



ABS
& AFFILIATED COMPANIES

**SAFETY
LEADERSHIP
IN A DECADE
OF CHANGE**

2022
ANNUAL REVIEW

ABS MISSION

The mission of ABS is to serve the public interest as well as the needs of our members and clients by promoting the security of life and property and preserving the natural environment.



2	CHAIRMAN'S MESSAGE
6	INDUSTRY LEADING SAFETY AND QUALITY
10	SUSTAINABILITY AND TECHNOLOGY
22	GLOBAL MARINE
32	GLOBAL OFFSHORE
42	GLOBAL GOVERNMENT
48	TALENT DEVELOPMENT AND CORPORATE CITIZENSHIP
52	ABS CORPORATE GOVERNANCE
56	ABS GROUP OF COMPANIES, INC.
63	ABS GROUP OF COMPANIES, INC. CORPORATE GOVERNANCE
64	ABS WAVESIGHT™



62.77

710.10

219.98

651.32

921.50

993.28

206.36

921.50

481.75

411.08

152.68

152.68

921.84

921

38

CHAIRMAN'S MESSAGE

We have seen rapid evolution on virtually all fronts in shipping in recent years. Now, with the clean energy transition and end-to-end digitalization, our industry stands on the cusp of a decade or more of truly disruptive change.

The energy transition requires a new language of shipping – which is CO₂ emissions per tonne mile – and forces all sectors to pursue a carbon neutral energy unit, which will be provided by the hydrogen and carbon value chain.

Development of these globe spanning industries and associated technologies is disrupting many of the long-standing fundamental operating principles of our industry – safety boundary conditions, technology readiness timelines and relationships between charterers and traders.

As decarbonization timelines matured in 2022, these forces were compounded by global geopolitics, which has generated new stressors on energy security and operations already recovering from disruptions caused by the COVID-19 pandemic.

Now we need to begin to balance what we're facing today, which is, essentially, how do we handle energy security relative to the short-term energy security challenge and the longer-term energy transition?

Against this uncertain backdrop, ABS has continued to deliver on its safety mission, identifying the unintended safety consequences generated by the application of advanced digital technologies and decarbonization strategies.

Awareness of this risk is a critical building block for the future of our industry, and this is exactly what ABS is built for. We operate across the technology, regulatory, ship operation and safety sectors because of our unique position and perspective in dealing with owners, shipyards, equipment manufacturers and governments.

As an independent organization guided by a time-tested, safety-centric approach, we are well-positioned to guide the industry with a focus on personal, industrial and operational safety.

That's why we are excited, not only about the great year we had in 2022, but about the years to come because we know that we are and continue to be a difference maker.

In 2022, ABS delivered strong growth and solid performance. Our continued focus on industry fundamentals allowed us to grow our classed fleet to 280 million gross tons and strengthen our number one position in global orderbook share. ABS leads the orderbook share with shipbuilders



“At ABS, our shared core values and aligned focus on safety and environmental risk guide our investment and operational decision-making across the enterprise to ensure we continue to deliver best-in-class services to support our mission and our clients.”

CHRISTOPHER J. WIERNICKI
CHAIRMAN, PRESIDENT AND
CEO OF ABS, CHAIRMAN OF
ABS' AFFILIATED COMPANIES

in China, South Korea, Singapore and the U.S., and we are the class of choice for existing fleet owners in Greece, Denmark, Singapore, Hong Kong, the U.S. and Brazil. We have also maintained our industry leadership across the entire global offshore market.

Last year, in the global marine sector, we continued to lead in classed tonnage of the existing fleet for tankers. We also led the orderbook share for gas carriers and maintained strong orderbook positions for containerships and bulk carriers. In addition, we extended our lead in sustainability and digital services and expanded our U.S. government footprint.

In 2022, ABS continued to guide the industry in safety and retained the leading position on overall Port State Control (PSC) Performance, being the top performing Recognized Organization (RO) in the three most active PSC regions of the world since 2017.

We continued to make significant investments in digital technologies to advance the cause of safety and operational excellence in tandem with the industry's decarbonization and sustainability ambitions while moving us toward a more condition-based approach to class.

Through pioneering joint development projects (JDPs) in fields such as carbon capture utilization and storage as well as the broad range of alternative fuels and through cross-sector partnerships in the critical development of green shipping corridors and global clean energy marine hubs, ABS has broken new ground and is leading the way.

Our global sustainability and technology centers in key locations around the world have united their full spectrum of capabilities to provide leading-edge solutions and support to our clients, while also helping industry coalitions advance research into vessel design, alternative fuels, digital technologies and decarbonization pathways.



SAFETY LEADERSHIP IN A DECADE OF CHANGE

We further supported these efforts with groundbreaking R&D, advanced technical services, such as multi-physics simulations, and the release of a series of industry-leading outlooks, guides and publications.

In the shipping sector, we assisted development of technologies that will be the foundation of new carbon and hydrogen value chains, as well as new and existing alternative fuels, and we introduced new tools and strategies for fleet-wide decarbonization. We also launched sustainability reporting and assurance services that allow users to demonstrate adherence to, compliance with, and progress toward recognizable sustainable operations.

In the offshore sector, ABS spearheaded the formation of a working group consisting of leading companies and regulators focused on developing best practices regarding the safety challenges of the aging global floating production storage and offloading (FPSO) fleet. In addition, we expanded our safety-focused guidance on operational life extension for floating production installations (FPIs).

We are well positioned now and for the future because of the investments we have made in our people, our systems and technologies. These extensive investments strengthen the ABS value proposition across the three different parts of our business – with ABS Bureau's core classification services, the ABS Group of Companies, Inc.'s (ABS Group) risk and consulting services and ABS Wavesight's maritime software as a service (SaaS) working together to deliver enhanced value for our clients.

In 2022, ABS Group continued to achieve the kind of industry-leading performance that, through more than a half-century of service to industry, has built a reputation for risk management excellence. And, once again, ABS Group performed without a lost-time incident in 2022, while ABS Group's subsidiary, ABS Consulting, won recognition from Forbes and Statista as one of America's Best Management Consulting Firms.

Despite ABS' accomplished lead in the application of digital technologies at sea, we doubled down in our pursuit of increased efficiency and operational optimization by leveraging digitalization, with the groundbreaking launch of ABS Wavesight™. This unites the expansive offerings of ABS Nautical



Systems[®] industry-leading fleet management software and the innovative performance and compliance tools of ABS My Digital Fleet™, our advanced risk-based business intelligence and operations platform into one powerful new SaaS business.

ABS did all this without ever losing sight of the men and women we expect to deliver in this changing environment and have kept a sharp focus on training tomorrow's seafarers in the skills they will need to operate with the next generation of dynamic fuels and technologies. We understand that technology can never be the most important part of the safety equation – that will always be the human factor.

Following a newly developed Learning Ecosystem roadmap, we implemented new methodologies and tools to develop our employees for the skills needed today and in the future, and last year, employees completed nearly 140,000 training hours or almost 70 man-years – the highest levels seen in the past five years.

In 2022, across ABS and our subsidiaries, we proudly and steadfastly continued delivering on our mission with impactful environmental, social and governance (ESG) initiatives that made a real difference to our people, our clients and, ultimately, to our planet.

High performing organizations embrace safety and diversity. Our team reflects the global nature of our business – with almost half of our employees located outside the United States. In fact, our workforce is home to 53 nationalities comprised of 31 ethnicities, and it is from this diversity that we draw our strength.

At ABS, our shared core values and aligned focus on safety and environmental risk guide our investment and operational decision-making across the enterprise to ensure we continue to deliver best-in-class services to support our mission and our clients. I would like to thank our clients for the trust they place in us – we understand that we must earn that trust every day.

I am proud to report that this Annual Review recounts a year of significant achievements as we ready ourselves to lead the industry through a decade overflowing with profound challenge. The constant thread through our past and into our future is the enduring power of the SPIRIT of ABS to provide safety leadership in a changing world.

This SPIRIT – Safety, People, Integrity, Reliability, Innovation, Teamwork and Quality – manifests differently with each challenge, but always rests on a core set of values and the ability to harness talent, knowledge and expertise in ways that leverage our corporate strengths to deliver consistent, high-quality performance.

The simple truth is that an organization's performance is the sum total of a great many individual efforts – success truly is a team sport.

All of our accomplishments in 2022 came to be because of our dedicated worldwide staff who live the SPIRIT of ABS every day.

I hope you enjoy our story.



Christopher J. Wiernicki
Chairman, President and CEO of ABS
Chairman of ABS' Affiliated Companies

INDUSTRY LEADING SAFETY AND QUALITY

SAFETY LEADERSHIP

Safety is the foundation of everything ABS does – a core value and endless pursuit. The organization has built its reputation as an industry leader in maritime safety underpinned by a commitment to continual improvement and developing a strong safety culture for its workforce. What ABS does matters to people’s lives and the quality of the environment. ABS empowers employees with the knowledge, tools and authority to maintain safety at work and in everyday life. The company’s safety record has been compiled on countless ships, offshore facilities, shipyards, industrial sites and offices globally. ABS is vigilant in its goals to improve safety practices and are dedicated to keeping its workplace safe.

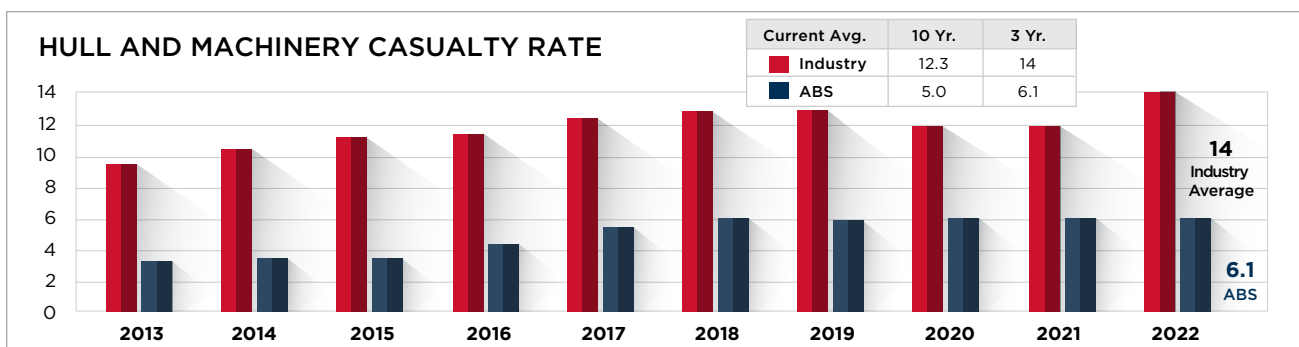
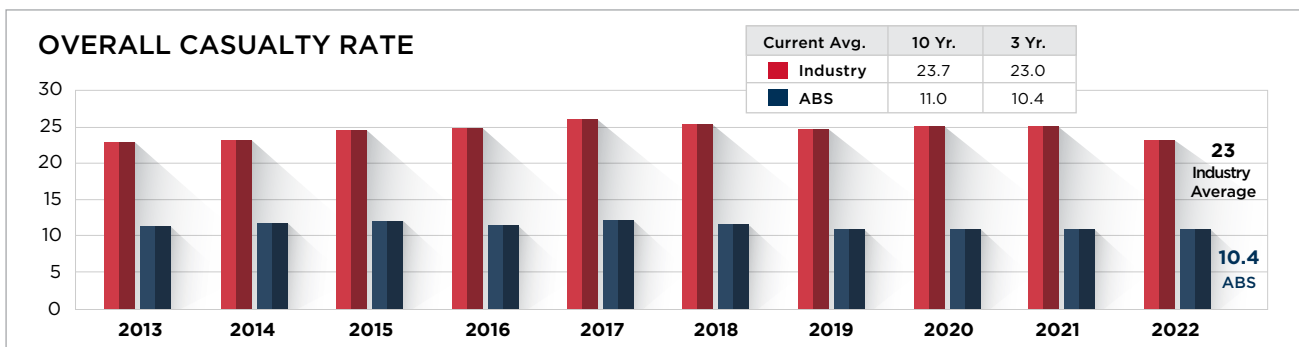
“As an independent organization guided by a time-tested, safety-centric approach, we are well-positioned to shepherd the industry with a focus on personal, industrial and operational safety.”

CHRISTOPHER J. WIERNICKI
CHAIRMAN, PRESIDENT
AND CEO

ABS SAFETY PERFORMANCE

In ABS’ long safety tradition, each year’s successes form the foundation of the following year’s achievements, fueling the voyage that has made ABS a global Health, Safety, Quality and Environmental (HSQE) leader. The company’s field staff continues to have weekly safety meetings. Office staff meets monthly to discuss specific safety issues locally and cover elements of ABS’ safety theme that is developed each year. In 2022, the ABS safety theme was “SafetyPresent,” a program dedicated to mental focus and monitoring changes in behaviors and conditions in the immediate environment, in addition to recognizing how these behaviors and conditions may change over time while completing tasks or migrating to different areas. The primary focus of this program in 2022 was related to critical safety behaviors identified within ABS.

In 2022, ABS issued 16 Golden Eagle Health and Safety awards to individual employees worldwide, while the Chairman’s Safety award was issued to five locations – focused on field activities. This further demonstrates that ABS is a safety-driven organization and is a testament to the safety awareness of its staff, their commitment to safe practices and procedures and the success of the organization’s overall safety methodology.



Source: ABS, Informa (LMIU) Database, December 2022

OCCUPATIONAL HEALTH AND SAFETY PERFORMANCE

The ABS ongoing safety excellence initiative incorporates strong occupational health and safety processes and policies, including a Stop Work Obligation rule authorizing all employees to intervene if safety is in question in any aspect of their work. ABS continues to increase engagement in leading safety behaviors, including timely reporting of potential incidents or hazards and documenting near misses. Health and Safety campaigns and robust incident reporting campaigns were used to reinforce reporting non-loss incidents and near misses.

- ABS' three-year averages of key safety measurements continue to be among the best in the industry:
 - Lost-time incident rate (LTIR) of 0.31
 - Total recordable injury rate (TRIR) of 0.41
- ABS employees continue to make good use of the global reporting system to capture unsafe conditions, unsafe behaviors, near misses, and work-related injuries or illnesses.
- ABS maintained ISO 45001 certification in 2022, with external audits performance by the British Standards Institute (BSI).

QUALITY PERFORMANCE

Through 2022, ABS' focus on industry fundamentals allowed the company to grow its classed fleet to 280 million gross tons (m gt); strengthen a leading position in orderbook share; maintain industry leadership across the entire global offshore market; and continue to guide the industry in safety and retain its position as the top-performing Recognized Organization (RO) since 2017 in the three most active port State regions.

In 2022, ABS continued high-quality service delivery to a global client base. ABS maintained its leading position on overall Port State Control (PSC) performance, being the top-performing RO in the three most active PSC regions of the world since 2017.

- U.S. Coast Guard (USCG) – ABS maintained zero RO-related detentions for the last 14 years.
- Paris MoU – ABS had one or fewer RO-related detentions each year over the last 10 years.
- Tokyo MoU – ABS averaged one RO-related detention per year over the last seven years.

ABS GROUP OF COMPANIES, INC. SAFETY PERFORMANCE

Building on the parent organization's ongoing commitment to its safety mission, ABS Group of Companies, Inc. (ABS Group) surpassed seven years without an LTI in 2022.

