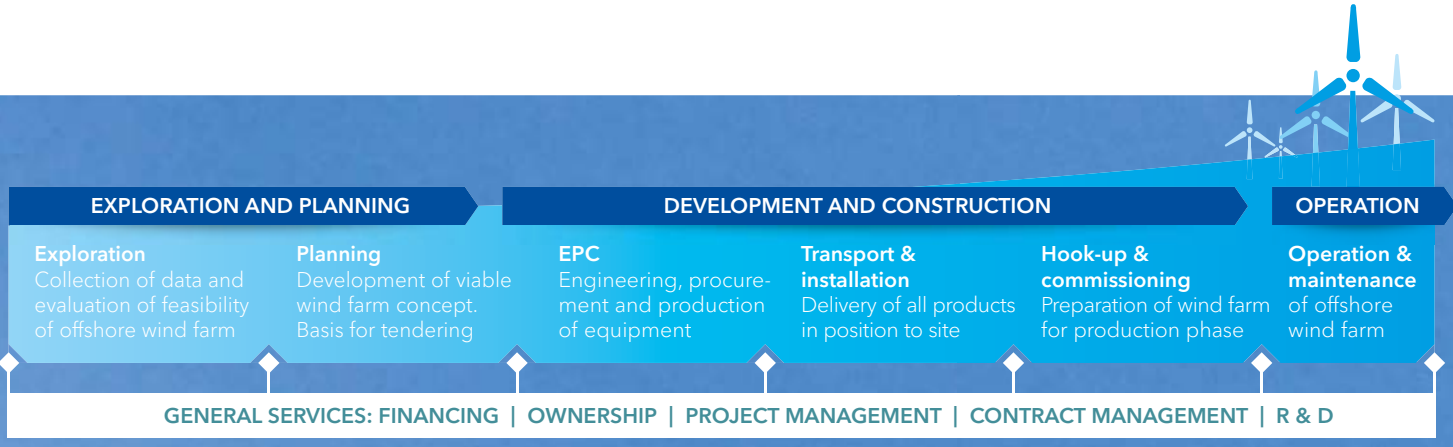
LARGE TURBINES (9+ GW) TO ENTER THE MARKET FROM 2020

Predictions are based on known projects in the pipeline today.



Capacity	Nacelle weight	Hub height
< 4 MW	100 t	90 m
5–6 MW	250 t	100 m
7–8 MW	400 t	105 m
9+ MW	600 t	120+ m

As wind turbines grow in size, the installation vessels must follow suit, and the assembly and installation routines must be adapted accordingly. Jack-up height and crane reach are key parameters.



From the early planning stages to final licensed operation, an offshore wind project takes about seven to eight years.

This remarkable upturn in the offshore wind market is not limited to Europe. Countries such as the US, China and Taiwan are seeing similar developments. As offshore wind energy is still in its infancy in these countries and construction and installation capabilities are limited, wind energy costs are still significantly higher than those of other energy forms.

But offshore wind offers several advantages that offset the higher costs. Wind farms can be sited in waters near densely populated coastal areas, avoiding the high prices of land. Compared to land-based wind turbines, offshore units benefit from higher wind speeds resulting in higher power output. Furthermore, wind energy combines well with other alternative energy sources, such as solar PV, as it can produce energy in bad weather and darkness when the loads are high. This helps balance the production profile throughout the year. Offshore wind produces energy at 35 to 55 per cent of installed capacity, compared to only 10 to 20 per cent for photovoltaic installations located in the northern hemisphere. The not-in-my-backyard (NIMBY) effect is also negligible when the nearest turbine is located miles away at sea.

Photo: Swire Blue Ocean

High-tech maritime support wanted

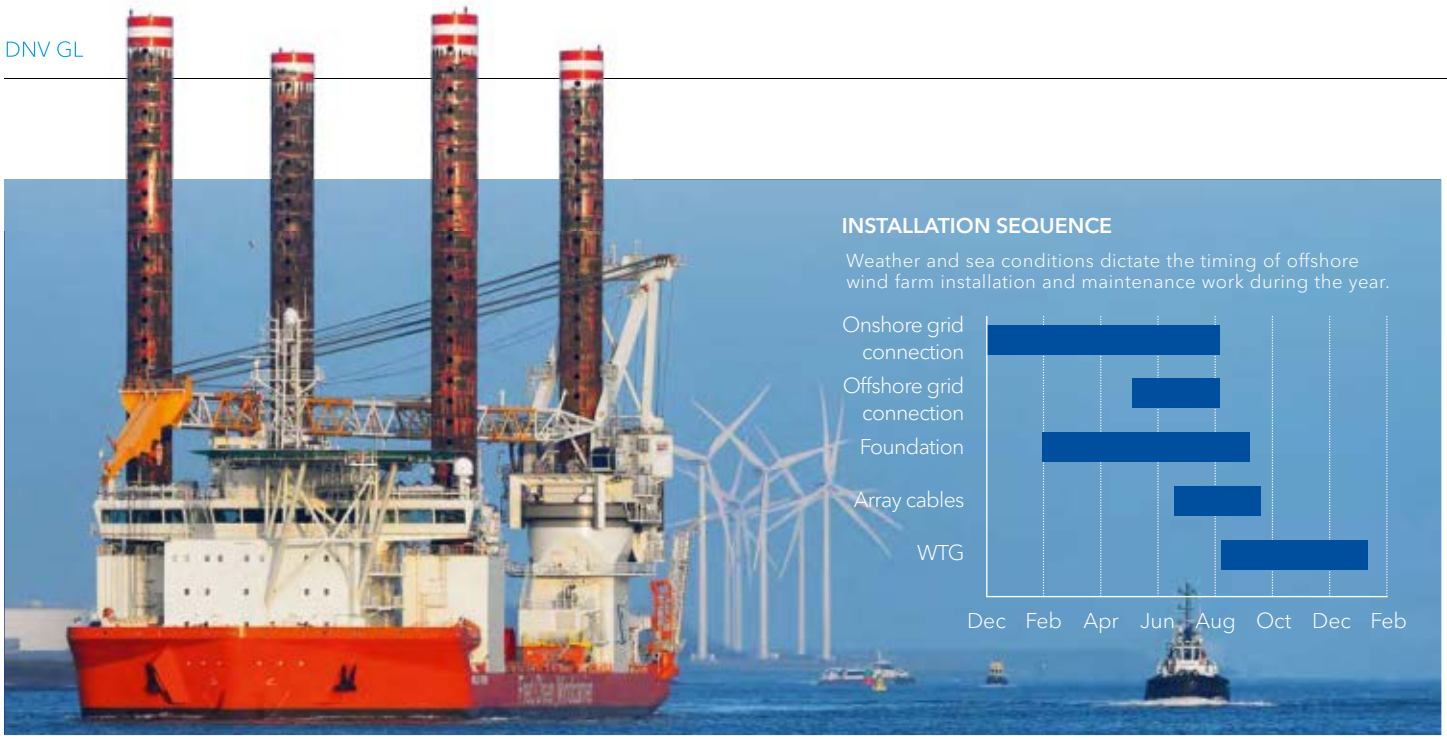
All main industry segments served by the DNV GL Group – Renewables, Oil and Gas and Maritime – are in some way connected with offshore wind. "You need to understand the relative importance of each discipline and how they affect each other to have a positive impact on the bigger picture. We look forward to supporting the entire supply chain needed to operate an offshore wind farm such that it is safe, efficient and environmentally friendly," explains Marte Riiber de Picciotto, Head of Section, Renewables Advisory. "The digital revolution is allowing us to connect our equipment and systems so that they operate faster, smarter and better. In this new world we are moving towards data-driven decision-making, which is also incorporated in our rules and standards," she adds.

One of the crucial issues during installation and operation is the marine supply chain. Transporting turbines to offshore locations, erecting, installing and maintaining them throughout their service lives and finally dismantling them requires highly specialized maritime assets ranging from crane barges and tugs to jack-up vessels, crew boats, floatels and fast service vessels.