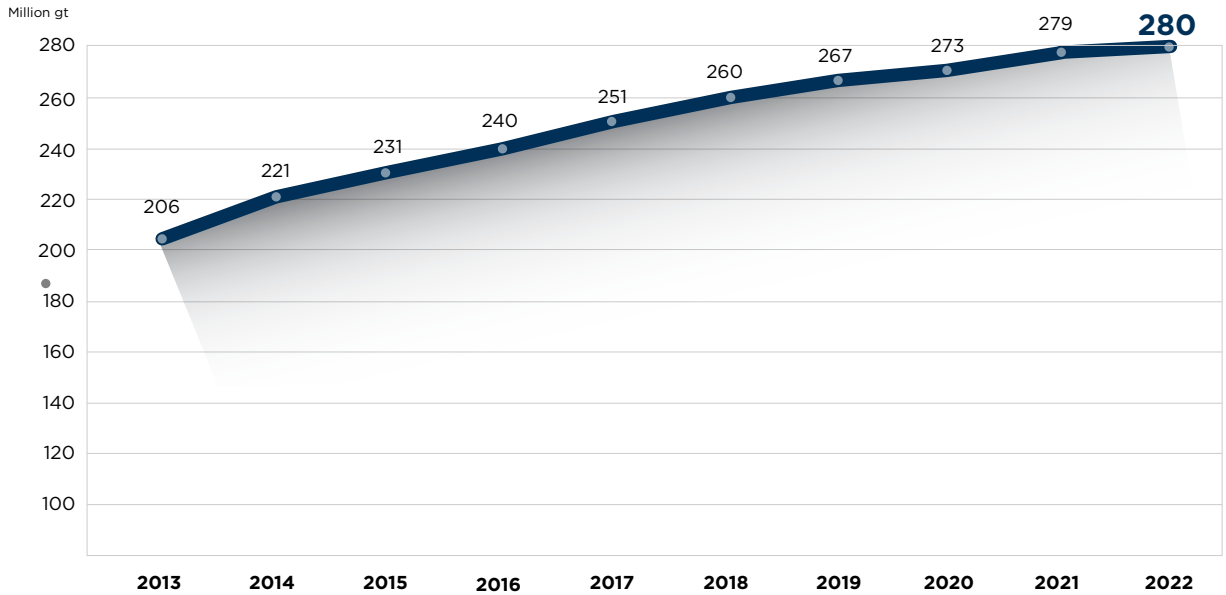
In 2022, ABS Group issued two Golden Eagle Health and Safety awards to individual employees worldwide, while the Chairman's Safety award was issued to the Risk and Reliability Team.

- ABS Group's three-year average of key safety measurements continue to be among the best in its industry:
 - Lost-time incident rate (LTIR) of 0.00
 - Total recordable injury rate (TRIR) of 0.00
- ABS Group employees continued to make good use of the global reporting system to capture unsafe conditions, unsafe behaviors, near misses, and work-related injuries or illnesses.
- ABS Group achieved recertification to ISO 45001 in 2022, with external audits performed by the British Standards Institute (BSI).

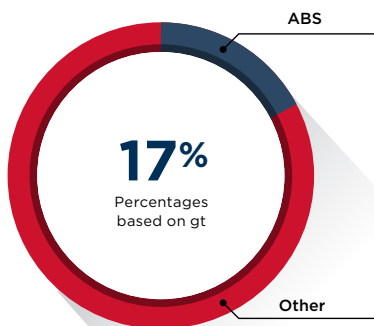
This achievement demonstrates ABS Group's focus on continually improving the effectiveness of its health, safety, quality and environmental culture, performance and management system.

INDUSTRY LEADING PERFORMANCE

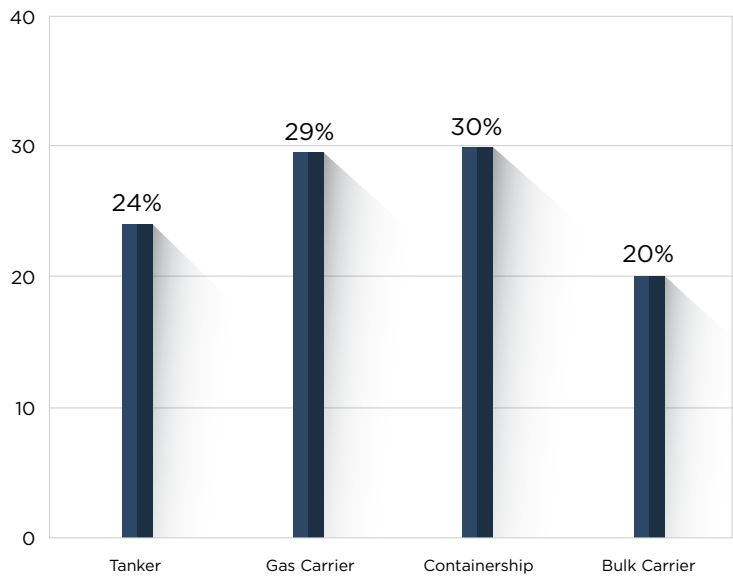
EXISTING FLEET 2022



EXISTING FLEET 2022



MARINE ORDERBOOK SHARE 2022





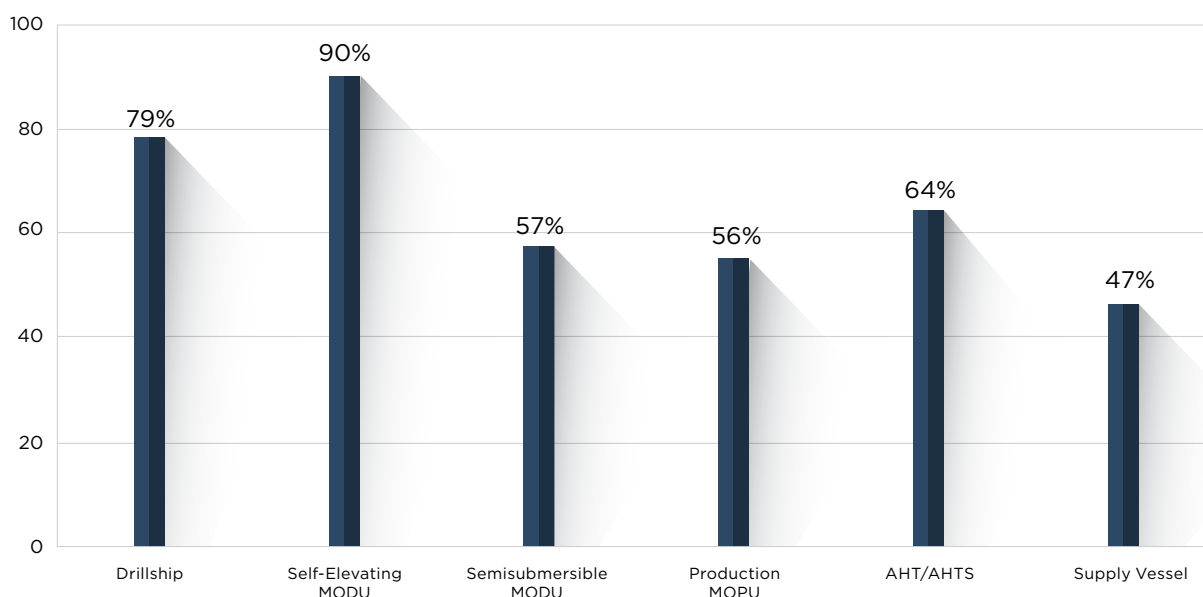
**LEADING ORDERBOOK
FOR SHIPBUILDERS**

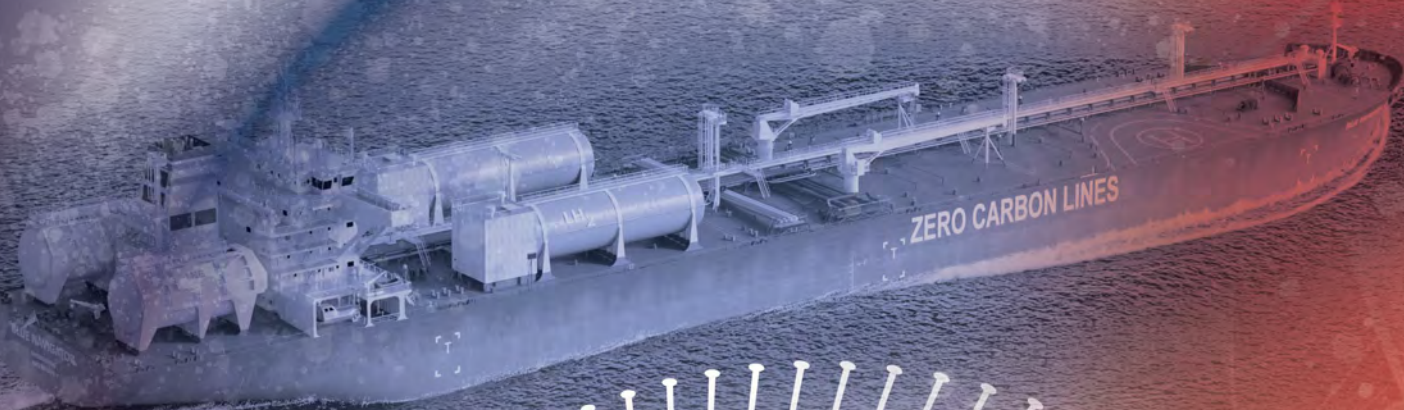
BRAZIL	S KOREA
CHINA	TAIWAN
SINGAPORE	USA

**LEADING EXISTING FLEET
FOR OWNERS**

BRAZIL	HONG KONG
DENMARK	SINGAPORE
GREECE	USA

OFFSHORE ORDERBOOK SHARE 2022





SAFETY LEADERSHIP
IN A DECADE OF CHANGE

**SUSTAINABILITY
AND
TECHNOLOGY**





With 2030 and 2050 rapidly approaching, sustainability and decarbonization agendas are increasingly ingrained in every aspect of the marine and offshore industries. Stakeholders are more conscious than ever of their carbon footprints and how to reduce them, driving growing interest in areas like carbon accounting, carbon capture technology and alternative fuels.

During 2022, ABS supported the industry's decarbonization and emerging value chains with approvals in principle (AIPs), joint development projects (JDPs) and a series of publications providing guidance for navigating key challenges, emerging technologies and regulations on the journey to net zero. From green shipping corridors to carbon economics, ABS stands ready to lead the industry into more sustainable, technology-forward operations.

In this section, ABS highlights many of the industrywide sustainability and technology initiatives it supported in the past year. Additional sector-specific sustainability and technology initiatives and activities are reflected in the Global Marine and Global Offshore sections of this Annual Review.

SUSTAINABILITY

The need to understand and quantify emissions is an increasingly critical part of doing business, especially as organizations look to understand the contribution of their supply chains to their overall sustainability goals and obligations. During the past year, ABS worked to bring clarity and provide guidance in the midst of rapid regulatory development and industry changes.

- In March, ABS added greenhouse gas (GHG) Inventory and Carbon Accounting to its industry-leading suite of marine and offshore sustainability services. The new services enable organizations to quantify GHG emissions, understand their climate impact and set goals to limit emissions and define their footprint and contributions in Scope 1, 2 and 3 accounting categories. GHG Inventory was developed in conformance with the ISO 14060 set of standards, which are applicable to a variety of individual units or projects as well as whole organizations.
- Soon after, ABS began working with leading U.S. tug and barge operator McAllister to support the sustainability journey of its fleet of more than 75 tugs, crewboats and barges. ABS specialists worked with McAllister to calculate its operational carbon intensity and benchmark the performance of its fleet. This led to an environmental, societal and governance (ESG) report that helped McAllister demonstrate a transparent governance and stakeholder engagement strategy, identify material ESG factors, set short- and long-term targets, and develop recommendations to generate continuous improvement.

JOINT EFFORT TO DEVELOP A DECARBONIZATION STRATEGY

In January, ABS announced formation of a partnership with Nakilat, one of the world's largest liquefied natural gas (LNG) shipping operators, to develop an industry-leading decarbonization strategy and evaluate its performance against the United Nations' (U.N.) Sustainable Development Goals (SDGs).

Nakilat's project team worked closely with ABS sustainability specialists to map out decarbonization pathways for the company's fleet of 69 LNG carriers and four liquefied petroleum gas (LPG) very large gas carriers (VLGCs). The project will ultimately see Nakilat's vessels receive the ABS SUSTAIN notation, which demonstrates alignment with the U.N.'s SDGs and establishes a pathway for sustainability certification and reporting.



The SUSTAIN notations were introduced with the *ABS Guide for Sustainability Notations* to help marine and offshore operators meet the environmental, social and governance (ESG) requirements outlined in the U.N.'s SDGs. The Guide focuses on sustainability aspects of vessel design, outfitting and layout that can be controlled, measured and assessed, including: pollution and waste; coastal and marine ecosystems; energy efficiency and performance monitoring; low-carbon fuels; human-centered design and asset recycling.

ABS AND DSME TEAM-UP ON DECARBONIZATION STRATEGY

In September, ABS and Daewoo Shipbuilding & Marine Engineering (DSME) formed a JDP to create a decarbonization strategy for DSME's LNG carrier designs.

Signed at the Gastech exposition, the JDP will see ABS and DSME investigate carbon emission performance of ships operating in various market segments, with specialists from ABS' Simulation Center in Singapore simulating the performance of a range of decarbonization technologies. The results of this investigation will help DSME compare and select the best decarbonization options for each specific ship segment.

ABS' industry-leading simulation center is key to this effort, as it provides the necessary concentration of expertise for understanding in rich detail how various decarbonization options play out at both the fleet and individual vessel levels.

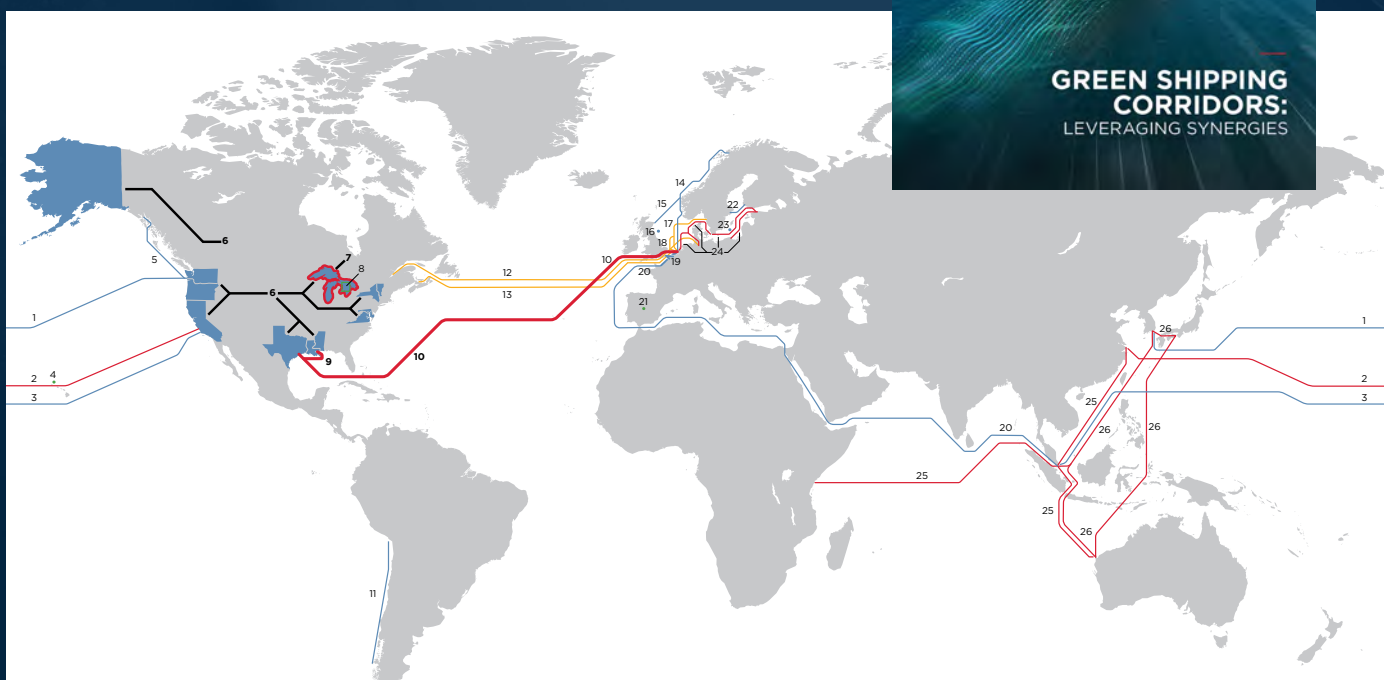


- Meanwhile, in June, the European Commission's Directorate-General for Mobility and Transport granted an ABS-led consortium a contract to carry out a technical study on the Future of Ship Energy Efficiency Measures. Part of the Smart and Sustainable Mobility Strategy adopted by the European Commission, which calls for the European Union (EU) to establish sustainability standards with the International Maritime Organization (IMO), the 15-month project will analyze the IMO's Carbon Intensity Indicator (CII), Energy Efficiency Existing Ship Index (EEXI) and Energy Efficiency Design Index (EEDI) framework and provide recommendations for further development, effective implementation and enforcement.

ABS INTRODUCES PLAYBOOK FOR GREEN SHIPPING CORRIDORS

ABS published the industry-leading *Green Shipping Corridors – Leveraging Synergies* document in October, providing an in-depth exploration of green corridors and insights into their critical contribution to the landscape of maritime decarbonization while highlighting the connection with energy hubs. The document sets out how green shipping corridors will help the industry determine the right balance between managing risks and achieving business success.

“In order to make green shipping corridors a reality there needs to be a playbook that provides structure around critical success factors. This is what ABS has done,” said Christopher J. Wiernicki, ABS Chairman, President and CEO. “Green shipping corridors and clean energy marine hubs are interconnectors. They bring all of the pieces of the decarbonization puzzle together, including point-to-point trading and spot trading, and address the challenges of a diverse, disaggregated and globally regulated industry with carefully calibrated ecosystems designed to deliver success at scale and pace. They are excellent examples of the public-private partnerships we will need in order to move up the steep gradient to get to net zero by 2050.”



SAFETY LEADERSHIP IN A DECADE OF CHANGE

- Green shipping corridors, clean energy marine hubs and decarbonization were among the broad subjects addressed when Mr. Teo Eng Dih, Chief Executive of the Maritime and Port Authority of Singapore (MPA) visited ABS' world headquarters in October. The range of industry issues discussed included the generational change in vessel design and operations, alternative fuels, the acceleration of low-carbon to net-zero solutions, electrification, renewable power, development of a hydrogen economy, green financing, cybersecurity, ESG and mariner safety and training.

The sustainability and decarbonization journeys are closely interlinked with the ever-evolving regulatory burden. It has become a fact of life that the speed with which a ship can demonstrate its regulatory compliance affects the speed with which it can resume normal operations.

- To assist in handling this complex and potentially time-consuming aspect of vessel management, ABS developed its Regulatory World Map, an interactive application that provides quick access to all regional, national and port-specific requirements and incentives that can be expected at a vessel's port-of-call. Released in November as part of a new suite of online tools accessible through the ABS MyFreedom™ client portal, this easily searchable database enables a ship to prepare itself for all applicable requirements, such as emissions, discharges, ballast water, biofouling, ship recycling, onshore power supply, special reporting and certification and Port State Control (PSC) inspections. At the same time, ABS also released ABS Regulatory Tracker, a tool designed to quickly update users on both current IMO requirements and upcoming regulations that might affect new designs or retroactively impact existing vessels.

SUMMIT FOCUSES ON CARBON ECONOMICS AND EMERGING VALUE CHAINS

The decarbonization journey has seen increasing pressure on service providers to adopt sustainable business practices from both consumers and supply chains, impacting investments and driving competition. This makes sustainable business practices essential for businesses to remain globally competitive.

That's why a capacity crowd attended the third annual ABS Sustainability Summit in September, hearing industry leaders discuss shipping's most pressing questions about carbon economics and the hydrogen and carbon value chains.

As the first in-person event in the series — the first two being held online during the pandemic — this summit was of particular interest because it brought together key industry voices with firsthand experience in tackling the industry's decarbonization challenges. Subjects included how carbon economics and pricing will shape the decarbonization of shipping, and how the interconnection between the emerging hydrogen and carbon value chains affects near-term emissions goals.



A NEW OUTLOOK ON CARBON ECONOMICS, HYDROGEN AND CARBON VALUE CHAINS

A groundbreaking analysis is at the heart of the fourth edition of the *ABS Setting the Course to Low Carbon Shipping* series, which focuses on the potential for carbon markets and pricing to reshape global shipping, along with the impact of emerging hydrogen and carbon value chains. Recognizing that new regulations, paired with carbon pricing and the development of new global hydrogen and carbon industries, are going to radically change the world's marine industries in the decades to come, ABS focuses this updated Outlook on the latest decarbonization research and thinking.

Each edition of the series has focused on a different aspect of the sustainability challenge, including the impact of energy and commodity trends on the global fleet and a detailed life-cycle, or value-chain analysis of the GHG footprint of the leading alternative marine fuels.

The 2022 Outlook also introduces the *Net Zero Navigator*, a design for a liquid hydrogen carrier of approximately 80,000 m³ in capacity. The design utilizes NASA hydrogen storage technologies, hydrogen fuel cells and batteries, which were used for power generation aboard the U.S. Space Shuttle. The design is based on a pioneering research project between ABS and Herbert Engineering to develop conceptual ship designs related to the transport of liquid carbon dioxide (CO₂) and to explore the challenges of carbon capture and storage on board conventional fossil-fueled cargo ships.



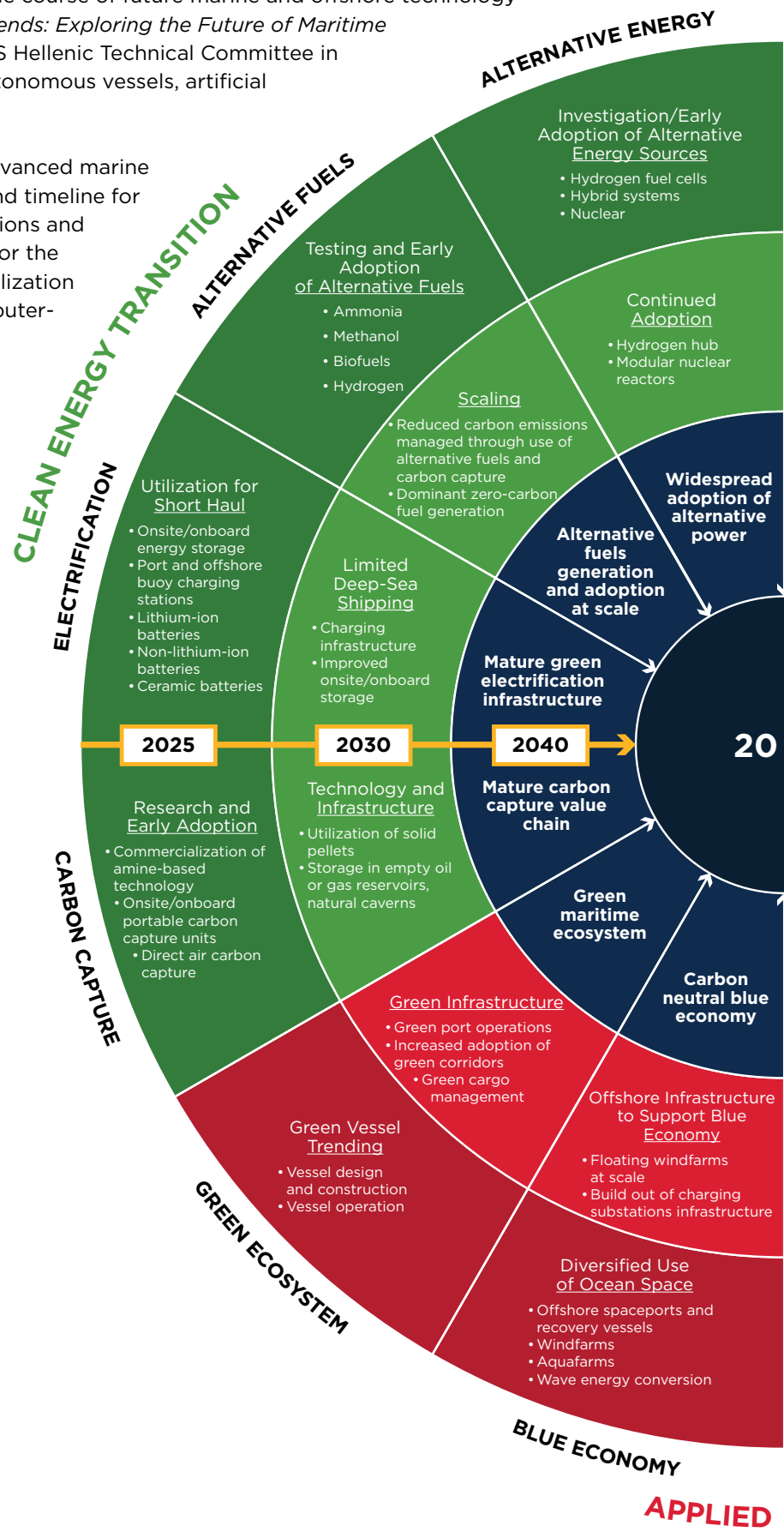
TECHNOLOGY

In 2022, ABS solidified its position as a technology leader by supporting the development and safe application of a range of emerging technologies that are maturing at rapid rates. ABS continued work with industry leaders in areas such as smart technologies, autonomous systems and new design approaches. In addition, pioneering publications provided insights into new technologies as well as glimpses into where current and future technologies may be headed.

LEADERSHIP IN REVOLUTIONARY MARITIME TECHNOLOGIES

ABS continued its mission of helping chart the course of future marine and offshore technology development with its report, *Technology Trends: Exploring the Future of Maritime Innovation*. The publication, launched at the ABS Hellenic Technical Committee in December, addresses questions surrounding autonomous vessels, artificial intelligence (AI) and nuclear power.

The report offers a glimpse into the future of advanced marine and offshore technologies, laying out a vision and timeline for key milestones on the journey to net-zero emissions and digitalization. It provides a high-level roadmap for the industry’s clean energy transition through digitalization and applied research in new materials and computer-aided design (CAD).



ALTERNATIVE ENERGY | Widespread Adoption of Alternative Power

- Increased prevalence of hydrogen fuel cells, hybrid systems and nuclear energy
- Improved efficient power generation technology from alternative energy sources
- Safe and sustainable byproduct waste management

ALTERNATIVE FUELS | Alternative Fuels Generation and Adoption at Scale

- Global adoption of low- and zero-carbon fuels
- Scaled up zero-carbon fuel generation and distribution
- New efficient zero-carbon fuel engines

ELECTRIFICATION | Mature Green Electrification Infrastructure

- Expansion of electrification infrastructure
- Improved storage for short haul and deep-sea use
- Enlargement of distribution substation network

CARBON CAPTURE | Mature Carbon Capture Value Chain

- Global adoption of carbon capture technologies
- Increased reach of carbon capture transport network
- Expansion of storage infrastructure

GREEN ECOSYSTEM | Green Maritime Ecosystem

- Green trending for manufacturers, shipyards and ports
- Certified green ships and operators
- Green labeled ship cargo

BLUE ECONOMY | Carbon Neutral Blue Economy

- Increased installation of blue technologies: space ports, aquafarms and wave energy generators
- Continued development of offshore charging substations infrastructure
- Floating offshore windfarms at scale

APPLIED

2050 GOALS

CLEAN ENERGY TRANSITION

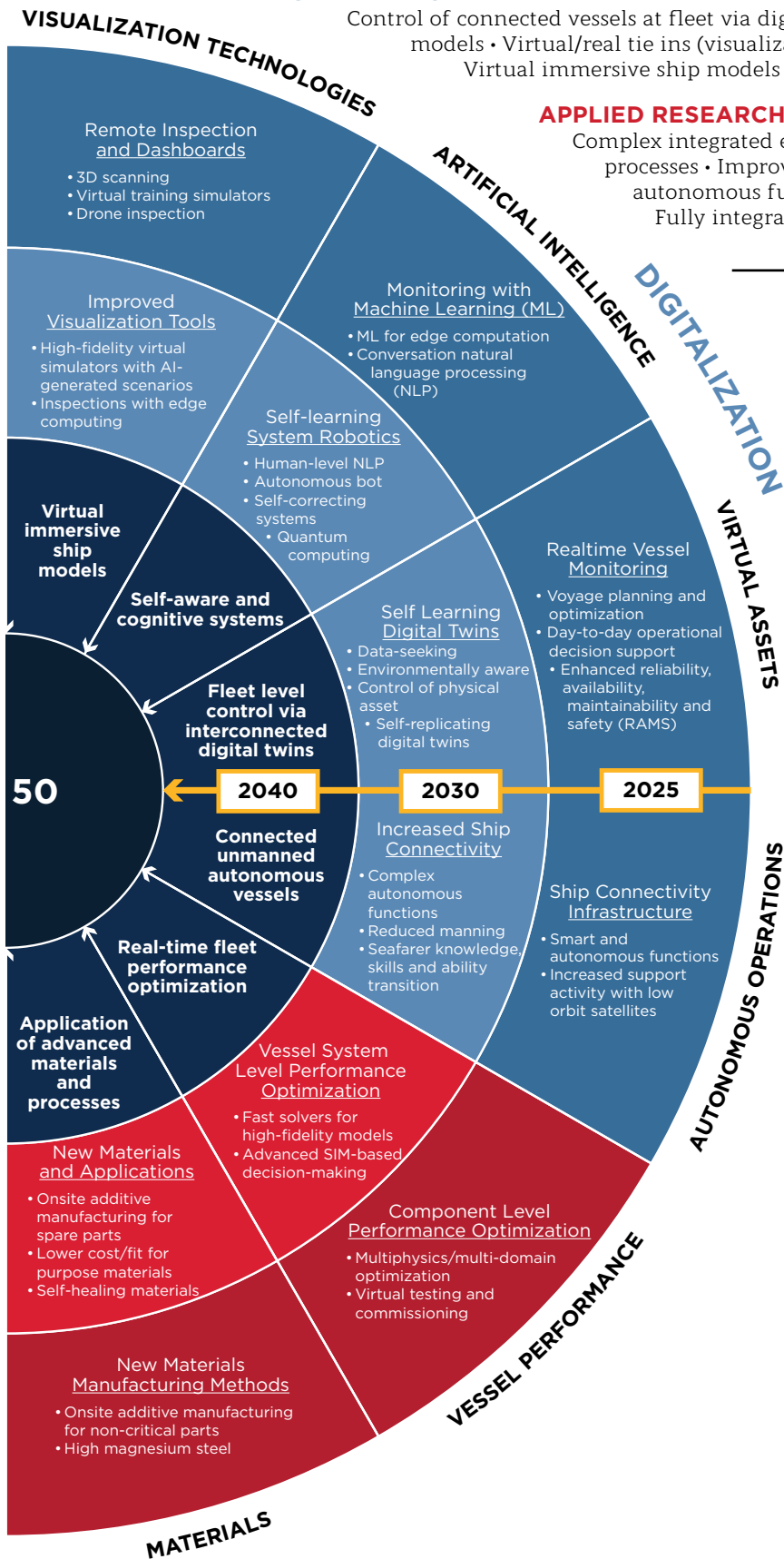
Fully transparent energy consumption and carbon footprint • Adoption of zero-carbon fuels at scale • Full electrification of inland, short haul • Partial electrification of deep-sea shipping • Mature carbon capture value chain

DIGITALIZATION

Control of connected vessels at fleet via digital twins • Data management • Connected system models • Virtual/real tie ins (visualization technologies) • AI-enabled self-correcting systems • Virtual immersive ship models

APPLIED RESEARCH

Complex integrated energy management systems • New materials and processes • Improved ship connectivity • Increased application of autonomous functions • Real time performance optimization • Fully integrated green ecosystem • Expanded blue economy



VISUALIZATION TECHNOLOGIES | Virtual Immersive Ship Models

- Global adoption of augmented and virtual reality inspection tools
- Personnel training through immersive simulators
- Remote control through visualization technologies

ARTIFICIAL INTELLIGENCE | Self-aware and Correcting Systems

- Technological advancements and adoption of self-diagnostics and self-repair
- Global application of quantum computing
- Increased presence of autonomous bots

VIRTUAL ASSETS | Fleet Level Control via Digital Twins

- Transition to fleet level virtual asset
- Global adoption of model-based systems engineering standards
- Improved cloud and edge computing

AUTONOMOUS OPERATIONS | Connected Unmanned Autonomous Vessels

- Increased use of autonomous functions
- Real-time decision support through advanced SIM-based analysis
- Diversification of seafarer knowledge, skills and ability
- Enhanced broadband coverage, speed and cybersecurity
- Increased complexity of autonomous functions

VESSEL PERFORMANCE | Real Time Fleet Performance Optimization

- Wide-spread adoption of energy saving devices to maximize vessel performance
- Enhanced high fidelity performance optimization at the vessel system level
- Higher fidelity analysis enabled by generative design

MATERIALS | Application of Advanced Materials and Processes

- Application of onboard additive manufacturing for repair and part replacement
- Serialized additive manufacturing through blockchain
- Adoption of lower cost/fit for purpose materials
- New self-healing materials

SUPPORTING ADVANCES IN AUTONOMOUS FUNCTIONS

The past year has seen rapid progress in the field of autonomous and remote-control operations. ABS worked with industry leaders on cutting edge projects involving autonomous functions of various ship systems focused on safe operations.