There are various types of offshore wind farm (OWF) installation vessels, including towed "dumb" barges fitted with cranes, sheerlegs crane barges, semisubmersibles, heavy-lift vessels, DP2 heavy-lift cargo vessels, leg-stabilized crane vessels, and self-propelled jack-ups. After project delays had caused an oversupply of these assets for several years, the industry is currently seeing a shortage of capable vessels, especially after the market introduction of 7 MW and 8 MW turbines.

The latest generation of jack-up installation vessels is dimensioned for 9 MW and larger wind turbines and water depths of more than 40 metres. But that is not the end of it: next-generation concept designs are expected to offer enhanced flexibility and to combine a variety of capabilities such as high transit speed and DP3 positioning, along with open deck spaces, long-reach, high-capacity cranes, and rapid and reusable sea fastenings.

The installation of nacelles and blades is one of the main challenges because of the extreme working heights which >



Thanks to many decades of experience in related fields and technologies, DNV GL has plenty of expertise to offer to offshore wind industry.

> amplify wave and wind-induced ship motion. Various installation methods are used to handle these challenges. On wind turbines larger than 5 MW the nacelle is typically installed first, followed by the entire rotor consisting of the pre-assembled hub and blades. However, since transporting the nacelle and rotor for turbines of this size exceeds the capacity of most crane vessels, installers today often install the hub first, then the blades one by one. But future crane vessels might be large enough to once again pre-assemble the rotor prior to installation.

Handling the motion of the ship and the crane load is another challenge during installation. Taglines connected to the deck of the ship or the boom of its crane are a typical remedy. Other solutions, such as specialized yokes, add mass to the crane to reduce motion when lifting blades. Siemens reports that a yoke developed in-house now enables installations at wind speeds of up to 14 m/s, and Liftra's Blade Dragon device has been certified by DNV GL for 18 m/s winds. Using lifting yokes and taglines or combinations thereof can avoid the cost of specialized cranes.

Feeder vessels can be used to support the installation process as well. They help maximize the productivity of the crane vessel while accelerating transit times. This means that for future projects, design engineers must account for the on-site transfer of components from one vessel to the other.

Once all the turbines of an offshore wind farm have been installed, workboats are needed for laying cables and other supporting tasks and, later on, during regular operation, crew boats and other specialized ships play an essential role in maintaining the wind turbines. "For major component replacements as part of the operation and maintenance phase, jack-up vessels are still practically the only option," Eknes Arnstein, Business Director Special Ships points out. "To reduce costs, offshore wind farm operators may switch from ad hoc contracting to sharing jack-ups across similar portfolios," he recommends.

Safe transit between ship and wind turbine

When maintenance technicians visit a wind turbine, one of the most challenging moments is the transfer from the crew boat to the wind turbine platform. The step-over method, while technically unproblematic, is limited to calm weather, but there are various ways to ensure transit safety even in high waves. As wind turbines and maintenance ships grow in size, more complex, DP-supported access systems with gangways ensure safe passage. In January 2017 DNV GL responded to the need for more sophisticated solutions by launching its Walk2Work class notation for motion-compensated gangways.

The number of specialized suppliers and vessels is still small, and owners, contractors, and subcontractors are still learning how to collaborate more efficiently. "It will take some time and experience but with more offshore wind farms being built, economies of scale will emerge, including cost-saving measures such as sharing crew transfer vessels and helicopters, and coordinating jack-up barges across assets and operators for major component replacements. Furthermore, emerging countries will profit from more experienced ones," de Picciotto is confident. ■ **JS**

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Block Island Wind Farm consists of five 6 MW wind turbines off the coast of Rhode Island.

OFFSHORE WIND'S NEXT FRONTIER

The United States is on a path to a new energy future. Indications are that the country is on the cusp of becoming the next major offshore wind market and the maritime industry is preparing to play a significant role.

Electrification in the coming decades will substantially contribute to a decarbonization of the world's energy system, as consumer behaviour and policy support for clean energy drive focus to renewable energy sources. This shift is evident in the United States, where significant developments in offshore wind suggest the world's next major market is in the western hemisphere.

A robust offshore wind pipeline

Over the past year, several key developments have contributed to the emergence of the US market and the establishment of a significant pipeline of projects from Maine to North Carolina.

Critical to this emergence was the completion in December 2016 of the first offshore wind farm in the US, Deepwater Wind's Block Island Wind Farm off the coast of Rhode Island. Since Block Island went online, 2017 has brought a flurry of activity that indicates a healthy market outlook for the United States.

The key driver has been ambitious state-level initiatives to establish offtake mechanisms and build demand for offshore wind, particularly in the north-east with Massachusetts, Maryland, and New York leading the charge.

Maryland was one of the first movers, establishing a modest carve-out for offshore wind in the state's renewable portfolio standard that resulted in the award in May of offshore renewable energy credits (ORECs) to two projects, providing the necessary revenue stream to support the construction of 368 megawatts (MW) of capacity off the coast of Maryland.

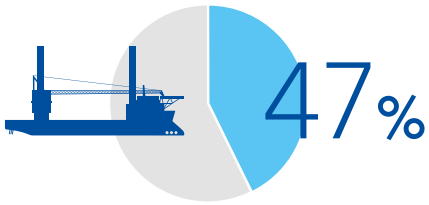
Massachusetts is not far behind with a 2016 legislation that requires utilities to procure 1,600 megawatts of offshore wind capacity over the next ten years. In July, Massachusetts utilities released their first solicitation for offshore wind power generation under this new law.

In New York, Governor Andrew Cuomo unveiled a blueprint in January 2017 for developing up to 2.4 gigawatts of offshore wind. Central to this blueprint is the development of an offshore wind master plan which will identify new potential lease areas >

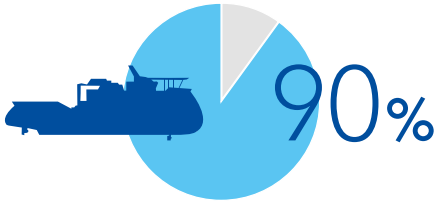
> "Multiple parties have announced plans to build a US flag WTIV, but at this point it is not clear when construction of such vessels will commence."
>
> **Sergio Garcia,** Business Development Director at DNV GL

Photos: Carsten Reisinger – stock.adobe.com, Deepwater Wind, DNV GL

The emergent US offshore wind energy sector will require a fleet of purpose-built vessels.



DNV GL has classed 47 per cent of the existing wind turbine installation vessels and 90 per cent of the service operation vessels that service the market.



> and establish a framework for procurement of offshore wind power.

With a newly elected governor, New Jersey is expected to join its neighbouring states in the offshore arena. With the support of Governor-elect Phil Murphy, the pioneering Offshore Wind Economic Development Act (OWEDA), passed in 2010, will emerge from a dormant status to actively support the development of at least 1,100 megawatts of offshore wind and potentially up to 3,500 megawatts, the target that the new governor pledged to pursue.

Collectively, these individual states' regulatory initiatives represent a pipeline of nearly 8 gigawatts of offshore wind, a substantial opportunity for electricity generation in the high-density coastal population centres along the Atlantic, and are a sign of a fast-growing clean energy economy.

European operators look west

The increasing promise of the US market has attracted significant interest from global players, including the biggest European offshore companies. Ørsted (formerly DONG Energy), Statoil, and Iberdrola are among those who have turned their attention to the west, eyeing what could very well be a market past its tipping point and on the verge of major growth.

With significant opportunities for expansion and additional lease areas being evaluated off of New York, Massachusetts and the southeastern states of North Carolina and South Carolina, as well as in the Pacific off the coast of California and Hawaii, the nation's market outlook is promising. However, some considerable challenges must be overcome before growth can be fully realized.