- In support of the industry's increasing interest in and adoption of autonomous capabilities, ABS published its *Autonomous Vessels* whitepaper in February. The publication provides a set of 10 goals for creating a framework for the design and operation of autonomous vessels and addresses critical issues in implementation. It proposes a global, goal-based framework for future rules regarding the safety and security of autonomous vessel operations. It also updated the progress of the IMO Maritime Autonomous Surface Ships (MASS) Regulatory Scoping Exercise, an important element in developing regulatory requirements governing autonomous operations.
- In April, a practical demonstration of autonomous capabilities was recognized when *Maju 510*, a remotely-operated harbor tug developed by Keppel Offshore & Marine (Keppel O&M), became the first in the world to receive the ABS AUTONOMOUS notation. Previously granted the REMOTE-CON (for remote-control navigation) notation, the 32 meter (m) tug, supervised by an onboard tug master, successfully performed autonomous collision-avoidance tasks.
- Remaining at the forefront of practical autonomous technologies, ABS collaborated with Sea Machines and Foss Maritime to issue AIP for Sea Machines' vessel autonomy system, the SM300. The system, which was installed on the harbor tug *Rachael Allen*, provided autonomous navigation and collision detection and collision avoidance (CDCA) for routine transits and stand-by operations.

ABS AND HD HYUNDAI COLLABORATE ON AUTONOMOUS VESSEL PROJECTS

In January at the 2022 Consumer Electronics Show in Las Vegas, ABS and HD Hyundai signed a Strategic Framework Agreement under which a group of JDPs would be pursued.

One landmark project announced at the time was the collaboration between ABS and HD Hyundai on a series of projects in autonomous vessel operation. ABS specialists will work with the HD Hyundai subsidiary Avikus to develop and integrate autonomous and remote-control functions into vessels.

The work will comply with requirements outlined in the *ABS Guide for Autonomous and Remote-Control Functions*, which provides a mix of goal-based and prescriptive requirements set against a broader risk-based approach.





- HD Hyundai was also among the industry leaders working with ABS on autonomous projects. In September, ABS granted AIP to HD Hyundai for developments in four areas of autonomous operation: navigation, machinery health management with condition-based maintenance, firefighting management and network infrastructure, all of which incorporate varying degrees of control by AI.

UNLOCKING THE POTENTIAL OF DIGITAL TECHNOLOGIES

While autonomous and remote-control functions offer significant potential for the maritime fleet, a wide variety of technologies have additional parts to play in the industry's broader digitalization and decarbonization trends. In 2022, ABS supported the industry with several JDPs and AIPs and provided guidance for many emerging technologies.

- In July, ABS and Samsung Heavy Industries (SHI) embarked on a JDP to enhance hull safety with smart ship technology for structural health monitoring (SHM). Using a package of advanced hull sensors, the technology aims to allow for better-informed and targeted hull surveys and expedite the transition to digital-based vessel management. Under the JDP, Samsung's Hull Stress Monitoring System will be developed in accordance with the *ABS Guide for Smart Functions for Marine Vessels and Offshore Units* and installed on a newbuild containership scheduled for delivery in 2024.

To help the industry tackle other aspects of the future's ever-broadening technical challenge, ABS released a series of forward-looking, industry-leading technical publications and guides in 2022. The company also supported several cybersecurity projects and training initiatives.

NEW JDP TO EXPLORE REMOTE SHIPYARD SURVEY TECHNIQUES



In February, ABS announced a pioneering JDP with Nakilat-Keppel Offshore & Marine (N-KOM) to examine how techniques developed by ABS for its industry-leading program of remote survey of vessels in service can be applied to surveys and inspections in the shipyard.

Under the JDP, remote inspection technologies will be applied to six class surveys to test how they can be used to verify survey or inspection. The overall goal is to optimize scheduling and minimize downtime for the shipyard, the vessels and ABS.

Specifically, the JDP will examine how remote techniques can be carried out on rudder clearance inspection, stern tube wear-down inspection, rudder plug opening inspection, boiler safety valve testing, fit-up inspections prior to welding and final weld visual inspection of non-critical items.



- *Practical Considerations for Hybrid Electric Power Systems Onboard Vessels* explores the different forms of hybrid electric power systems and offers insight into applications. It provides information on renewable energy sources, energy storage systems (ESSs) and battery management methods. The publication also examines the potential role of modeling and simulation and the impact on port infrastructure and regulation.
- *Insights into Vessel Connectivity* explores the necessity for enhanced vessel connectivity driven by smart, autonomous and remote-controlled functions on board vessels. It provides insight into the current state of communication technologies and guidance on preparing marine assets for future connectivity advances.
- As vessel design is increasingly optimized, vibrations from rotating machinery and natural ocean waves contribute to structure fatigue, cargo loss, crew habitability issues and machinery and electrical malfunctions. *Insights into Ship Vibration Analysis* presents the latest developments in vibration analysis, vibration criteria and mitigation measures, exploring four real-world cases in which vibration issues have been identified, analyzed and mitigated.
- In November, ABS announced it was joining a team of iTrust, Center for Research in Cyber Security at the Singapore University of Technology and Design (SUTD) and Singapore Polytechnic's Center of Excellence in Maritime Safety (CEMS) to collaborate on the Maritime Testbed of Shipboard Operational Technology (MariOT) Systems. The state-of-the-art MariOT will support a host of cybersecurity activities to meet the challenges in the maritime industry's push towards digitalization. MariOT will be the world's first industrial-grade, cyber-physical platform, combining essential shipboard operational technology (OT) systems with virtual simulation models.
- The long and successful cooperation between the MPA and ABS was underscored in two earlier events in the year. In May, a total of 17 students graduated from a pioneering digitalization learning program delivered by SkillsFuture Singapore and ABS. Leveraging industry-leading capabilities from the ABS Global Simulation Center in Singapore, the course provides hands-on training in modeling and simulation of systems. In September, it was announced that ABS had joined the MPA, Pacific Carriers Limited and Pacific International Lines in founding the Singapore Maritime Foundation's new Alliance for Future Maritime Talent, a group that will help prepare Singapore's maritime workforce to respond to the rapid evolution of the industry.



SAFETY LEADERSHIP
IN A DECADE OF CHANGE

GLOBAL
MARINE



As the maritime industry continues the journey to decarbonization and net zero, the need for safety remains a constant. Safety is a cornerstone of the ABS mission, and the organization has a long tradition of enabling safe operations throughout the industry. The past year was no different as ABS supported the industry through classification, training, updated rules and more.

Despite disruptions from geopolitical events, a slow economy and inflation, the shipping industry had a remarkable year. Disruptions had varying impacts on different sectors of the industry. The container market experienced a sharp correction in the second half of 2022 as trade volumes and congestion eased. Bulk carrier rates generally increased in 2022 amid pressure on demand. The tanker market saw significant improvement through 2022, driven by trade flow changes from the Russia-Ukraine conflict and related sanctions, as well as an improved “post-COVID-19” global supply and demand. Liquefied natural gas (LNG) day rates also reached all-time highs and newbuild investment rose to a new record with 182 vessels.

Throughout 2022, ABS led the orderbook share for gas carriers with 29 percent and maintained strong orderbook positions with 24 percent of tanker orders, 30 percent of containership orders and 20 percent of bulker orders. This includes achieving the leading orderbook share for major shipbuilders in South Korea, Singapore, China, Taiwan, the United States (U.S.) and Brazil. ABS was also the class of choice for owners in Greece, Singapore, Hong Kong, Denmark, the U.S. and Brazil.



MAINTAINING LEADERSHIP IN CLASS

- Already a global leader in the classification of tankers, with the largest classed fleet by gross tonnage, ABS added to its fleet in March when the third and final tanker in an order of bunker vessels built to ABS Class was delivered to Hai Soon Diesel & Trading (HSDT). The three 6,060 deadweight (dwt) oil tankers were constructed at Zhejiang Shenzhou Sunshine Heavy Industry Co., Ltd. and joined HSDT's 21-strong fleet.
- Recognizing that emissions concerns and new technology challenges also touch the world of luxury vessels, ABS brought together leading yacht designers, builders and flag Administrations to help develop new rules to advance emissions reduction and safety technologies for super-yacht and mega-yacht design and operation. Attendees at the inaugural ABS European Yacht Technical Committee Meeting discussed the technology and innovation required by the yachts of the future, with a focus on flexible design, emerging technologies, advances in hybrid propulsion technology, efficiency improvements, safety and sustainable operations. Many of the advances discussed at the meeting had debuted on recent individual yacht designs, such as on the ABS-classed superyacht *Phi*, a 58.5 meter (m) boat featuring new environmental technologies, an optimized hull form and very low overall weight of less than 500 gross tons.
- In June, ABS expanded its U.S. dredger class leadership when it was chosen by Great Lakes Dredge & Dock Company to class a second trailing suction hopper dredge for the company. Capable of dredging at depths of up to 100 feet, the 6,500-cubic-yard-capacity vessel is expected to be delivered in 2025. It will be equipped with a direct high-power, pump-ashore installation, dredging system automation, dynamic positioning and tracking, U.S. Environmental Protection Agency (EPA) Tier 4-compliant engines and additional features designed to minimize the impact of its dredging process on the environment.
- The 24,000 twenty-foot equivalent unit (TEU) capacity *Ever Alot*, the largest containership in the world at the time, was delivered to ABS Class in August. The 400 m megamax-24 type ship was the latest in a series of five being built by Hudong-Zhonghua Shipbuilding in China to ABS Class.

- Meanwhile, the LNG-fueled containership fleet expanded in September with the delivery to Pasha Hawaii of the ABS-classed *M/V George III*, built by Keppel AmFELS in Brownsville, Texas. In addition to classification services, ABS supported construction of the new vessel with an innovative design optimization process that used computational fluid dynamics and parametric hull form optimization to reduce both the vessel's power requirements and carbon dioxide (CO₂) emissions.
- During the year, ABS continued working with operators around the world on methanol projects; these include aiding the progress of a series of 12 large containerships capable of dual-fuel methanol operation ordered to ABS Class by Mærsk, and the granting of an approval in principle (AIP) for the world's first methanol-powered Newcastlemax bulk carrier.

SUPPORTING DEVELOPMENT OF ALTERNATIVE FUELS

The ships of the future will need sustainable fuels to drive them. Rather than one main global marine fuel, as has been the case in the past, it is likely that future vessels will choose from a basket of fuel alternatives, selecting the variety best suited to their unique service demands. ABS continued to help industry in its pursuit of alternative fuels throughout 2022, advancing the development track of methanol, ammonia, hydrogen and LNG technologies.

- The year opened with the publication of the *ABS Guide for Methanol and Ethanol Fueled Vessels*, highlighting one of the leading alternative fuel options. The Guide sets out classification criteria for the arrangement, construction, installation and survey of machinery, equipment and systems for vessels operating with methanol or ethanol as fuel, focusing on minimizing risks to the ship, crew and environment.

SUMMIT EXAMINES THE ROLE OF METHANOL IN SHIPPING'S ENERGY TRANSITION

With practical benefits related to ease of storage and handling, tank-to-wake carbon intensity reduction, and a pathway to carbon neutrality through green methanol, many players in industry see methanol as a promising part of the decarbonization journey.

That's what drew the crowd to the London Methanol Summit, hosted by ABS and the Methanol Institute (MI) in November. ABS and MI programmed a deep dive into the potential of methanol as marine fuel to contribute to shipping's decarbonization objectives, bringing together leading shipowners, shipyards, regulators, ports and methanol producers for an afternoon of panel discussions.



One panel discussed opportunities and challenges for methanol adoption as well as some of the emerging technologies that will support scaling up of methanol infrastructure, while a second panel focused on the maritime value chain and the viability, advantages and roadblocks in the methanol pathway.

BRINGING METHANOL BUNKERING TO SINGAPORE

In October, ABS, Mitsui and Mærsk agreed to jointly conduct a detailed feasibility study of methanol bunkering logistics in Singapore. The joint effort adheres to both the International Maritime Organization's (IMO) initial strategy to halve the shipping industry's greenhouse gas (GHG) emissions by 2050 compared to 2008 levels, and the Maritime and Port Authority of Singapore's (MPA) goal to achieve decarbonization of Singapore's maritime industry.

Project participants see promise in green methanol as an alternative fuel that can potentially make significant contributions to reducing GHG emissions in the shipping industry and believe that the establishment of a safe and reliable operational platform is valuable to Singapore as a leading bunkering location.

The project will investigate the design of a methanol bunkering vessel and its safe operating procedures, as well as fuel storage and regulatory considerations, and expects to conduct an actual ship-to-ship bunkering operation during 2023.

SIX MORE METHANOL-FUELED MEGA-CONTAINERSHIPS ORDERED TO ABS CLASS

In October, a further six methanol-fueled containerships were ordered to ABS Class by A.P. Møller-Mærsk (Mærsk). With this order, a total of 19 mega-containerships with dual-fuel methanol capability are on order from Mærsk.

Recognizing that decarbonization of shipping is a complex challenge with many moving parts, and that green methanol is a promising future fuel for the decarbonization journey, Mærsk has committed to building a methanol-fueled armada and has chosen ABS as a partner in pursuit of that goal.

The 17,000 TEU vessels will be built at HD Hyundai and are scheduled for delivery in 2025. When all 19 vessels are in service and operating on green methanol, it is believed they will generate annual CO₂ emissions savings of around 2.3 million tonnes.



- Soon after, ABS announced completion of a joint development project (JDP) with SDTR Marine and the Shanghai Merchant Ship Design and Research Institute (SDARI), which produced a design for an innovative methanol-fueled bulk carrier. In addition to technical support and plan review, ABS provided an outlook on the methanol fuel market and an evaluation of the design's performance in various operating scenarios, including under the European Union Emissions Trading System (EU ETS).
- In November, an ABS-led consortium of researchers delivered two reports studying alternative fuels and decarbonization technologies for the European Maritime Safety Agency (EMSA). The reports, the first of up to six in a four-year project, provide a comprehensive view of biofuels and ammonia, analyzing each using such criteria as GHG impact, sustainability, fuel availability, fuel scalability and human needs, with each analysis accompanied by three hazard identification studies.