Sergio Garcia, Business Development Director at DNV GL, flagged that the limited number of Jones Act-compliant specialized vessels for support of near-term construction activities is a hurdle. He commented, "To achieve a comparable level of cost reduction in the US that Europe has seen, optimized vessel construction, operation and logistics solutions need to be in place. This will require a fleet of purpose-built vessels including wind turbine installation vessels (WTIV), crew transfer vessels, service operation vessels and others – all of which need to satisfy Jones Act compliance. Multiple parties have announced plans to build a US flag WTIV, but at this point it is not clear when construction of such vessels will commence. Alignment among the northeastern states for a common development strategy, which is now maturing, will allow for the development of the long-term project pipeline necessary to justify such vessels being built locally. Let's not forget there is also port infrastructure and a supply chain that must be developed, or adjusted, to support the complex logistics of these infrastructure projects."

Realization of a modern US flag fleet

Compared to the early days of the European offshore wind industry, development of wind farms in the US has a significant advantage in that older, inefficient technologies can be leapfrogged from the beginning. Larger wind turbine technology, which has quickly developed to today's eight-to-nine-megawatt capacity and could approach 20 megawatts by the end of the next decade, will be the primary driver.

"The application of cutting-edge technologies that allow lower costs, better reliability and safer operations is projected, and decisions made now need to account for this potential technology evolution considering the entire value chain, including the related US flag fleet," Garcia points out. ■ **MD/MF**

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AIMING FOR ZERO EMISSION

Fuel cells, advanced battery packs and electric power – zero-emission technologies are becoming an emerging force in the offshore industry.

The international shipping industry is facing an increasingly tight regulatory environment, especially when it comes to emissions to air. And with the recent decision to implement the global sulphur cap in 2020 and to add the North and Baltic Seas to the list of nitrogen oxide (NO_x) emission control areas, the pressure is on. For zero- and low-emission solutions such as fuel cells, battery and hybrid technology, these developments have been a real boost.

The oil industry is also changing mindsets, and big oil companies have started focusing on technologies that could improve energy production and enhance energy efficiency and other efforts to mitigate the risk of climate change.

ExxonMobil, for example, is going to partner with two Singaporean universities to open a Singapore Energy Centre in 2019 to develop and improve green technologies. Total bought the French battery maker Saft Groupe to invest in clean energy and Statoil STI invested in the battery manufacturer Corvus. Statoil Norway is complementing its oil and gas portfolio with a partnership with E.ON investing in the German Arkona wind farm in the Baltic Sea. Shell and Qatar Petroleum's Wave LNG Solutions signed a framework agreement to develop an LNG bunkering infrastructure at strategic shipping locations across the globe.

As one of Statoil strategic goal's is to continuously reduce its operational footprint, the company has awarded contracts to five shipowners for seven supply vessels to support the company's >

The offshore service vessel *Viking Princess* is refitted with a hybrid power system that incorporates batteries.

Photos: Wärtsilä

The electrical shore connection enables offshore vessel *KL Sandefjord* to shut down its engines during berthing at port.

> offshore activities in Norway. The key decisive factor in the selection process was the ability to operate in an environmentally friendly way. Vessels that could demonstrate low fuel consumption have therefore been successful in this award. Based on Statoil's experience battery operation has a good impact on consumption and emissions. None of the selected vessels have a system for battery-operation or shore power yet. This equipment will however be installed, and the NO_x fund is a key support player and contributor to the shipowners in their effort of installing batteries. The vessels will have DNV GL's Battery Power class notation, which allows them to use the battery as spinning reserve (saving fuel and maintenance cost) while working in dynamic positioning alongside the installations. Statoil is also offering fuel saving incentives to serveral shipowners for vessels that are capable of operating energy efficiently, thus reducing the total fuel costs. These and many more initiatives showcase the demand for a clean supply chain among the entire offshore sector, including support vessels and the different fuel technologies that can lead to greener operations.

Hybrid battery technologies

As presented at this year's Maritime Battery Forum, batteries are currently a fast growing technology in shipping with a compound annual growth rate of about 40 per cent in terms of megawatt hours (MWh) installed battery capacity.

In October 2017 the platform supply vessel *Viking Princess*, classed DNV GL, returned to service after being refitted with a hybrid power system that incorporates batteries. It is the first offshore support vessel on which batteries have been used to reduce the number of generators on board. According to Wärtsilä the hybrid system will generate savings through improved engine efficiency, as the operating profile of supply vessels is highly variable. When using the energy storage system on board *Viking Princess*, the fuel saving potential can be up to 30 per cent in various operations and the CO_2 emissions can be reduced by up to approximately 13 to 18 per cent per year, depending on the operational conditions and requirements. The vessel now runs on a combination of a battery pack for energy storage and three liquefied natural gas-fuelled Wärtsilä engines.

"To date, hybrid battery solutions have been mostly confined to smaller offshore supply vessels and tug boats, where they can handle spikes in power demand," says Narve Mjøs, Director Battery Services & Projects at DNV GL – Maritime. However, innovative research conducted to develop batteries for the automobile industry means that today battery cells boast enhanced power density. The cost of lithium-ion battery cells has been lowered by up to 80 per cent over the past four years, making battery and hybrid technology a more attractive option for larger ship segments as well. One of the latest innovations in this field is a wireless charging solution offered by Wärtsilä. The first 1 MW fully automatic charging station for a coastal ferry has been installed in September 2017.

Project Pa-X-ell, one of the e4ships pilot projects, is putting high-temperature PEM fuel cells to the test on passenger vessels.

Electric shore power

In August 2017, the offshore vessel *KL Sandefjord*, owned by "K" Line Offshore in Norway received DNV GL's "Shore Power" class notation. The new certification will allow *KL Sandefjord* to perform cold ironing, which means the vessel will be able to shut down its engines and rely on a shore-based electrical supply during berthing at port. Vessels are able to reduce their fuel consumption and eliminate various related emissions by employing cold ironing or using onshore electricity sources.

The process is also helpful in improving air quality at the port and surrounding environment, since it helps reduce the levels of nitrogen oxide (NO_x), sulphur oxides (SO_x) and carbon dioxide (CO_2) emitted from the ship.

A new generation of fuel cells

Another low-emission technology which has gained traction is fuel cells. Fuel cells are quiet, efficient and cause no noticeable vibration. The European Maritime Safety Agency (EMSA) contracted DNV GL to provide a technical study on the use of fuel cells in shipping to evaluate the potential and constraints as prime movers and energy sources in shipping. The technology overview includes the major maritime fuel cell projects to date. The second chapter is dedicated to current applicable standards, regulations and guidelines for bunkering, on-board storage and distribution

KL Sandefjord is the first offshore vessel with DNV GL's "Shore Power" class notation.

> "To date, hybrid battery solutions have been mostly confined to smaller offshore supply vessels and tug boats, where they can handle spikes in power demand."
>
> **Narve Mjøs,** Director Battery Services & Projects at DNV GL – Maritime

of fuel as well as use of on-board fuel cell installations. Finally, a risk assessment study to analyse possible safety challenges for maritime fuel cell applications on ro-pax vessels and a chemical tanker investigated 148 failure scenarios related to the usage of the three different types of fuel cells and fuels. As a result, for a total of 100 scenarios, additional mitigation actions were recommended. Taking these recommendations into account, the analysis team recognized that tolerable risk levels (ALARP) could be reached with respect to operational and human safety.

In Germany, leading German shipbuilders, shipowners, suppliers and DNV GL have joined forces in the fuel cell project e4ships. Launched in 2009 with support from the German government, e4ships aims to develop technical solutions for the implementation of fuel cells in marine applications and feeds into the development of international regulations on fuel cells.

To make this technology safe to use and commercially viable, the e4ships consortium has developed fuel cells capable of running on low-sulphur diesel or methanol, and has tested them in several pilot projects. Currently, the e4ships project partners are focusing on the next development steps and prototype tests as well as the design of decentralized on-board networks comprising several fuel cells. Project phase II is scheduled to continue until 2021 – the ultimate goal is to present production-ready technologies.

Regulatory work with impact

New insights, generated by e4ships and its pilot projects, have already made an impact on the shipping world. "The results of the first phase have made an important contribution to the IMO's International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code), which entered into force in January 2017. The code is an important prerequisite for fuel cell technology to reach market maturity, and we are very proud to be part of that," says Dr.-Ing. Gerd Würsig, Business Director Alternative Fuels at DNV GL – Maritime.

The code contains mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels, focusing initially on LNG. It addresses all areas that need special consideration for the usage of low-flashpoint fuels, taking a goal-based approach, with goals and functional requirements specified for each section forming the basis for the design, construction and operation of ships using this type of fuel. Technical provisions for other low-flashpoint fuels can be added as new chapters to the Code, but in the meantime, ships installing fuel systems to operate on other types of low-flashpoint fuels will need to individually demonstrate that their design meets the code's general requirements. **JS/SJ**

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Photos: DNV GL, e4ships, "K" Line Offshore

DP STATION-KEEPING: THE NEXT LEVEL

In July 2016 DNV GL published a new standard for the assessment of a vessel's DP capability, DNVGL-ST-0111. Now after more than one year it is time to review the value the industry has gained from the standard and its related services so far and to move forward with enhancements based on customer experience.

The new standard, which applies to both newbuilds and vessels in service, includes methods for assessing the station-keeping capability of dynamic positioning (DP) vessels as DP Capability Levels 1, 2 and 3 plus two sub-levels for site-specific assessment. Simultaneously a free web app supporting DP Capability Level 1 was released on DNV GL's Veracity platform. "Since the release, the standard and the free web app have been used by ship designers, vessel owners, consultants, oil companies, equipment vendors, research institutions and universities," reports Luca Pivano, Principal Specialist DP Simulations at DNV GL. "In general, the feedback on both the standard and the free web app has been very positive. We have also been involved in quite a few customer projects where we performed thorough Level 3 analyses using our time-domain tool DynCap, which also is available as a web app," he points out.

When Total started planning DP drilling operations in a harsh environment dominated by extreme ocean currents, they soon contracted DNV GL to evaluate the vessel performance using DynCap. They found that running time-domain simulations with DynCap for comprehensive dynamic operability analyses allowed them to better understand vessel performance and limitations. The simulation results provided valuable and reliable input for the operational risk assessment and planning. The DynCap results were also compared to full-scale data from trials performed with the drill ship *Maersk Venturer* off South Africa in particularly harsh environmental conditions, including high current speeds and large waves. Despite the uncertainties on the models and environmental conditions, the results showed a realistic match and the correct trends between the full-scale data and the simulations. The results were published at the MTS DP conference in Houston.

"With this project, we managed to demonstrate that DynCap is an important addition to other available tools, offering unique insight into the details of a vessel's station-keeping performance," explains Luca Pivano.

A drilling contractor in the Gulf of Mexico purchased the DynCap web tool for its entire DP drilling fleet. The aim was to run in-house analyses to strengthen their position in bidding tenders and to have a reliable tool for operational and contingency planning. The feedback has been very positive. "The customer received valuable results from DynCap, such as vessel footprints and complete vessel motion analyses which cannot be obtained with traditional static methods, in addition to automatically generated reports," Pivano points out. "As DNV GL can log on simultaneously with experts from our customers to support the analysis, results can be achieved much faster. DynCap runs in the cloud, which also reduces effort for IT maintenance," he emphasizes.

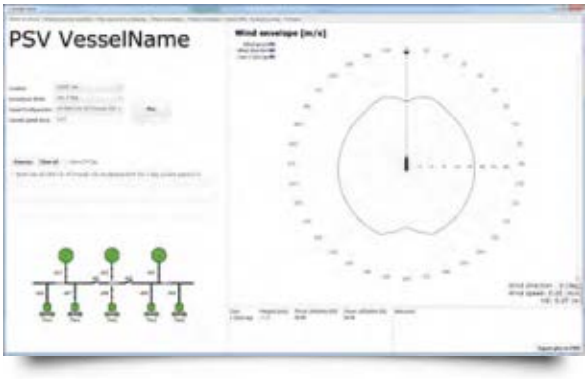
An International Exploration and Production company commissioned DNV GL to provide DP station-keeping analyses using DynCap. This included an assessment of the DP capability and operability for diving activity of a DP Class 2 vessels with two bow thrusters forward, two main propellers with rudders aft, and a single stern tunnel thruster. The DP station-keeping performance and reliability of vessels with similar configurations has known to be characterized by poor robustness, particularly in post-failure condition upon loss of the single stern tunnel thruster. Such characteristics have been identified in papers published and available in the public domain. The study for the diving vessel was carried out according to the standard DNVGL-ST-0111 – Level 3-Site which defines requirements for DP station-keeping performance testing using running time-domain simulations.

Simulations hold true

"Time-domain simulations have provided a more robust method of estimating vessel performance than traditional quasi-static DP capability analyses, which have been unable to predict the dynamic station-keeping footprint and excursions that may ultimately compromise operations," explains Pivano. For manned diving operation, the robustness of the vessel's post-failure DP station-keeping capability is of primary importance. DynCap offers insights into the details of a vessel's station-keeping performance that were hitherto unavailable. The data and conclusions derived in that project provided valuable and reliable input to operational risk assessment and planning.

However, a first release typically offers opportunities for improvement, and many suggestions based on user experience were received. "For us it is also important to react to changing and emerging requirements and to adapt to the users' needs. That is why we collected feedback and suggestions from the industry regarding both improvements for the standard and new features, especially for the Level 1 web app. Some challenges on how to apply and use the standard and web app have also been addressed," explains Aleks Karlsen, Senior Principal Specialist – DP Systems.

A common request from the industry has been to make Level 2 and Level 2-Site DP capability calculations available >



The revised DynCap web app provides customers with an easier, more reliable and transparent process when assessing a vessel's station-keeping capabilities.

The new release of the standard makes sure the interaction between a thruster race and a skeg results in a thrust loss factor in line with industry practice.

Photos: DNV GL

TYPICAL USAGE AND VALUE OF DP CAPABILITY LEVELS

DP capability level	Typical use	Value
Level 1	■ High-level DP capability assessment (e.g. chartering, early design phase) ■ Vessel benchmarking (can replace older methods resulting in excessive variation in output data) ■ Oil companies have begun to require this in tenders	■ Prescriptive method: consistent and comparable results ■ Improves decision input when choosing vessels ■ Free web app ■ Easy to deliver DP capability assessment numbers required for class
Level 2	■ When vessel-specific parameters are important	■ Allows to take advantage of equipment/vessel-specific performance ■ For hull shapes other than monohulls
Level 2-Site	■ When site-specific environmental conditions are important (e.g. shallow water, high current) ■ When external forces are important (other than those created by environment, e.g. riser, cable or pipe forces)	In addition to the items listed for Level 2: ■ Allows to account for site-specific weather data and external forces ■ For preliminary operational planning
Level 3/ Level 3-Site	■ When more information on vessel performance is desired (e.g. planning and selection of a vessel for critical operations; site-specific analysis and inclusion of external forces) ■ When vessel and equipment dynamics are important (e.g. position, heading or other motion in other degrees of freedom, thruster/power dynamics, gangway motion, etc.)	**Designers and yards** ■ Proper vessel size, realistic fuel consumption calculation, operability ■ Effects of hull design, equipment type and rating on the DP performance ■ Can be used for battery sizing **Operators** ■ Better data for choosing the right vessel for specific operations in a specific environment ■ Improved planning, improved operating limits – improved risk control **DP vessel owners** ■ Ticket to business – prove to oil companies that a vessel is suitable for intended operation ■ Operational and contingency planning

> in the web app on the Veracity platform to support vessel and project-specific calculations. A new version of the app including such a feature will be released on Veracity this year. The new release will also allow users to perform DP capability computations for vessel shapes other than monohulls, such as semisubmersibles and catamarans. Users will be able to apply site-specific environmental conditions, include external forces, vessel-specific environmental load coefficients and thruster forces in the same view. A feature comparing the performance of up to four vessels in the same view will also be incorporated.