Supporting the industry's interest in ammonia as marine fuel, ABS continued its sector-leading work in tackling the specific safety and technology challenges that use of this fuel presents. This work was reflected in four notable approvals in principle (AIPs).

- In June, ABS issued an AIP to Samsung Heavy Industries (SHI) for design of an ammonia-fueled neo-panamax containership, and to Keppel Offshore & Marine (Keppel O&M) for design of an ammonia-fueled ammonia bunkering vessel. The bunkering vessel, intended to be both an ammonia carrier and a bunkering vessel for ammonia-fueled ships, is at the heart of Project Saber, a joint effort between ABS and a group of leading maritime organizations to develop an ammonia bunker supply chain in Singapore.
- In September, ABS granted AIPs to HD Hyundai and Hyundai Mipo Dockyard (HMD) for the concept design of two ammonia-fueled liquefied petroleum gas (LPG) carriers. Development of the 40,000 cubic meter (m³) and 60,000 m³ capacity carrier designs is the completion of the first phase of a JDP between ABS, HD Hyundai, Eastern Pacific Shipping and the MPA.
- The maturation of LNG as a marine fuel continued during the year, beginning in February when the 209,936 dwt dual-fuel bulk carrier *Mount Tourmaline* took on its first load of LNG fuel in Singapore. As the first of a series of 13 ABS-classed LNG-fueled newcastlemax bulk carriers ordered by Eastern Pacific Shipping, the vessel represents the start of a new era of large LNG-fueled ships for the dry bulk sector.
- ABS also awarded an AIP to Daewoo Shipbuilding & Marine Engineering (DSME) for the design of a hybrid power system for large LNG carriers. The configuration, previously limited to smaller vessels, includes a battery energy storage system (ESS) and shaft generator.
- An AIP is often the beginning of the road to the safe commercialization of a design. For example, in June ABS witnessed the 1:1 scale performance test of the X-Reli reliquefaction system for low-pressure, dual-fuel gas engines developed by SHI. The system, which allows reliquefaction of LNG boil-off gas (BOG) without using additional refrigerant, received an AIP for its conceptual design in 2019; this was followed by detail design approval in 2020 and development for testing and performance verification last year.

WORLD'S FIRST AMMONIA-READY VESSEL

February saw a true milestone in the maritime industry's decarbonization journey, when the world's first ammonia-fuel ready vessel, the ABS-classed suezmax tanker *Kriti Future*, was delivered to owner Avin International.

Built by New Times Shipbuilding, the landmark vessel is currently conventionally fueled, but complies with ABS Ammonia Ready Level 1 requirements, indicating it is designed for conversion to run on ammonia in the future. The vessel also meets the ABS LNG Fuel Ready Level 1 requirements.

The vessel was classed according to the requirements outlined in the *ABS Guide for Gas and Other Low-Flashpoint Fuel Ready Vessels*, which is part of a suite of industry guidance on alternative fuels.

AIPS SUPPORT AMMONIA-FUELED VESSEL DEVELOPMENT

In November, ABS awarded AIPs to COSCO for ammonia-fueled vessel and ammonia supply system designs, which are being trialed on a tugboat. The tug is designed to be 36 m in length with a towing capacity of up to 60 tonnes.

This is the first comprehensive technology research project in China focusing on an ammonia-diesel dual-fuel engine, ammonia fuel supply system, exhaust gas treatment and onboard application demonstrations.

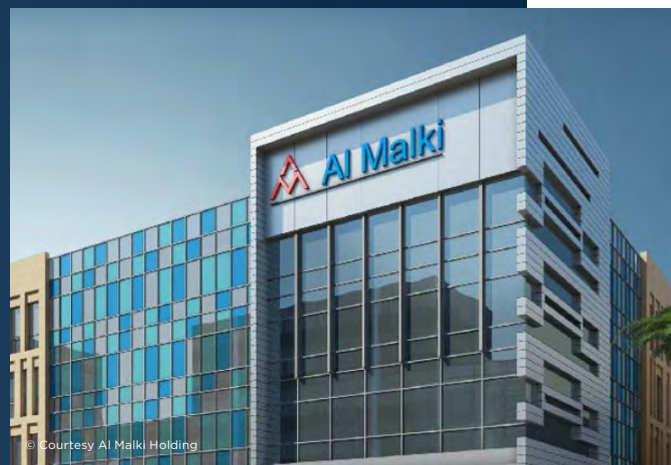
Given the safety and technology challenges presented by ammonia as a marine fuel, ABS conducted a comprehensive review and risk assessment of the safety and reliability of the systems, focusing on ammonia filling, storage, supply, ventilation and emergency handling.



ABS ANNOUNCES LNG TRAINING CENTER IN DOHA

LNG as marine fuel is one of the more mature alternative fuels and has the potential to accelerate decarbonization efforts in the maritime industry. At the same time, LNG-fueled vessels employ unique technologies that require additional, specialized training for mariners.

Recognizing this, in October ABS announced plans to open an LNG training center in Doha, Qatar, as part of its support for Qatar's National Vision 2030 and the Tawteen Program, which focuses on providing education and quality employment for Qatari nationals. In collaboration with local corporations, the state-of-the-art training center will focus on LNG production and operations, ensuring that seafarers are skilled to work with this dynamic fuel and the most modern fleet of vessels.



As an organization, ABS has the most extensive LNG experience in the industry. It is the only class society to have classed every type of LNG containment system ever developed and has participated in the development and evolution of every important LNG technology — beginning with the first LNG vessel to go to sea over 60 years ago. Its trainers reflect this accumulated experience, themselves having expertise in both theoretical and practical knowledge of LNG and LNG carriers.



- The development of hydrogen transportation technology also took a step forward last year, when a 20,000 m³ liquefied hydrogen carrier design from SHI received an AIP from ABS. The AIP was the culmination of a JDP between the two organizations to review and prove various elements of the vessel design including Type C cargo tanks, cargo handling and fuel gas supply systems.

SUPPORTING ADVANCEMENTS IN CARBON CAPTURE, UTILIZATION AND STORAGE

In addition to developing new fuel technologies, the global decarbonization journey also requires advances in carbon capture, utilization and storage (CCUS) technologies. As the marine and offshore industries tackle the many challenges surrounding CCUS over the coming decade, ABS will be there to provide technical support, as it did in several notable projects during the past year.

- The overall carbon value chain faces a long road to maturity, with many questions to answer regarding such factors as onboard power supply, fuel types, onboard storage and exhaust characteristics. That is why ABS released *Insights into Onboard Carbon Capture*, a new publication studying emerging onboard carbon capture technology. The report examines various technologies for onboard carbon capture, handling, storage and downstream operations, and takes a look at various regulatory issues.
- In June, ABS announced the start of a landmark study into carbon capture and the global supply chain that will be carried out in a joint effort between ABS and Texas A&M University at Qatar. The project will research the potential of carbon capture technology at sea, explore CO₂ reduction strategies and technologies, and establish a model for effective CO₂ capture on an LNG vessel. The study will also examine the effect of the energy transition toward a hydrogen-based economy on processing, emissions and shipping.
- In September, ABS awarded an AIP to DSME for its design of cargo tanks for super-large, liquefied carbon dioxide (LCO₂) carriers. The 15,000 m³ cargo tank is designed for a 100,000 m³ LCO₂ carrier, featuring a vertical asymmetric structure to maximize the loading weight and provide enough space on board for installation of LNG-fueled engines and future carbon capture devices.
- ABS also issued new technology qualification (NTQ) to the Rotoboost Company for a first-of-its-kind, pre-combustion carbon capture system based on the thermocatalytic decomposition process (TCD). This TCD system is expected to allow continuous hydrogen production and carbon capture on board marine vessels. It converts natural gas into hydrogen and solid carbon using a liquid catalyst, with the resulting gas to be used for fuel cells or as a blend-in fuel for combustion engines or gas-fired boilers. The idea is that blending in hydrogen will significantly reduce methane slip in combustion engines and reduce particulate matter emissions by capturing carbon in solid form before combustion.

PIONEERING JDP TO DEVELOP ONBOARD CARBON CAPTURE TECHNOLOGY

In June, ABS, DSME and GasLog joined forces in a leading project to develop carbon-neutral shipping. This project focuses on an onboard CO₂ capture and storage system using emissions reduction technology that returns exhaust gas CO₂ to the ship for storage by the process of absorption, regeneration and separation, with the stored CO₂ to be safely offloaded at shoreside facilities.

The project will seek to obtain ABS AIP for the system, and then verify it through various risk analysis and tests before installation and operation on an LNG carrier that will be built by DSME.

DSME received orders for four LNG carriers from GasLog last year, scheduled for sequential delivery beginning in the first half of 2024. The installation of the capture and storage system is targeted to coincide with vessel construction.

JOINT EFFORT TO DEVELOP THE WORLD'S LARGEST LIQUEFIED CO₂ CARRIER

The pioneering carbon capture cooperation between ABS and HD Hyundai took a further step in 2022, in a project involving development of a next-generation ultra-large LCO₂ carrier.

Working with the Republic of the Marshall Islands (RMI) Maritime Administrator, the JDP will develop a design for a 74,000 m³ LCO₂ carrier based on the 40,000 m³ “super gap” technology developed by HD Hyundai in 2021. ABS will verify the design, leading to basic design approval, with RMI involved where design acceptance and equivalent arrangements are required.



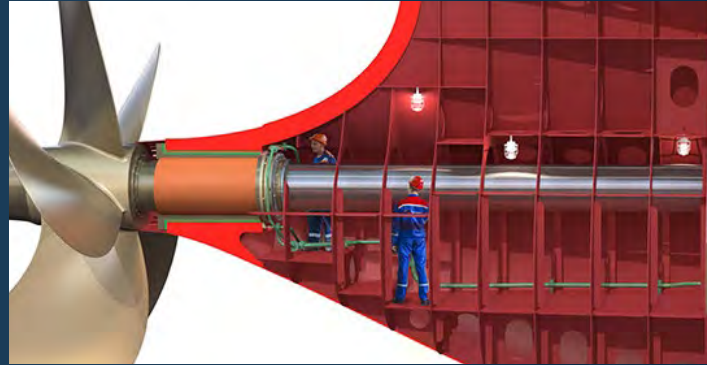
The JDP is part of a broad vision for establishing the marine support needed by the developing carbon capture/storage market, in which ultra-large LCO₂ carriers are expected to play a major role. Recently, ABS awarded AIP to the design of a CO₂ injection platform developed by HD Hyundai to store CO₂ that has been captured on land, liquefied at high pressure and transported to the sea through a carrier or pipeline.

AIP FOR A REVOLUTIONARY APPROACH TO STERN TUBE DESIGN

In June, ABS granted AIP to SDARI for the design of a novel aft layout for vessels that is expected to reduce pollution and promote efficiency. Developed in cooperation with Thordon Bearings and the National Technical University of Athens, the design removes the stern tube casting, uses seawater for lubrication and creates a chamber that permits in-water maintenance for the first time in history.

Installation of an appropriate torsional vibration damper can eliminate the Barred Speed Range, which is present in the vast majority of direct-drive diesel engine vessels, to better support simplified compliance with such environment-focused regulations as the Energy Efficiency Existing Ship Index (EEXI). It is also expected to enable more efficient use of the engine's propulsive power since the whole revolutions per minute (RPM) range of speeds is available for continuous operation. This would enable owners to consider an Engine Power Limitation (EPL) if needed to comply with Carbon Intensity Indicator (CII) power output requirements.

As a result of decreased shaft line length, the new concept gives new possibilities and flexibility for designers to optimize the engine room arrangement. For shipbuilding, this can lead to potential cost reductions in construction materials, labor and the overall shipbuilding process. The design proposal complies with all ABS rules and regulations and the tail shaft survey can be maintained at the maximum 15-year interval if the ABS TCM-W notation is adopted.



HONORING THE COMMITMENT TO HELP THOSE IN DISTRESS AT SEA

- In two separate ceremonies, ABS honored German and Norwegian shipowners for their commitments to the Automated Mutual-assistance Vessel Rescue (AMVER) system, which was established by the U.S. Coast Guard (USCG) in 1958 to support search and rescue efforts for distress calls at sea. In all, 342 vessels from 57 German-managed companies and 261 vessels from 40 Norwegian shipowners and operators were honored in ceremonies in Hamburg and Oslo, where they were awarded colored pennants for their roles in maintaining maritime safety and in recognition of the owners' commitment to assisting search and rescue activities all around the world.

CONTINUING THE BATTLE AGAINST INFECTIOUS DISEASES

- The battle against the COVID-19 pandemic taught the industry many things about the importance of onboard disease mitigation. As a result, many shipowners continue to incorporate disease mitigation technologies into the design of new vessels of all sizes. Among the latest of these vessels was Saudi Aramco's hydrographic survey vessel *Karan 8*. Last year the vessel became the first in the Middle East region and second worldwide to be awarded the ABS Infectious Disease Mitigation (IDM-A) notation, which attests that a vessel meets arrangement requirements addressing the configuration of spaces that can be used for the isolation and segregation of crew, passengers and onshore visitors, as well as the ventilation on board and the interior surfaces of certain accommodation or working spaces.

The background features a large, detailed offshore oil rig structure, possibly a jack-up rig, set against a dramatic sky with a large sun or moon. The rig is composed of various metal frameworks, cranes, and platforms. A central white circle is superimposed over the rig, containing the main text. The overall color palette is a mix of deep blues, greys, and vibrant oranges and reds, suggesting a sunset or sunrise. A semi-transparent orange globe is visible in the upper right corner. A small helicopter is seen flying near the lower part of the rig.

SAFETY LEADERSHIP
IN A DECADE OF CHANGE

GLOBAL
OFFSHORE



Driven by increased energy prices, improved demand and supply-side limitations, ABS saw significant improvements in the offshore market in 2022. Global rig demand rebounded with utilization rising to 86 percent. 2022 was a record-breaking year for the production segment, with a significant increase in contracting – 15 newbuild and conversion contracts were signed, including 10 floating production storage offloading vessels (FPSOs) supported by higher energy prices. The support segment also experienced strong growth, driven by increased demand and limited supply.

In 2022, the offshore wind vessel segment saw a record-breaking increase in newbuild orders for wind turbine installation vessel (WTIV) and commissioning service operation vessels. There has been a focus from vessel owners and operators on reducing emissions by ordering units equipped with batteries and alternative fuel capabilities for service vessels.

Throughout 2022, ABS continued to lead in all segments of the offshore orderbook – exploration, production and supply vessels. ABS maintained 79 percent of drillship orders, 90 percent of self-elevating mobile offshore drilling unit (MODU) orders, 57 percent of semisubmersible MODUs, 56 percent of mobile offshore production units, 64 percent of anchor handling tug supply orders and had a 47 percent order share of all other supply vessels.

2022 also marked the 75th anniversary of the offshore oil and gas sector and also a unique anniversary for ABS. In 1947, ABS was called on to provide classification services and technical advice for the first offshore oil platform installed out of sight of land. Since then, ABS has provided critical technical services and assistance to nearly every significant advance in the offshore sector.

This unique relationship grows stronger with time as ABS continues a long-standing tradition of supporting the offshore sector. Throughout the past year, ABS provided leadership across several areas and helped reach many milestones, including publishing essential guidance, awarding approvals in principle (AIPs) and offering qualifications for many emerging technologies.

NEW PUBLICATIONS GUIDE OFFSHORE TECHNOLOGY DEVELOPMENT

- Continuing its industry-leading series of sustainability guidance, ABS released the new publication *Offshore Production of Green Hydrogen* in February. Hydrogen offers exciting potential in the global decarbonization journey as a marine fuel and a form of energy storage. The new publication explores the conditions driving the marine and offshore industries toward adopting and producing green hydrogen using power from renewable energy sources such as offshore wind turbines. The publication also explores the technologies expected to make green hydrogen production feasible and how those technologies could be incorporated into an offshore facility. During the year, ABS also announced that it is working with HD Hyundai to jointly develop technical guidance for green hydrogen production from offshore platforms, with an eye on the design and construction of a facility by 2025.
- Launched in March, *Enhancing Safety on FPSOs: Leveraging Digital Technologies* reviews the latest digital technologies for advancing the safety performance of the global FPSO fleet and considers how new technologies such as remote inspection are allowing the industry to rethink the methods to conduct asset inspections, collect and evaluate condition data. The publication also explores the latest artificial intelligence (AI) tools used to aid corrosion detection and measurement and the potential of an accurate digital condition model, or digital twin, to support modern risk-based inspection techniques.
- Another safety milestone for the FPSO sector came in May when an ABS-led working group of industry leaders and regulators published *Enhancing Safety on FPSOs, Practical Considerations for Operations and Maintenance*. Among other things, the publication collects industry best practices for addressing the challenges posed by the aging global FPSO fleet. Partnering with ABS in this collective effort were Chevron, Shell Trading (U.S.), Petrobras, MODEC, SBM, The Bahamas Maritime Authority, the Republic of the Marshall Islands Registry and the U.S. Coast Guard 8th District. The publication discusses best practices relating to areas such as tank design and arrangement, cleaning and inspection, risk-based inspection of hull structures, composite repair tracking and carrying out repairs while operating.

CONTINUING FPSO TECHNOLOGY LEADERSHIP IN BRAZIL

More than 60 percent of all FPSOs in Brazilian waters are under ABS Class. This leadership position was underscored when ABS was selected to class two newbuild FPSOs for Petrobras: the *P-80* and the *P-82*. Contracted by Singapore companies Keppel and SembCorp, respectively, these FPSOs will be deployed in the pre-salt field of Buzios, offshore Brazil. Based on Petrobras' own design dubbed as "large capacity," each FPSO will be capable of producing 225,000 barrels of oil per day (BOPD). These projects extend the fleet of newbuild hulls based on Petrobras design and classed by ABS, with the *P-78* and *P-79* FPSOs currently under construction in Korea.

In addition, the *FPSO Atlanta* was contracted for conversion to service the Atlanta Field offshore Brazil. Operated by Enauta, the Atlanta Field is located in the Santos Basin at a water depth of 1,500 meters (m).

Formerly named *OSX-2*, the *FPSO Atlanta* is being converted at Dubai Drydocks World with structural upgrades, refurbishment and equipment enhancement. It is intended to have a production capacity of 50,000 BOPD and a storage capacity of 1,800,000 barrels.

ABS has extensive experience developing detailed practical guidance to assist offshore operators in navigating Brazil's unique regulatory environment. The ABS publication *Practical Considerations for Regulatory Compliance in Brazil* is designed to help floating production installations (FPIs) operating in Brazilian jurisdictional waters comply with a series of requirements that are specific and set forth by multiple local agencies.

ABS GIVES A GLIMPSE INTO THE FUTURE OF OSV DESIGN

In May, ABS released an industry-leading document providing a road map for the evolution of offshore support vessels (OSVs). The publication *Insights into Future OSV Designs and Operations*, launched at the Offshore Technology Conference (OTC) in Houston, addresses a future vision of sophisticated OSVs that are connected, sustainable, increasingly autonomous and highly capable of adapting to serve a variety of use cases.

The publication examines future OSVs as multi-functional vessels equipped to serve multiple offshore sectors, featuring larger accommodation spaces, heavy-lift cranes, helidecks and streamlined hull forms, all designed to perform complex support operations — such as required by diverse sectors like offshore wind, space missions (launches and recoveries), carbon capture (transport) and subsea mining.

The document also considers concepts such as an OSV mothership, from which a human crew would operate a fleet of autonomous surface vessels, remotely operated vehicles (ROVs) and autonomous underwater vehicles used for repair and maintenance, cargo distribution and subsea inspections.



- *Emissions Reduction Insights for FPIs*, also launched in 2022, examines the current emissions-related challenges and mitigating strategies for FPIs, including low-carbon technologies, reduced manning and renewable power solutions. Offshore oil and gas industry assets covered by the publication include FPSO, floating storage and offloading, spars, tension-leg platforms, and semisubmersibles.
- In August, ABS published the first sustainability Guide to target the offshore industry. Developed in collaboration with major offshore industry clients, the *ABS Guide for Sustainability Notations* offers detailed requirements for greener offshore operations, including offshore asset compliance requirements. It addresses topside functions on offshore assets, such as emissions and discharge. It also outlines how carbon reduction technologies such as zero-flaring and zero-methane slip policies can enable assets to receive the SUSTAIN-2 notation.
- In November, ABS issued its *Requirements for Bonded and Composite Repairs of Steel Structures and Piping*, which provides valuable information for offshore structures that remain on site over very long periods. In such structures, corrosion damage is frequently discovered but difficult to repair using traditional methods involving hot-work welding and drydocking. The requirements address adhesively bonded repairs, which can be used on site to reduce operational downtime, minimize disruption on board and reduce safety risks. The document details two repair systems important to marine and offshore steel structures: fiber-reinforced plastic laminate and elastomer and steel plate reinforcement.

AIPS HELP ADVANCE OFFSHORE TECHNOLOGY

Receiving AIP remains one of the most successful steps toward the safe development and commercialization of new offshore technologies.

- In January, ABS awarded AIP to Samsung Heavy Industries' (SHI) design for a one-side spread mooring system for floating liquefied natural gas (FLNG) facilities. The design will allow an FLNG unit to be safely spread-moored on one side only, leaving liquefied natural gas (LNG) carriers to berth and load on the opposite side free from obstructions.
- The same month, ABS granted AIP to Wison Offshore & Marine's Extended Front-End Engineering and Design (FEED) for its standardized 3.5 million tonnes per annum (mtpa) FLNG design, which is claimed to reduce carbon dioxide (CO₂) emissions and shorten engineering schedules by about 40 percent.
- In April, ABS granted AIP for an innovative concept for building new FLNG vessels reusing the storage tanks from old LNG carriers. The concept, jointly developed by Kawasaki Kisen Kaisha, Ltd. ("K" LINE) and JGC Corporation, involves removing the spherical LNG storage tanks (also called Moss tanks) from old LNG carriers and transferring them into the hulls of new FLNG vessels. Reusing existing tanks increases the number of shipyards able to build FLNG units, potentially supporting forecasted demands for broader and quicker adoption of FLNG technology.

SUSTAINABILITY NOTATIONS FOR TWO HARVEY GULF VESSELS

In December, two OSVs from Harvey Gulf International Marine were awarded the ABS SUSTAIN 1 Notation, which attests that their design and operation align with United Nations' (U.N.) Sustainable Development Goals (SDGs) related to vessel design, outfitting and layout that can be controlled, measured and assessed.

The *Harvey Blue-Sea* and *Harvey Sub-Sea* were the first in a group of 12 Harvey Gulf OSVs evaluated by ABS for their performance against six U.N. SDG criteria. The remaining 10 vessels are also being considered for SUSTAIN notations, which establish a clear pathway for fleetwide sustainability certification and reporting.

Harvey Gulf was among the leaders in OSV evolution when, in 2011, it built two of the industry's first LNG-fueled supply vessels. The new SUSTAIN notations recognize a commitment to the U.N. SDGs and, as in Harvey Gulf's case, reflect on the commitment to achieving and maintaining fleet-wide sustainability.



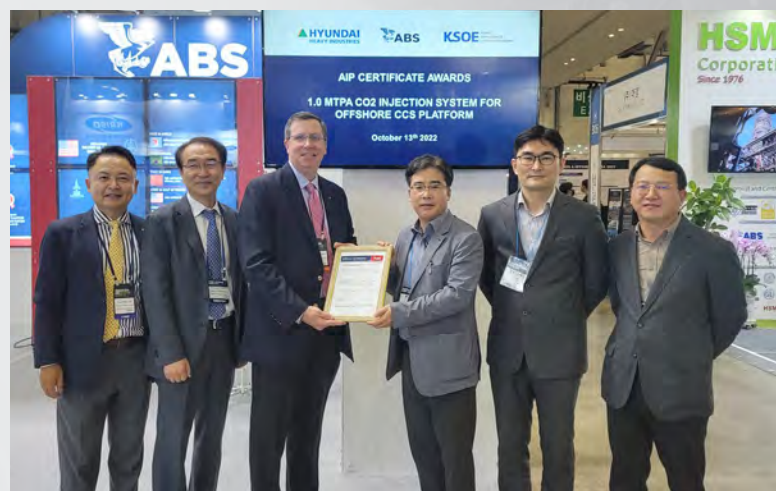
© Harvey Gulf International Marine

AIP FOR PIONEERING CO₂ INJECTION SYSTEM

In October, ABS granted an AIP to HD Hyundai's design of a large-scale, CO₂ injection system for offshore carbon storage in subsea geological formations.

Intended for installation and operation on a floating offshore platform that will receive CO₂ from visiting gas carriers, the one-million-ton injection system is designed to aid the maturity of the carbon value chain by supporting the development of an offshore floating geological storage platform.

The system design includes a powerless CO₂ heating circuit, in which the heating medium is circulated through a closed loop using seawater without relying on an external power source. This is designed to improve efficiency and allow the capture of the emitted gas to be stored underground on site.



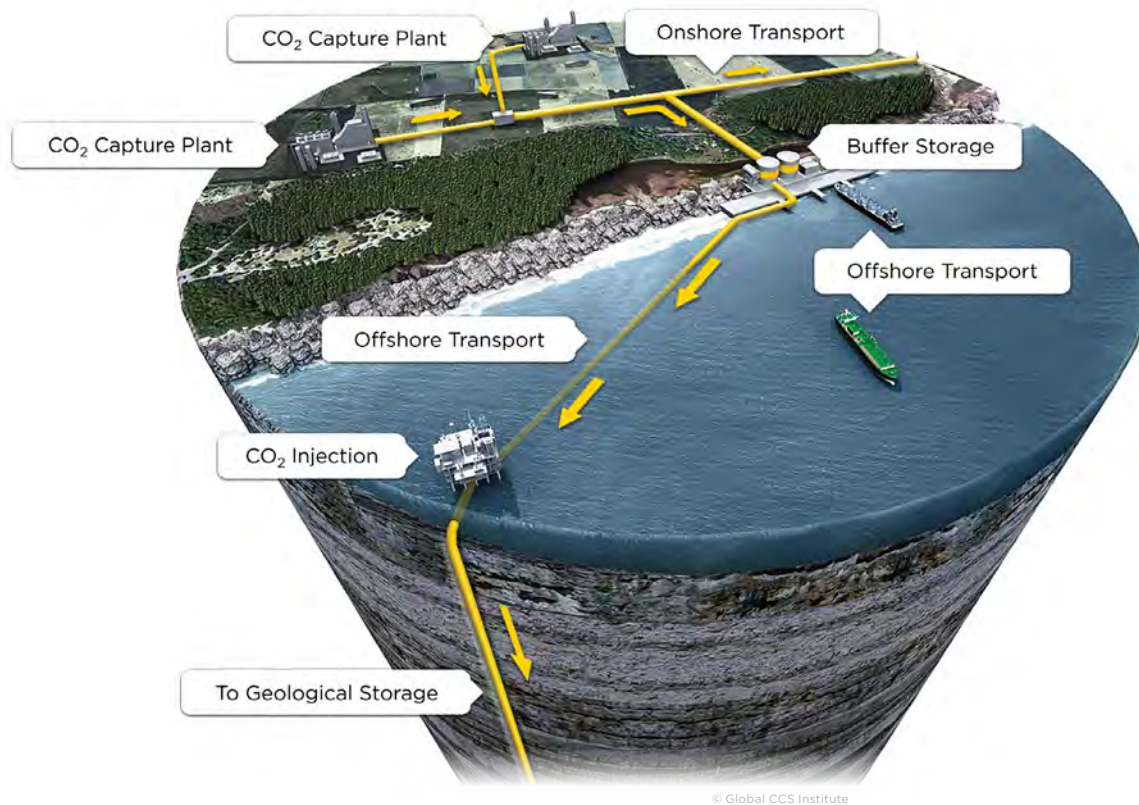
ADVANCING TECHNOLOGY FOR REMOTELY CONTROLLED ROCKET RECOVERY DRONESHIPS

In June, ABS signed a JDP with SpaceX to review the remotely controlled functions of autonomous rocket recovery droneships used for booster rocket recovery at sea.

The droneships are entirely uncrewed during landings and use an onboard robot to secure the rocket booster before the vessel returns to port. The droneships are modified with an expanded deck to increase the size of the landing platform, four thruster engines for propulsion and to hold on station, and blast shielding to protect electrical and engine equipment on deck.

Under the JDP, ABS will review the design of one of SpaceX's three droneships for compliance with the ABS *Guide for Autonomous and Remote Control Functions*, operating requirements.





- In May, ABS awarded AIP for the design of a CO₂ injection platform developed by HD Hyundai for the storage of CO₂ that has been captured on land, liquefied at high pressure and transported by sea in a carrier or pipeline. The goal for this particular platform design is the storage annually of 400,000 tonnes of CO₂ offshore in Korea's East Sea gas field, a project planned to start in 2025.
- ABS also awarded AIP to HD Hyundai for a new regasification system designed for floating storage regasification units (FSRUs) and FLNG terminals. Named Hi-ReGAS+, the system design features a natural circulation system, which uses the fluid density difference in the intermediate heat transfer system – transferring heat from seawater to LNG – to create a highly energy-efficient circulation system that reduces energy consumption. To obtain AIP, HD Hyundai built and operated a 1/100-scale regasification system to demonstrate, verify and improve the design's performance.

SUPPORTING ADVANCES WITH NEW TECHNOLOGY QUALIFICATION

ABS' industry-leading new technology qualification (NTQ) process is an important step in the early adoption of novel technological advances. The process offers guidance on the early adoption and efficient implementation of new technologies, demonstrating that potential risks have been systematically identified and reviewed.

- In August, ABS announced that its NTQ services would be a key element in a new JDP with NOV, Equinor, Shell, The Research Council of Norway and the Net Zero Technology Centre to develop a pioneering subsea storage technology. The JDP unites these industry leaders to pursue an economical subsea solution for the safe storage of larger volumes of fluids, such as enhanced oil recovery chemicals, production chemicals, oil, condensate and maritime fuels.
- ABS' NTQ services will also be applied to the first OSV in Malaysia, which will feature an innovative vessel design and battery system expected to support more sustainable vessel operations. The NTQ process will evaluate the Blue G Battery System, which can be charged by generator sets on board or from any shoreside sources, allowing a vessel to save fuel and reduce its carbon footprint, operational expenses and life-cycle costs.



OFFSHORE WIND

SUPPORTING RAPID GROWTH IN OFFSHORE WIND

Just as ABS has been a leader in the offshore industry from the beginning, ABS has likewise been at the vanguard of supporting the budding offshore wind sector. This is especially true in recent years as several governments worldwide, including the U.S., have pushed to improve energy security through increased offshore wind energy production. As a result, ABS has positioned itself to provide industry-leading guidance and support in all areas of offshore wind development – from floating turbine platforms to specialized support vessels.