Enhancements and improvements

The main feedback regarding the standard was related to the calculation of forbidden sectors in thrust allocation in the presence of a skeg. In certain designs, the resulting forbidden zone did not allow the actuator to produce any net force. In the new version of the standard the interaction between a thruster race and a skeg will result in a thrust loss factor in line with industry practice, delivering more realistic results. Other improvements in the revised standard include clarified definitions and formulations.

Another concern raised was the relatively low results for some existing vessels when compared to prior assessments based on older methods and standards. This may be attributable to the fact that the legacy standards were too flexible and not conservative enough. The new DP Capability standard aims to remove some of the flexibility regarding the assessment requirements, deliver more conservative results and provide a better tool for benchmarking vessel performance. It is difficult to claim that the new standard results in data that are closer to reality; however, it will ensure consistency of the applied method and the results needed for benchmarking (particularly for Level 1). In addition, it is well known that previous approaches often delivered overly optimistic results.

One very important and clear conclusion based on discussions and experience is that the responsibility of evaluating the assessment with respect to the actual DP capability and capacity needed rests with the user who should not base his decisions solely on the vessel with the highest DP capability numbers or limiting wind speed. "All these are major improvements in the standard and the web tools that will provide customers with an easier, more reliable and transparent process when assessing a vessel's station-keeping capabilities," Karlsen emphasizes. ■ **JS**

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Photos: DNV GL

Hrönn is a monohulled offshore utility ship servicing the offshore energy, hydrographic and scientific, and fish-farming industries.

Photo: Kongsberg

SHIPS WITHOUT A HELMSMAN

Equipped with a new test bed, and with several research projects underway, autonomous shipping is one step closer to becoming a reality. DNV GL is developing the necessary rules.

The little craft bearing the DNV GL logo gingerly braves the waves as it skippers across the Trondheim Fjord under the watchful eyes of Kjetil Muggerud and Henrik Alfheim from the Norwegian University of Science and Technology (NTNU) in Trondheim. Both students are investigating how advanced control systems and navigation software could control an unmanned vessel, using a 1:20 model of DNV GL's concept vessel *ReVolt*: "Advances in sensor technology, data analytics and bandwidth to shore are fundamentally changing the way shipping works. And as operations are digitalized, they become more automated," says Dr Pierre C. Sames, Director of Group Technology & Research at DNV GL.

In 2016 government agencies and industry bodies established the Norwegian Forum for Autonomous Ships (NFAS) to promote the concept of unmanned shipping. In support of these efforts, the Norwegian government has turned the Trondheim Fjord into a test bed for autonomous ship trials. Other nations, most notably Finland and Singapore, are pursuing similar goals.

DNV GL is in the midst of this development, following its mission to make sure the technologies enabling autonomous ships will perform to the benefit of humans, their assets and the environment.

"Autonomy will be a game changer for the class societies," says Bjørn Johan Vartdal, Head of DNV GL Maritime Research. "Traditionally we have been involved in approving ship technology, but the operational part we've left to the crew. But in autonomous vessels, the operation is embedded in the technology, it's the software that decides how it will manoeuvre, so we will have to approve the safety of the whole operation. This is, of course, really challenging and it will have to be a case of continuous development," he adds.

The human factor

DNV GL experts identified three main factors that could positively influence the uptake of autonomous shipping: automation reduces the potential for human error. With a battery propulsion >

> system, as seen on DNV GL's *ReVolt* model, an autonomous ship would also be lower in maintenance than conventional ships. Additionally, an unmanned cargo vessel would also become more economical, as eliminating the superstructure would save weight and create more cargo space. Furthermore, unmanned ships may be used in hazardous operations, for example firefighting, or as stand-by rescue vessels for offshore structures.

Small craft with great ambitions

DNV GL has initiated or is taking part in various projects revolving around ship automation and autonomous control. In the offshore sector, the unmanned offshore vessel *Hrönn* is currently under construction at Fjellstrand shipyard. The vessel ordered by a Norwegian and UK consortium led by Automated Ships and Kongsberg will be delivered in 2018. The light-duty, fully automated utility ship will be deployed in a shuttle service for offshore installations as a remotely piloted ship: to this end, the control systems, including dynamic positioning, automation and ECDIS, will be replicated at an onshore centre. *Hrönn's* sea trials will take place in Norway's officially designated automated vessel test bed in the Trondheim Fjord and will be conducted under the auspices of DNV GL and the Norwegian Maritime Authority (NMA). The *Hrönn* will ultimately be classed and flagged, respectively.

Control systems for remotely operated vehicles could go into operation in a matter of a few years.

The challenges

Overall, autonomous shipping opens up great opportunities for the European shipbuilding and shipping industries. But new competencies have to be built before autonomous ships can become a commercially viable reality. Key research must be done to improve sensor technology, the acquisition of high-resolution ranging data and instrumentation accuracy. Software plays a very important role in this scenario by enabling situational awareness, a prerequisite for automated decision management.

While existing know-how from the aerospace and automobile industries can be leveraged, specific expertise in ship autonomy has yet to be built up. The research activities at NTNU, sponsored by DNV GL and industry stakeholders, are instrumental in creating a new generation of highly skilled ship autonomy experts.

Another concern is the operational availability of on-board machinery. No immediate repairs are possible on an unmanned craft so reliability of all mechanical and electronic components is of utmost importance. "In addition, having battery-powered

The DNV GL experimental-scale model *ReVolt* is used by NTNU in Trondheim to determine how advanced control systems and navigation software can control an unmanned vessel.

Benefits of unmanned vessels include reduced risks for offshore workers, elimination of human errors, and lower operating costs.

> "The most likely scenario is that the technology which enables autonomous ship operations will simply be an additional option for operation."
>
> **Dr Pierre C. Sames,** Director of Group Technology & Research

unmanned vessels would eliminate movable parts from the power generation system and make them easier to maintain," says Sames.

Segments that could see the first autonomous vessels in operation include ferries and offshore supply vessels operating in coastal areas or smaller cargo vessels operating in short-sea shipping.

However, the expert cautions that, as yet, there is no legal framework that governs the use of unmanned ships. DNV GL is developing a set of rules, but to avoid potential conflicts with international law autonomous ships will not be able to operate in international waters until the IMO develops appropriate regulations, which will take time. For the deep-sea segments, autonomous shipping is not an option today, says Sames. "These vessels travel distances that go beyond the range of battery propulsion, and they require well-trained crews on board who can respond quickly to any technical issue," says Sames.

Additional crew support

However, advances in automation can benefit all industry segments in some way, even without fully autonomous control. In the future, some ship traffic could be controlled remotely from land-based virtual bridges – with one ship master overseeing several vessels at the same time. "But the most likely scenario is that the technology which enables autonomous ship operations will simply be an additional option for operation – meaning it could be used for specific purposes without fully replacing traditional, manned operations," Sames suggests. "So, for example, autonomous navigation and control systems could support the crew in steering a vessel, increasing safety and optimizing operational efficiency." **AK**

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Photos: DNV GL, Rolls-Royce plc

CLASSIFICATION FOR SMARTER OPERATIONS

The traditional class and statutory survey regime consisting of annual and five-year cycles has been shown to be too rigid for mobile offshore units (MOUs). Leveraging advanced digital technology, DNV GL's revised Offshore Rules which will come into force in January 2018 will provide much more flexibility.

The road towards digitalization in the offshore industry is long and many steps need to be taken to ensure safe and smart operations. Yet, there is an increasing need for new and alternative approaches to the cooperation between class and customer, especially with the aim of reducing "out-of-service" calls. In response DNV GL is updating its rules for mobile offshore units (MOUs) to make sure classification remains relevant and keeps abreast of new technologies and trends.

New, collaborative options

The new rules for MOUs in service introduce a new concept called "Classification for Smarter Operations". Are Torstensen, Director Technology and Service Development, Offshore Classification at DNV GL, explains: "The main objective of this initiative is to find smarter ways of working to improve the utilization of assets, reduce downtime, and minimize the impact of testing and inspection activities."

Classification for Smarter Operations takes a holistic approach, offering various arrangements and methods that may be selected in accordance with the company's asset management strategies and plans. The concept promotes integration between class and owner by allowing the owner to take a more active role in testing and inspection activities, and by performing our classification activities on a continuous basis aligned with the actual operation of the unit.

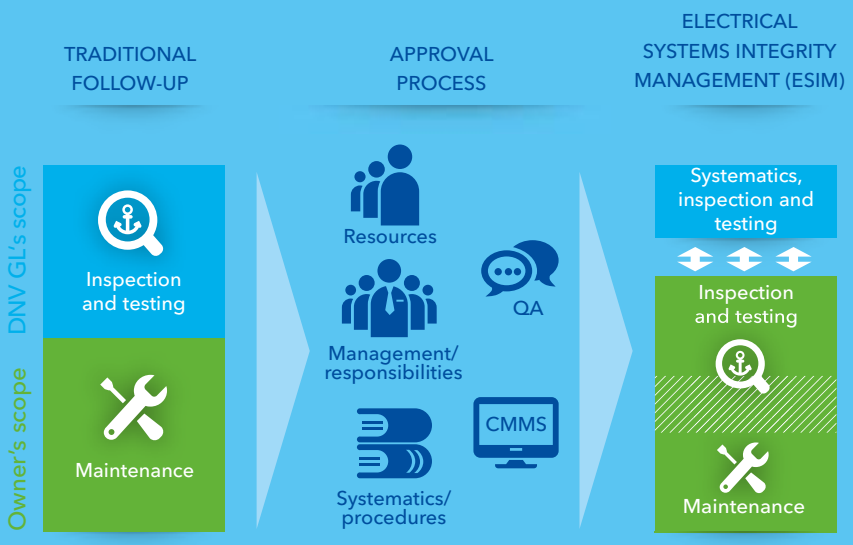
A modern MOU generates huge amounts of data from various sensors every day. It is a challenge to get an overview of what data is available, select and collect the most meaningful information, and use it to determine the condition of various systems or pieces of equipment. Classification for Smarter Operations introduces alternative arrangements and methodologies for utilizing sensor data, including rules for data management and data quality.

For example, the concept supports the implementation of condition-based maintenance (CBM) for machinery, thrusters, drilling equipment, etc. by combining both preventive (time-based) and predictive maintenance (based on condition monitoring) and making use of sensor data and data analytics.

ELECTRICAL SYSTEMS INTEGRITY MANAGEMENT (ESIM)

The new Electrical Systems Integrity Management scheme introduced by the revised Offshore Rules from DNV GL allows certain inspections and tests to be performed by certified owner employees (hatched section on the right). Furthermore, the scope of the full, five-year survey can be spread across the entire five-year period to avoid disruption and downtime on the "official" due date.

DNV GL continues to perform key tests and surveys and makes sure the customer applies the right systematics and uses a type-approved computerized maintenance management system (CMMS). Alternative IT-based test methods, such as fault simulations, reduce the impact of class surveys on operations.



New technologies such as drones and other types of remote inspection techniques applied in structural inspections are a welcome means to determine the right time for the next inspection and avoid unnecessary downtime. Risk-based corrosion and fatigue management based on sensor data are other examples.

Another newly developed concept called Electrical Systems Integrity Management allows alternative test methods, such as fault simulations, isolation and local testing as well as built-in test functionalities, to be applied in the inspection and testing of electrical installations. These tests can be performed by the owner's own, qualified personnel on a continuous basis, resulting in better coordination between the class and the owner while further reducing equipment downtime.

A solution developed for dynamic positioning (DP) provides for a distributed survey scope enabling continuous follow-ups. The scope of testing can be adjusted from year to year depending on operational activities. FMEA testing is spread over the five-year period. The owners have the option to have parts of the testing performed by their own specifically qualified personnel. This new testing and inspection scheme will serve as a framework for the new D-Class, which is currently under development (see page 22), and can be seen as a basis for further development within the D-Class project.

For lifting appliances, a new and efficient alternative inspection approach has been introduced under the name Condition Assessment. The inspections and tests can be optimized based on an analysis of the actual utilization history in relation to the design life of the lifting appliance. Accounting for the utilization history results in a more realistic inspection and testing schedule. "The new classification concept will provide a good basis for the new age of digitalization and further developments," Torstensen believes, adding that these innovative tools and methods are just the beginning of digitalization in the offshore industry. ■ **JH**

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MOUs will benefit greatly from the modernized, data-supported DNV GL survey arrangements scheme.

The premium jack-up *Sapphire Driller* is managed by Vantage Drilling.

PARTNERING TO WIN

It takes prudence and a steady hand to persist in the current economic environment. As the leading classification society, DNV GL can offer a high level of expertise to help customers cut operating costs.

It has been an unusually prolonged dry stretch for rig and drillship owners, no doubt. With oil prices at subterranean levels for years, many owners started considering their options: what to do with their unused assets, how to tackle the financial challenges or whether to let go of their staff are just a few challenges that need to be overcome. Smart decisions needed to be made to avert a worst-case scenario.

In this environment, the recent news that the offshore contractor Vantage Drilling International reported a solid third-quarter operating result was a rare glimpse of hope. The Houston-based company, owner of three ultra-deepwater drill ships, four premium jack-up drilling rigs, and one standard jack-up drilling rig, had taken appropriate steps at an early time to avert the issues encountered by most other drilling contractors. Apart from restructuring before the financial pressures got out of hand, Vantage had evaluated its options in terms of optimizing operations and cutting costs, and decided in favour of a transfer of class to DNV GL.

A case for change

Bill Thomson, VP Marketing and Business Development at Vantage, provides some background: "We've always been a small company. The management structure is pretty flat and most of the people have been here quite a while and as such there are short lines of communication which means we can take decisive action when we see things need to be done. We have good rigs, good processes and procedures, but it's the quality and diversity of our people that make the difference." When Vantage came out of restructuring in early 2016, it was these "good people" who played a key part in allowing the company to refocus on ways to keep the same operating performance whilst saving costs. One of the areas reviewed was the role of the classification society: "We wanted to figure out how to get the best value for our money in terms of classification. We did a rigorous comparison of the class societies and found that not only the price of DNV GL was competitive but we also liked their approach; they were organized, proactive, aligned with our needs and had some good ideas for managing the operations of our rigs more efficiently. It was clear that in DNV GL we had found a partner that understood our needs. That's when we made the decision to take our four jack-ups and the three drill ships and switch them over."

Craig A. Koehne, Offshore Class – Business Development Manager at DNV GL – Maritime in Houston, who was working closely with Vantage explains: "Our focus to reduce downtime due to regulatory requirements was an important decision factor, as this is where the major cost savings are found. Vantage also appreciates DNV GL's principles regarding transparency and working towards a relationship that will allow them to operate their assets in the most cost-efficient manner, while simultaneously maintaining high rigour towards the safety and reliability of their assets."

"DNV GL is present in most markets and works with many drilling contractors, and they've got lots of good ideas."

Bill Thomson,
Vice President Marketing and Business Development at Vantage Drilling International

Transferring class to DNV GL is an easy process. A dedicated project team at DNV GL takes care of all the coordination, including documentation reviews, making sure of a smooth transfer. Customers can expect more efficient rig operations and streamlined class-related procedures. DNV GL places great emphasis on providing comprehensive, 24/7 customer support and optimizing the vessel lifetime costs. "What has truly paid off for Vantage," says Bill Thomson, "is the proactive approach DNV GL takes to classification. They have some good ideas on how to do things differently. In the current market situation, you can't always take some big piece of equipment and send it to shore for overhaul, shutting down a rig. You need to find ways of keeping your operations working efficiently offshore." In particular, he points out, challenging the traditional, rigid five- and ten-year overhauls in favour of a more condition-based inspection scheme that accounts for actual usage and is less disruptive on rig operations makes a big difference for Vantage. Many OEMs have moved to this condition-based maintenance, an approach vigorously supported by DNV GL, but not all OEMs are there yet.