- To reach the U.S. government's goal of 30 gigawatts (GW) offshore wind power by 2030, the industry will require a variety of specialist vessels for installation and maintenance. Many such vessels are already under development with technical safety assistance from ABS. In January, ABS granted AIP to a coordinated design for a WTIV using the innovative BargeRack feeder barge system by Friede & Goldman (F&G). The design will give the Jones Act-compliant barge a lifting system that is claimed to reduce motion and increase the operational time window.
- In May, ABS granted AIP to F&G for the design of a WTIV suitable for all offshore wind markets. Capable of installing turbines of 15 megawatts (MW) and larger, it can be equipped with F&G's BargeRack feeder system to support Jones Act-compliant operations. The BargeRack system is removable, meaning the vessel will be able to operate anywhere as a typical WTIV.
- Beyond U.S. waters, ABS joined a government-industry initiative to help Poland achieve 11 GW of offshore wind power. Announced in August, the Polish Offshore Wind Sector Deal aims to generate 5.9 GW of electricity by 2030 and 11 GW by 2040, with economic improvement and job creation at its heart.

ABS CLASS FOR JONES ACT SUBSEA ROCK INSTALLATION VESSEL

In January, the Great Lakes Dredge & Dock Company chose ABS to class what will be the first subsea rock installation vessel for U.S. waters. To be built by Philly Shipyard in Philadelphia, the Jones Act-compliant vessel will be capable of transporting and depositing loads of up to 20,000 tonnes of rock on the seabed, providing scour protection for offshore wind farm foundations, cables and other structures.

Designed to the ABS SUSTAIN-2 class notation, the 140 m vessel will employ U.S. Environmental Protection Agency (EPA) Tier 4 engines and have plug-in capability to obtain electric power from shore while loading. It will be able to run on biofuel, be equipped with active emissions control technology to minimize NOx emissions and have a battery pack to help reduce fuel consumption and emissions.

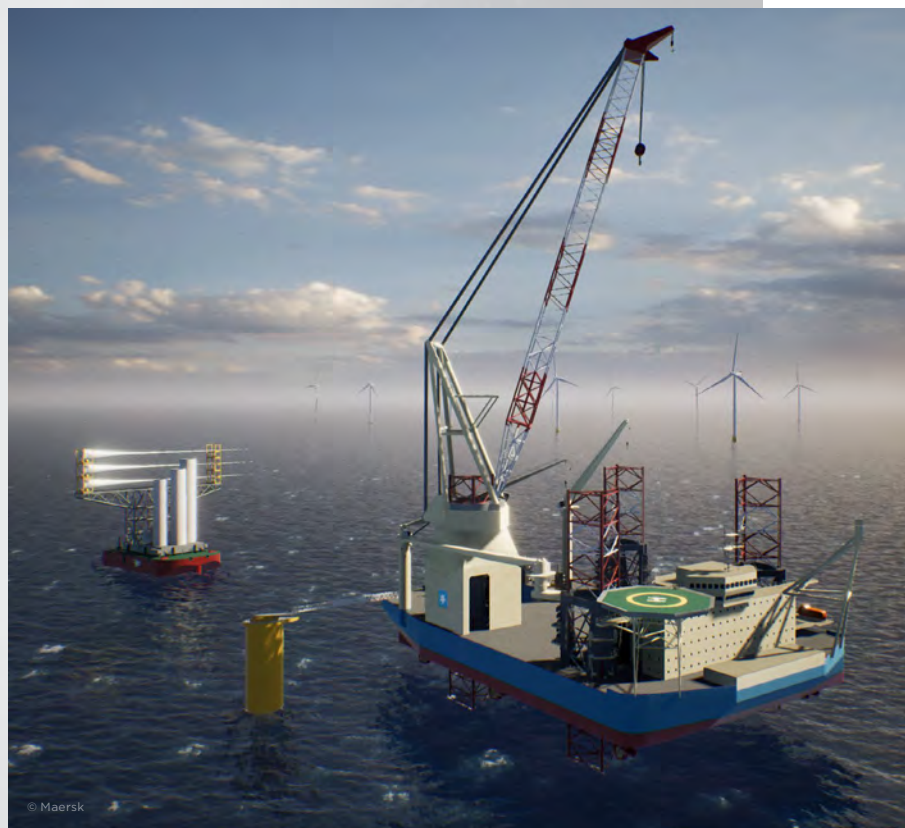
Offshore wind has the potential to serve an essential role in the current vision for decarbonization and clean energy in the U.S., and Jones Act-compliant support vessels such as this will be required to build the infrastructure needed.

ABS CLASS FOR EMPIRE WIND SUPPORT VESSELS

An installation vessel capable of handling 15-MW turbines for the Empire Wind project will be built to ABS Class by Sembcorp Marine for Mærsk Supply Services. In addition, Kirby Offshore Wind will build two new feeder barges and two diesel-electric hybrid tugboats to ABS Class and which will be Jones Act compliant. They will transport project components, such as towers and turbines, from the South Brooklyn Marine Terminal to the installation vessel offshore New York.

It is believed that the Jones Act feeder solution will give Mærsk a level of efficiency that will help control project costs and allow installation in most weather conditions.

The wind installation vessel is scheduled for completion in 2025, with work on the Empire Wind project and associated feeder barge services expected to commence in late 2025 or early 2026.



U.S. OFFSHORE WIND FORUM LOOKS AT SCALING THE SUPPLY CHAIN

There is currently only just under one GW of offshore wind power operating or under construction in the U.S., which means that just under nine 14-MW turbines will need to be installed every week from April to October per year — beginning in 2023 — to achieve the U.S. offshore wind power target of 30 GW for 2030. That was the message for delegates at ABS' third annual Offshore Wind Forum, held in December 2022. Attendees represented all industry segments, from developers to transportation and installation offshore service providers to shipyards to marine engineering firms and government regulators.

One panel discussion examined financing opportunities for offshore wind vessels, featuring speakers from Crowley, Clarksons, Otto Candies and Citizens Bank. The speakers shared thoughts on infrastructure challenges, risks in financing large capital expenditure vessels and public-private partnerships. Another panel focused on clean technology power systems adoption and sustainability, with representatives from Great Lakes Dredge & Dock, Shell, Vestas and Hornbeck Offshore Services discussing alternative fuels and hybrid power options.

The final panel examined maritime workforce challenges of the next decade, with representatives from Edison Chouest, Texas A&M University, Massachusetts Maritime Academy and Maine Maritime Academy discussing the skills and training necessary to develop a sustainable and well-trained maritime workforce to support the offshore wind industry.





SAFETY LEADERSHIP
IN A DECADE OF CHANGE

GLOBAL
GOVERNMENT

INDUSTRY-LEADING MARITIME EXPERTISE HELPS GOVERNMENTS AROUND THE WORLD

ABS' uncompromising dedication to safety enabled by robust digital technologies energizes every area of the organization's activities, especially its work with global governments.

SUPPORTING THE U.S. GOVERNMENT

The relationship between ABS and the United States (U.S.) government dates to World War I, when the government sought assistance from ABS in creating a larger and up-to-date merchant marine to support the war effort. Over the century since, ABS has rendered invaluable assistance to numerous U.S. government organizations, helping realize important advances in engineering, technology and construction.

For more than 100 years, ABS has been the official classification organization of the U.S., and under U.S. law, the only classification organization permitted to class U.S. government vessels. There are over 200 government-related ABS-classed vessels in the U.S. alone – a vast fleet that benefits from committed support and dedication to advancing technology in the service of safety. Today, ABS continues to provide steadfast support for the U.S. government and its required safety regimes, through classification, maritime advisory and new technology development services that help the U.S. Coast Guard (USCG), U.S. Navy and other government shipowners maintain uninterrupted naval, law enforcement, research, survey and logistics operations.



SAFETY LEADERSHIP IN A DECADE OF CHANGE

ABS' long and fruitful relationship with the U.S. government continued in 2022, as it participated in and led several ongoing technical, educational, and research and development (R&D) projects. Some highlights of these activities include:

- ABS worked with the USCG Offshore Patrol Cutter (OPC) program to support the largest surface acquisition program in USCG history. The OPC program made substantial progress during the year. With technical support from ABS surveyors and engineers under the management of ABS Global Government, the OPC program is poised to achieve major milestones in 2023.
- The organization continued a long tradition of support for the U.S. Military Sealift Command (MSC) while assisting with the fleet replenishment oiler acquisition program. In July, the U.S. Navy accepted delivery of the ABS-classed *USNS John Lewis* (T-AO 205). Throughout the year, ABS continued to support the construction of follow-on hulls being built at General Dynamics NASSCO.
- International Safety Management (ISM) audits performed by ABS supported the U.S. Maritime Administration's (MARAD) Every Mariner Builds a Respectful Culture (EMBARC) initiative. The EMBARC program outlines requirements for vessel owners and operators enhancing safety while training U.S. Merchant Marine Academy (USMMA) cadets aboard their vessels.
- ABS continued to provide life-cycle support for U.S. government vessels, including class-related cybersecurity and condition-based maintenance services. ABS supported numerous agencies including MARAD, MSC, and National Oceanic and Atmospheric Administration (NOAA), among others.
 - The technical complexity of increased automation and digital connectivity, along with the potential threat environment for U.S. government vessels, calls for increased control of cyber risk at sea and in port. ABS views cybersecurity as another engineering discipline that contributes to system reliability,



© NOAA's National Ocean Service

ABS HELPS REEXAMINE NUCLEAR ENERGY FOR COMMERCIAL MARITIME USE

Modern nuclear technologies are increasingly seen as a potential solution to shipping's decarbonization challenge but raise many concerns regarding their safe commercialization for the industry. That's why the U.S. Department of Energy (DOE) awarded ABS a contract to study the barriers to adopting advanced nuclear propulsion on commercial maritime vessels. The \$800,000 research project, awarded by the DOE's Office of Nuclear Energy, will see ABS creating models of different advanced reactor technologies for maritime applications and developing an industry advisory on the commercial use of modern nuclear power.

ABS has the longest history with maritime nuclear energy sources of any classification society, dating back to 1959 and the classing of the world's first merchant ship powered by a nuclear reactor, the *NS Savannah*.

Project support will be provided by the DOE's National Reactor Innovation Center, based at Idaho National Laboratory, which will provide the advanced reactor framework to help propose how a maritime nuclear demonstration could take place. In a separate award, DOE also contracted ABS to support research into molten salt reactors being carried out by the University of Texas.

safety and security through both technical and procedural controls. In July, ABS released a new *ABS Guide for Risk Management Framework Implementation (RMF) for U.S. Government Vessels and Maritime Assets* and offered a new CS-RMF notation. The Guide defines boundaries of critical information technology (IT) and operational technology (OT) systems in the shipboard network environment. It also maintains the RMF compliance parameters needed for demonstration by the owning agency to achieve authority to operate (ATO).

- Recent advances in technology, such as sensor hardware, data accumulation and transmission, advanced analytics, and artificial intelligence (AI), have enabled new approaches to vessel health understanding that support improved system safety and reliability. ABS recognizes that U.S. government vessel operators and owners require improved life-cycle management approaches to achieve high levels of operational availability and readiness. In June, ABS released a new *ABS Guide for Condition Based Program (CBP) for Government Vessels* that offered a tiered set of six new CB Structure and CBP Machinery notations. The Guide's intent is to leverage both design and operational data and a compliance risk model to support the class survey and crediting process. It enables U.S. government vessel operators to increase operational availability and flexibility, minimize unplanned hull, mechanical and electrical (HM&E) failures, and improve maintenance and availability planning.
- Additionally in 2022, ABS provided early life-cycle support related to government acquisition programs through ABS' approval in principle (AIP) and new technology qualification (NTQ) processes, as well as sustainment support through ABS' Service Life Evaluation Program (SLEP). The collective deployment of these programs and services continues to enable government clients to conduct essential life-cycle planning and management to ensure assets meet service life expectations.
- Throughout the year, ABS was active in supporting decarbonization and clean energy transition initiatives within government agencies including DOE, MARAD and the California Air Resources Board (CARB). ABS supported agency-specific initiatives and acted as maritime subject matter experts. Direct support to government agencies included conducting alternative fuel feasibility studies for commercial harbor craft and Great Lakes shipping for MARAD, supporting CARB's Tier Four engine regulations compliance, and actively supporting the DOE Testing Expertise and Access for Marine

SAFETY LEADERSHIP IN A DECADE OF CHANGE

Energy Research (TEAMER) program. ABS supported multiple projects that materialized from the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA), including support for the Hydrogen Hub coalitions that have a notable maritime nexus. In addition, ABS provided expertise to several partners for green shipping corridors research, analysis and other activities supporting the U.S. Department of State's (DOS) Green Shipping Challenge announced at COP27, including the Gulf of Mexico, the Great Lakes, and the Antwerp-Bruges to Houston green shipping corridors.

SUPPORTING INTERNATIONAL GOVERNMENTS

Likewise, ABS' work with international governments continued, as the company supported class and class-related services including technology development and educational programs.

- In late 2022, American Bureau of Shipping Canada Incorporated was formally registered as a Canadian Company. Driven by security requirements associated with long-term support of Canada's Department of Defense, the establishment of ABS enables broader opportunities to support government agencies in Canada.
 - ABS continued support of the Royal Canadian Navy (RCN) as a Non-Combatant Classification Society (NCCS). During the year, the fleet of ABS-classed ships within the RCN increased with the addition of two Arctic and Offshore Patrol Vessels (AOPV). ABS support across the RCN fleet also broadened to include additional service life evaluation modeling and initial sustainability services through ABS Canada, Inc. and ABS Wavesight™.
 - ABS continued strong engagement with the Canadian Coast Guard (CCG) through Delegated Statutory Inspection Program (DSIP). Several existing CCG ships came fully into ABS Class in 2022, including four new Bay Class search and rescue (SAR) ships that joined the fleet. ABS involvement with significant CCG vessel life extension programs increased in 2022. R&D engagement with the CCG is underway in the area of underwater radiated noise modeling and prediction. Going forward, ABS Canada, Inc. will broaden the service offerings adopted by the CCG and the next focus is on sensor technologies and safety culture.
 - ABS worked with Transport Canada (TC) in the government organization's role as both regulator and shipowner. The company's engagement with TC on uniquely Canadian Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII) regulator development continued, helping position ABS as a leader in providing regulatory guidance for commercial Canadian laker operators. In addition, ABS-Class work on two large TC-owned hybrid ferries being designed and built at Chantier Davie Canada Inc. entered preliminary design, offering ABS an opportunity to broaden its capabilities in the area of classing fuel cell and sizeable battery onboard installations.





- Based at Memorial University of Newfoundland, the ABS Harsh Environment Technology Center (HETC) continued support for vessels that face the unique challenges of Arctic environments. Significant projects in 2022 included:
 - Icebreaker preconcept support for the USCG in terms of icebreaker rules synthesis tool.
 - Polar Code implementation for commercial operators continues to be a core offering with multiple owners engaged.
 - Safe speed in ice analyses is a growing area for HETC as means to characterize and define the inherent strength of any steel-hulled ship to operate in ice. Engagement on this in the naval ship community and liquefied natural gas (LNG), bulk and tanker carrier owners is increasing.
- In March, the Indian Ministry of Defence signed a contract with Larsen & Toubro (L&T) Shipyard for the acquisition of two multipurpose vessels (MPVs) for the Indian Navy to be built to ABS Class based on the *ABS Guide for Building and Classing International Naval Ships*. These vessels, to be built by L&T's shipyard at Kattupally (Chennai, India), will perform multirole support functions such as maritime surveillance and patrol, launching and recovery of torpedoes, and operation of various types of aerial, surface and underwater targets for gunnery and anti-submarine warfare (ASW) firing exercises. The units, planned to be 107 meters (m) in length with a displacement of 3,750 tonnes, will also be capable of towing ships and rendering humanitarian assistance and disaster relief (HADR) support with limited hospital ship capability. The multipurpose vessels are the first-of-its-kind platforms, constructed to provide a cost-effective solution to meet a variety of requirements for the Indian Navy.