Always ready to go

Unlike many competitors who cold-stacked their unoccupied rigs during the critical years and laid off their crews to save costs, Vantage had decided in favour of warm-stacking its rigs so they could be reactivated and be ready for deployment at short notice and without major investments. Acknowledging the immense value of its workforce, their experience and familiarity with the hardware, Vantage agreed with the crew to find all means necessary to reduce the cost to be able to keep the rig warm-stacked. This included reducing salaries and changing positions to minimize the warm-stacking cost. This allowed Vantage to keep the personnel available and the rig in a good condition ready for reactivation, where others had decided to cold-stack their rigs and release their trained and experienced people. Doing so enabled Vantage to seize any new opportunity in the market quickly with experienced crews. The benefit of retaining the people, keeping the vessel warm-stacked, and working with DNV GL was seen when Vantage reactivated the *Platinum Explorer* in less than four months from contract award for a three-year contract with ONGC in India.

The transfer of class made sense as part of the company's strategic approach to riding out the crisis. "It's lining up with people like DNV GL that helps," says Bill Thomson. "DNV GL is present in most markets and works with many drilling contractors, and they've got lots of good ideas. Our technical teams in Houston and Dubai appreciate that the DNV GL teams are approachable, willing to listen to ideas, discuss their differences of opinion and reach positive solutions."

Maximizing asset value

Vantage's four DNV GL-classed Baker Marine Pacific Class 375 jack-up rigs are the company's workhorses, says Thomson. "These jack-ups are designed to be robust and we have over the past eight years been impressed with how capable they are. Our technical team, working with DNV GL, has been able to find areas where it has been possible to significantly improve on the original design and push the vessel performance to the next level. This is done in full conjunction with the experts at the class society to ensure that we not only improve performance but maintain the same levels of redundancy and safety." In a highly competitive environment, an expanded range of operating conditions for the rigs can make a big difference for Vantage – another example that shows how working with the right classification society can produce very tangible benefits. A fifth jack-up Vantage purchased recently is currently being evaluated, and DNV GL has supported the drilling contractor in this process as well.

Whether it is maintaining the assets in the most cost-efficient manner while maximizing safety, performance and uptime, handling the complex interaction with local regulatory bodies, providing technical advice and support, or offering flexible inspection and testing schemes and reducing regulation-related downtime, transferring class to DNV GL has paid off for Vantage, especially now that nearly 100 per cent of the company's assets are under contract.

It may still take a couple of years until the drilling business fully rebounds, but the people at Vantage are confident they have chosen the right partner to support their three "wildly important goals": firstly, maintain their stellar safety performance and operational record; secondly, put all of their rigs back to work to maintain their continuous operational track record, and finally to manage costs and preserve the cash to safely reach the end of this industry downturn. **AK**

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Photos: DNV GL, Vantage Drilling International

D-CLASS TAKES SHAPE

Downtime, delays, and interruption of operations are common consequences of dynamic positioning verification schemes. DNV GL wants to change this by incorporating modern technology.

Digitalization is radically changing the way the shipping and offshore industries operate, opening up new opportunities to improve even the most advanced technologies. Dynamic positioning (DP), computer-controlled position-keeping based on mathematical modelling of sensor data, was first applied in 1961. DP has since become an integral part of complex operations.

While advances in technology and reference systems have made DP more reliable over the years, classification societies and other verification bodies continue to rely on traditional class verification methods and tools that require a witness on site. These methods have yet to take advantage of the efficiency provided by modern technology and vessel operating practices, and often disrupt routine operation or even cause downtime and delays.

"With data-driven innovations gaining momentum, and in anticipation of expected market demand, DNV GL is now developing an improved, less invasive classification scheme for verification of DP systems by leveraging modern technology," says Jan van Tiggelen, Principal Consultant Shipping Advisory at DNV GL – Maritime.

The industry shares the vision

Advanced data analysis, control and monitoring concepts are enabling new and better ways to verify the integrity of DP systems. DNV GL has launched a "D-Class" (Data Smart Classification) joint development project to develop an innovative DP verification approach. In a series of workshops DNV GL is seeking input from the industry regarding the goals, methods, means and deliverables of the project.

These workshops provide industry stakeholders with an opportunity to engage in the project and contribute to the collection of data, influence how it will be used and shared, propose alternative methods to satisfy the core of intended requirements, and help frame what the verification scheme will look like.

To date, more than 30 offshore drilling operators, oil majors, shipowners, shipyards, equipment manufacturers, associations and academics have taken an interest in this development. For offshore stakeholders, D-Class is a vision for the future that will unlock the potential of the data the industry collects. Several customers have approached DNV GL to explore pilot projects incorporating D-Class.

Strong advantages

Some of the benefits expected from the new D-Class verification scheme include:

Increased safety

- Improved level of third-party verification by employing a tailor-made verification scope
- Improved management of change processes

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PERSPECTIVES: DNV GL ON THE RIGHT PATH

At a D-Class workshop in Houston DNV GL sat down with project partners to discuss the new verification scheme. While views vary, all partners see the project moving in the right direction.

What role do you see classification societies taking when it comes to industry innovation, and will class involvement open any doors to future developments?

Jan Mikalsen, President, Marine Technologies:
"Class is an enabler for innovation in our industry. The technology and data needed for innovations such as D-Class already exist. What DNV GL is providing is the framework for analysing the operational data. We operate in a world of constrained resources, and we need to extract the maximum amount of value from the resources available to us. Where class offers schemes that are less invasive, it allows vessels to be more efficient.

D-class is a facilitator for what is coming: remotely operated or even autonomous vessels. It will also support safer, smarter and greener operations. I don't think with D-Class alone we can harvest the full extent of those benefits, but without D-Class it will be a struggle to achieve the de-manning vision pursued by the industry. Today's class schemes don't truly allow us to achieve what we want in the future, but D-Class is the type of development that moves us closer to that vision."

D-class is another example of using today's rapidly evolving technology to reshape operations. With digitalization and connectivity increasing, what is most important to you?

Edward Bourgeau, Engineering Discipline Manager, Electrical Transocean Offshore Deepwater Drilling:
"Trust is a big component for us. The whole idea is that we are gathering data on the rig and we're saying this data is meaningful. We have the responsibility to answer questions, including from ourselves, about whether that statement is true or whether we are fooling ourselves.

One of the primary reasons we work with DNV GL is because the company is a trusted third-party advisor. We want to tell our customers that what we are doing meets the approval of a respected body. The level of quality and assurance we receive is unmatched, not just from class but from all of DNV GL's services.

With D-Class, if our data meets DNV GL's integrity standards, our customers and their contractors will have confidence in it too. Of course they will scrutinize it, but DNV GL's approval lends a level of credibility to our data. DNV GL's stamp of approval gives legitimacy to what we are doing, and our customers see that."

Innovative methods and schemes will eventually change the way classification surveys work. Self-verifying systems, automation, remote testing and other technologies will reduce scheduling issues and the need for physical presence.

Increased efficiency

- Flexible schemes that move away from five-year calendar-based surveys
- Less intrusive verification that reduces the need for physical surveyor presence

While the industry readily embraces the benefits of the project, the success of the new verification scheme relies heavily on collaboration and optimized management of shared data. Not unexpectedly, this raises questions regarding data security, data ownership and other specific characteristics of the new verification scheme.

The reliability and integrity of sensor data will be critical to D-Class but there is much more to be considered. Numerous methods are being evaluated for phased implementation, including:

- Automated tasks and verification during operations
- Remote witnessing
- Use of monitoring and data analytics
- Built-in test equipment and self-verifying cyberphysical systems

Self-verifying systems, automated testing, extended simulation and remote surveys will facilitate a more flexible and efficient verification process that delivers improved verification accuracy.

Schemes and methods of the new D-Class for verification of DP systems are intended to be transferable to other systems. This approach aligns with the application of digital twins and will facilitate the industry's vision for de-manning and autonomous vessels. "While D-Class may significantly reduce or even eliminate the need for a DNV GL surveyor's presence on board, the purpose and role of the classification society as an independent verifier remains unchanged," says Aleks Karlsen, Senior Principal Specialist – DP Systems. "Under D-Class, DP systems must meet the same set of requirements as under the current verification scheme." ■ **MF**

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DNV GL'S DIGITAL JOURNEY

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

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

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

Single access point to all digital services

When our customers interact with classification, they want this to be as simple and efficient as possible. To help, we launched the Veracity marketplace. This is a single access point for all of our digital services, with many applications designed to support our customers in areas such as port state control inspections (see info box – PSC Planner), cybersecurity preparedness and regulatory compliance. To provide worldwide access to class documentation, DNV GL customers can now use electronic certificates. This means their documentation never gets lost, is always up to

ELECTRONIC CERTIFICATES

Started in October 2017, DNV GL introduced electronic certificates for the class and statutory regimes. In the first three weeks since the launch over 11,000 certificates on more than 1,600 vessels have been issued. Accessible from anywhere in the world, electronic certificates bring many advantages to both DNV GL and its customers. By eliminating paper handling, they reduce the administrative burden on all stakeholders. A validation solution ensures that electronic certificates are just as safe as paper. In addition, electronic certificates are easy and convenient to share. Compiling them in Fleet Status in Veracity provides a comprehensive overview of key ship data that cannot get lost and is just a few clicks away. For DNV GL, electronic certificates help make processes more efficient, and they provide experts with easy access to certificates when they need to check up on something, be it during a survey or at a customer meeting. Electronic certificates are rolled out gradually and are being implemented with a vessel's next annual survey.

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

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

Knut Ørbeck-Nilssen, CEO of DNV GL – Maritime

SMART SURVEY BOOKING

The Smart Survey Booking simplifies survey booking, fitting inspections into the customers' schedule while saving time and costs. This is how it works:

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

date and is accessible from any device (see info box – Electronic Certificates).

"And with the introduction of our new Smart Survey Booking tool in October 2017, we have also started using intelligent software agents to help customers find the best time and place to book a survey," adds Ørbeck-Nilssen (see info box – Smart Survey Booking). When customers have questions or run into a problem, they can get in touch with one of DNV GL's technical experts through the DATE service. "This service has been a great success and now, to make it even better, we have introduced a tool that uses machine learning to automatically match our customers with the right expert for their question," says Ørbeck- Nilssen. The tool has already analysed more than 300,000 requests and is continuing to learn (see info box – Machine Learning). "Soon, we expect it will be able to answer simple questions on its own," he adds.

Modern survey methods

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

Photos: DNV GL, DragonImages/panalot/zinkevych - Fotolia

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

Turning data into business intelligence

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

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

The broader view

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

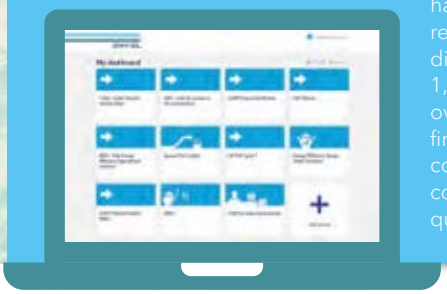
A new industry data platform

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

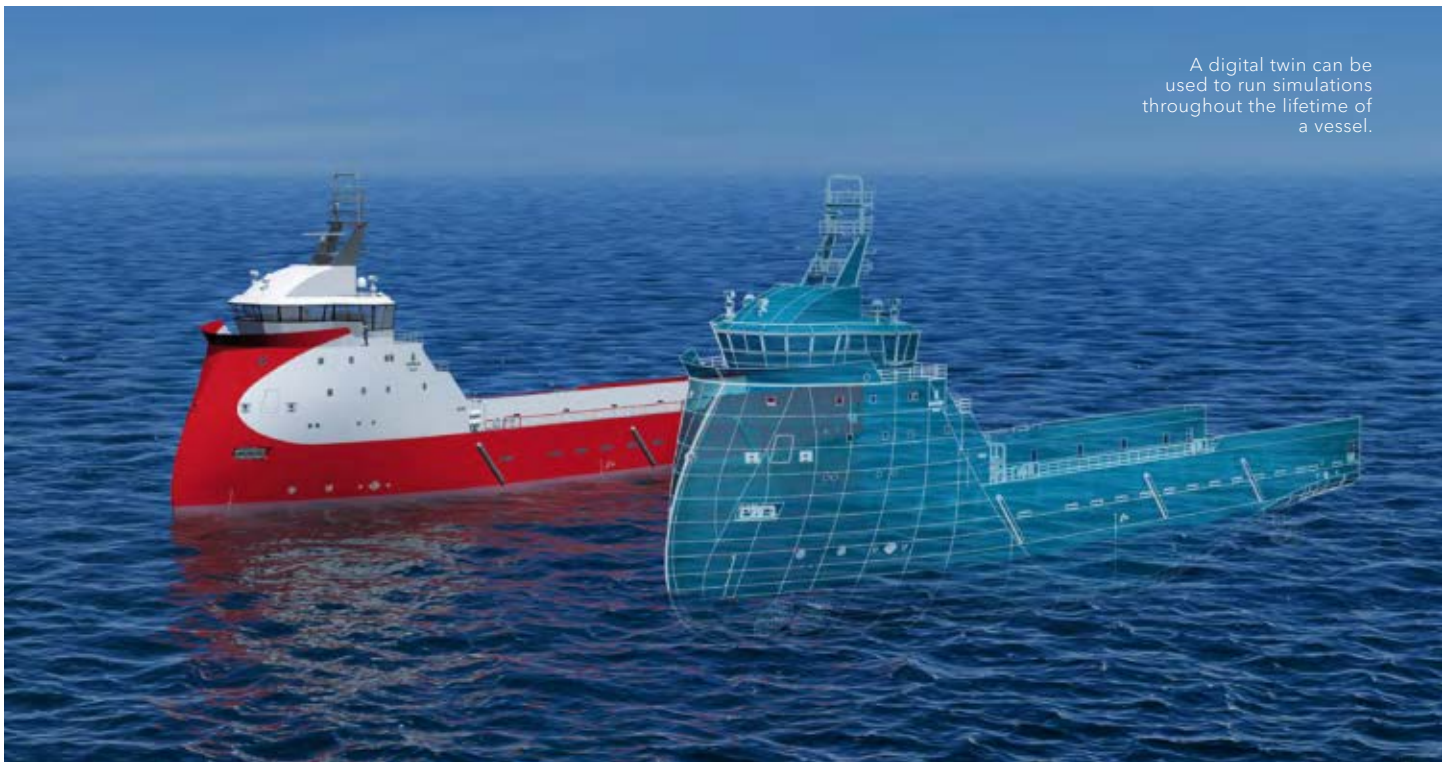
Photos: Carabay - Fotolia, Devrimb - Thinkstock, DNV GL

MACHINE LEARNING

DNV GL has introduced a new machine learning tool to the Direct Access to Technical Experts service (DATE). When customers have a query, this service connects them to one of more than 400 technical experts located at five support hubs worldwide. On average, DATE was used 2,300 times per month in 2017, with over 97 per cent of requests being completed within the customer's deadline. Matching every request with the right expert as quickly as possible is essential. DNV GL's new machine learning tool searches for key words in a customer enquiry to create a profile for each request. Then it sends the request to an appropriate expert. After a piloting phase the machine learning tool went live for all DATE requests at the beginning of May 2017. It has viewed about 300,000 requests already and has direct access to more than 1,000,000 drawings and over 15 years of survey findings and is learning continually. In the future, it could even answer simple questions on its own.



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



A digital twin can be used to run simulations throughout the lifetime of a vessel.

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

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

VERACITY

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

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

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

PSC PLANNER

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

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

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About DNV GL
DNV GL is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property and the environment, we enable our customers to advance the safety and sustainability of their business. Operating in more than 100 countries, our professionals are dedicated to helping customers in the maritime, oil & gas, power and renewables and other industries to make the world safer, smarter and greener.

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

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