OTHER ACCOMPLISHMENTS

- In 2022, ABS published *Requirements for Autonomous and Remote Control Functions*, offering its government clients a pathway to acquire, analyze and develop requirements for new technology related to autonomous, uncrewed, unmanned, and remote control systems, vessels and equipment. ABS used this framework, in partnership with several defense contractors and the U.S. Navy, to certify one of the Spearhead-class logistics ships, *USNS Apalachicola* (EPF-13), for autonomous operations. Similarly, ABS published the *Guide for Assessment of the Process for Product Reliability*, which supports the government's ability to analyze components of an acquisition for reliability performance, complementing the development of autonomous and unmanned vehicles.

TALENT DEVELOPMENT AND CORPORATE CITIZENSHIP

DEVELOPING THE TALENT PIPELINE

The pace of change in the workplace continually tests ABS' ability to ensure that the organization's workforce is resilient, competent and ready to take on the challenges of today and tomorrow. In this rapid evolution of technology, ABS remains well-positioned as a technical and safety leader. The core engineering and technology competence of ABS' people and the wealth of experience they bring to problem-solving is a key differentiator for the organization. Analysis and critical thinking are key points of emphasis in ABS' career development planning.

That's why ABS is focused on continuing to develop the organization's employee base to be best in class through continuous learning, training and preparation to support the business' commitment to set standards of excellence as a leader in maritime safety – now and in the future. In order to do this, ABS constantly considers how to enhance employees' skills in areas like learning agility and developing a growth mindset. Both of those skills help unlock future potential for learning and growth in employees.

The path forward for ABS is clear based on three defining goals – safety, service and solutions. The organization has been able to achieve those goals through the innovative thinking, enthusiasm and professionalism of highly experienced employees. Years of experience, training and continued education have made ABS confident in its actions and secure in its decisions. ABS employees remain committed to the company's mission, and the "SPIRIT" of ABS is the core of everything ABS does from a career development standpoint.

As an organization committed to investing in and cultivating a sustainable, diverse, multiskilled talent pipeline across a broad range of disciplines – traditional marine and offshore architecture, engineering studies, data analytics, sustainability and digital transformation – ABS is well-prepared and ready to meet the challenges of an evolving industry.

ABS' robust internal career development efforts are aligned to best practices and designed to provide a balance of development activities for employees, using a combination of job experience, mentoring, coaching and formal training.



TRAINING

In 2022, ABS began its journey into dynamic learning. Following a newly developed Learning Ecosystem roadmap, ABS implemented new methodologies and tools to develop employees for the skills needed today and in the future. For example, an artificial intelligence (AI)-driven micro-learning tool provided surveyors with training individualized to help them learn and retain more knowledge.

Nearly 140,000 training hours were completed by ABS employees in 2022, the highest levels seen in the past five years. This significant investment is necessary to prepare the company's workforce for the rapid changes and advancements taking place in the marine and offshore industries. The fundamental skills required for surveying and engineering were not forgotten, as ABS continued quarterly blended Keystone technical training programs.

The ABS client training team also turned an eye toward the future. The organization released a new decarbonization web-based training program to provide anyone in the industry with a comprehensive overview of decarbonization drivers, challenges and potential solutions available in the market today. ABS also held its first classroom training on Methanol as a Marine Fuel, the first in an upcoming suite of alternative fuels training programs.



CAREER DEVELOPMENT

ABS offers employees award-winning career development programs which are well known to them and keenly supported by management. These two programs, introduced in 2020, continue to be enhanced and refreshed, ensuring that employees can access tools and resources that support their growth. This includes innovative offerings like an internal career-development podcast, career pathing documents, and external training tools like LinkedIn Learning. These programs are:

- The *Beacon Career Development Program* offers a wide variety of professional and career development tools, resources, trainings and opportunities for all employees. As an example, in 2022, employees completed 7,787 hours of LinkedIn Learning training, including completing 6,955 individual courses and 147,705 short learning videos, with the top courses being in Effective Listening, Project Management, Power BI skills, Critical Thinking, Presentation Skills and Finance for Non-Financial Managers.
- The award-winning *Propel Accelerated Leadership Development Program* was recognized as a Gold-Standard program in Talent Management by Chief Learning Officer magazine in 2022. Propel offers tailored development opportunities for identified high potential employees. In 2022, nearly 200 high potential employees from around the world expanded their careers and capabilities through targeted assignments, projects and trainings delivered as part of the Propel program.

ASPIRE PROGRAM

The Aspire program is a 14-month rotational trainee program for new employees who were new graduates in the areas of architecture/marine engineering, mechanical engineering, structural engineering, electrical engineering, data analytics, computer science, and related disciplines. The Aspire program provides participants with a unique, holistic understanding of ABS' core operational areas. Placement into the business after the program aligns the participants with their career interests and the company's business needs. Since Aspire's founding in 2014, 136 early career professionals have been hired into the program, including the cohort that started work in July 2022. Aspire alumni who are currently in the ABS workforce are four times more likely than the organization's general population to be identified as high potential future leaders. As such, Aspire has become the company's "early careers early talent" pipeline.

UNIVERSITY RELATIONS

In 2022, ABS provided scholarship commitments of over \$1 million to scholars attending colleges and universities in the Americas, Europe, Middle East, Africa, China and Pacific regions.

Additionally, ABS supported endowed academic chairs at seven campuses:

- ABS Chair of Naval Architecture and Marine Engineering and ABS Chair of Marine Transportation at the State University of New York (SUNY) Maritime College
- ABS Chair of Engineering at the California State University Maritime Academy (formerly known as the California Maritime Academy)
- ABS Chair of Metallurgical and Materials Engineering at the Colorado School of Mines
- ABS Chair of Ocean Engineering at the University of California Berkeley (UC Berkeley)
- ABS Chair of Marine and Offshore Design Performance at the University of Michigan
- ABS Career Development Chair at the Massachusetts Institute of Technology (MIT)
- ABS Chair of Naval Architecture and Marine Engineering at the Webb Institute

ABS ESG

ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) EXCELLENCE

A sustainable future is an integral part of the ABS mission. For the marine and offshore industries, the key to sustainable success is strategic alignment with the United Nations' (U.N.) Sustainability Development Goals (SDGs) framework – focused on achieving environmental, social and governance (ESG) excellence. Therefore, in 2022, ABS launched a consolidated method of sustainability reporting through a new ESG Report. This report showcased the organization's commitment to sustainability in all its operations and the way employees work at ABS across programs, tools and processes in areas of social responsibility, safety, environmental protection, diversity, equity, and inclusion (DE&I), and governance.

ABS' SUSTAINABILITY PRIORITIES

ABS' PEOPLE

The people at ABS are the organization's most valuable assets. ABS embraces DE&I as part of its commitment to global citizenship. The company engages with its personnel and provides them with clear career choices, as well as equal opportunities. The organization respects the rights of its people across the globe and together brings positive social benefits to the wider community.

HEALTH AND SAFETY

Ensuring the health and safety of ABS personnel is a top priority. ABS established its own safety management system and a comprehensive monitoring mechanism to achieve enhanced safety performance. The organization actively identifies safety hazards and risks in the workspace and creates initiatives to mitigate those risks in order to reduce the number of incidents. In 2022, ABS developed and implemented a new set of analytical tools that allow the company to identify and address safety performance and trends at the business unit level and enable the deployment of customized safety training and awareness across the enterprise.



COMMUNITY ENGAGEMENT

ABS believes in being a responsible corporate citizen and playing an active role in the communities where it operates. As a multinational organization, ABS recognizes the importance of corporate social responsibility and actively engages in numerous local events, initiatives and community projects to make a positive impact on the lives of those around the business. Some examples include the United Way campaign in the United States, the ABS global scholarship program, volunteerism and charitable contributions. By working together, ABS can help ensure that the communities where employees live and work are vibrant and thriving places for generations to come.

GOVERNANCE AND INTEGRITY

ABS' reputation for ethical and reliable service is one of the organization's most important assets. This means employees must, at all times, operate with the highest level of integrity. The ABS Code of Ethics sets out the standards and practices that form the foundation for conduct. The organization's strong commitment to ethics and integrity is not just good for business – it is part of the fabric of what ABS is as an organization and as individuals. ABS clients trust the organization to be their partner, and employees trust one another to operate according to the highest standards of conduct. The same level of commitment to ABS values of diversity and inclusion, human rights and resource conservation is requested from suppliers and outlined in the organization's procurement policies. Commitment to ethics and integrity benefits ABS, its clients and the industry at large.

TECHNOLOGY AND INNOVATION

ABS is leading the way in supporting digitalization of the maritime industry. The company recognizes the importance of innovation and digitalization in driving energy efficiency and reaching long-term sustainability targets.

ENVIRONMENT

ABS is an industry leader in promoting environmental sustainability. The organization is committed to complying with all environmental laws and regulations in its global operating sites and reducing the environmental impact in its business practices. ABS' research and innovation provide solutions to clients for reducing their carbon footprint and achieving environmental compliance.

To find more information on ABS ESG activities and performance, please download the 2022 ABS ESG Report. A copy of the report is available on the ABS website at www.eagle.org.



SAFETY LEADERSHIP
IN A DECADE OF CHANGE

ABS
CORPORATE
GOVERNANCE

ABS BOARD OF DIRECTORS

Christopher J. Wiernicki
Chairman

Michael L. Carthew
Lead Director

David W. Grzebinski

William E. Jenkins

Susan K. Neely

Louis A. Raspino

Mark H. Ross

Philip J. Shapiro

Craig H. Stevenson Jr.

Elizabeth D. Whitaker, Esq.

Darryl K. Willis

ABS CORPORATE OFFICERS

Christopher J. Wiernicki
Chairman, President and
Chief Executive Officer

John P. McDonald
Executive Vice President and
Chief Operating Officer

Laura C. Fulton
Senior Vice President and
Chief Financial Officer

Kara Pelecky
Senior Vice President and
Chief Information Officer

Robert G. Clyne
Senior Vice President
General Counsel and Secretary

Chuck Kemper
Senior Vice President and
Chief Human Resources Officer

Patrick Ryan
Senior Vice President and
Chief Technology Officer

Vassilios Kroustallis
Senior Vice President
Business Development

Jessica A. Mahaffey
Senior Vice President and
Chief Marketing Officer

Derek S. Novak
Vice President and Chief Engineer

Adam W. Moilanen
Vice President and Chief Surveyor

ABS ADVISORY COUNCIL

Morten Arntzen
Team Tankers International

Mark W. Barker
Interlake Steamship Co.

William T. Bennett Jr.
TexBass LLC

Michael L. Carthew

Angela A. Chao
Foremost Group

Robert G. Clyne
ABS

John G. Coumantaros
Southern Star Shipping Co. Inc.

Thomas B. Crowley Jr.
Crowley Maritime Corp.

Cesare d'Amico
d'Amico Società di Navigazione SpA

Richard D. DeSimone

Dimitrios J. Fafalios
Fafalios Shipping S.A.

Nicholas G. Fistes
ADK Maritime Pte Ltd.

Angeliki N. Frangou
Navios Maritime Holdings Inc.

Peter John Goulandris
Triandros Corp.

David W. Grzebinski
Kirby Corp.

Michael S. Hudner
B+H Shipping Group

William E. Jenkins

Capt. Robert E. Johnston

Capt. Spyros N. Karnesis
European Navigation Inc.

Renee Klimczak
Alvarez & Marsal

Charles Kurz II*

Donald R. Kurz
Keystone Shipping Company

Gerhard E. Kurz*

John P. Laborde*

Michael C. Lemos
CM Lemos & Co. Ltd.

Dr. Donald Liu

Peter G. Livanos
GasLog LNG Services Ltd.

Adam W. Moilanen
ABS

Derek S. Novak
ABS

C.R. Palmer*

T. Peter Pappas
Atlantic Capital LLC

Spyros M. Polemis
Seacrest Shipping Co. Ltd.

Antony Prince
G.T.R. Campbell Marine Consultants Ltd.

Stein Rasmussen
SBM Offshore

Bruce S. Rosenblatt
Bruce S. Rosenblatt & Associates, LLC

Dott. Alcide Ezio Rosina*
Premuda SpA

Stefano Rosina
Rosina & Partners

Philip J. Shapiro
Liberty Maritime Corp.

Capt. Cesare Sorio*

Craig H. Stevenson Jr.
Pecos Shipping

Katherine Trauth
Shell Trading (U.S.) Company

Nikolaos P. Tsakos
Tsakos Energy Navigation Ltd.

Chee Chen Tung
Orient Overseas International Ltd.

Michael D. Tusiani
Poten & Partners, Inc.

Capt. Graham Westgarth
V.Group Limited

Christopher J. Wiernicki
ABS

*Emeritus Member

SAFETY LEADERSHIP
IN A DECADE OF CHANGE

ABS GROUP
OF COMPANIES,
INC.

ABS Group of Companies, Inc. (ABS Group), through its operating companies, provides risk-based engineering, safety, performance and certification solutions to support operational excellence in the industrial and government sectors. The organization's technical advisory services deliver value to global markets including the aerospace, automotive, critical infrastructure, manufacturing, marine, oil and gas, petrochemical, pharmaceutical and process industries.



SAFETY LEADERSHIP IN A DECADE OF CHANGE: SOLVING RISK-RELATED CHALLENGES TODAY TO SUPPORT THE SAFETY OF CRITICAL INFRASTRUCTURE TOMORROW

In 2022, ABS Group and its subsidiaries, which provide safety and risk consulting operations across the Americas, Europe, Middle East and Asia Pacific regions, continued to deliver world-class technical risk solutions to support critical infrastructure across key industries, including oil, gas and chemical, power and energy, industrial manufacturing, government, and marine and offshore.

Once again, ABS Group's risk consulting subsidiary, ABSG Consulting Inc. (ABS Consulting) was named one of America's Best Management Consulting Firms by Forbes and Statista in 2022, placing the organization among the United States' leading consulting firms. With over half a century of safety leadership and expertise covering operational to catastrophic risk, ABS Group continues to provide practical, tailored solutions that address the challenges of today and the opportunities and threats of tomorrow.

ABS Group's breadth and depth of experience across a multitude of industries, regulators and standards organizations drive its applied risk management solutions. This foundation has allowed for the expansion of the Risk and Reliability service offerings, with a primary focus on critical infrastructure, from new construction to aging assets. In addition, ABS Group has further expanded its cybersecurity portfolio, adding new capabilities to seamlessly support the evolving landscape of both commercial and government markets.

A FOUNDATION OF RISK EXPERTISE: IMPLEMENTING PRACTICAL SOLUTIONS TO UNIQUE OPERATIONAL ENVIRONMENTS

ABS Consulting has developed a unique and holistic approach to risk management based on decades of industry-wide experience. Its legacy of safety leadership includes providing services to the maritime industry to improve efficiency and the performance of global fleets, remaining a trusted risk advisor to government agencies and the public sector, and investing in powerful partnerships that support safer, more reliable assets and operations.

IMPLEMENTING FULL-SCALE INDUSTRIAL CYBERSECURITY PROGRAMS FOR 24/7 VESSEL MONITORING

The evolution of digitalization in the maritime industry has introduced a new set of operational and safety risks and cybersecurity threats for both maritime organizations and the physical vessels that transport 90 percent of the world's goods, including oil, electronics, food and more. Cybercriminals, known to be sophisticated and agile, have taken notice of this transformation and designated the maritime industry as a top target. As a result, industry organizations and regulators, such as the International Maritime Organization (IMO), have released guidance to help companies navigate and adapt to the changing cyber landscape.

In 2022, ABS Consulting assisted one of the world's largest liquefied natural gas (LNG) shipping operators in developing and implementing a comprehensive industrial cybersecurity program, monitoring its fleet of LNG vessels. This industry-first program initially outfitted 29 vessels with technology to enable critical 24/7/365 cybersecurity monitoring and remote managed services for onboard operational technology (OT) and information technology (IT) systems. This partnership highlighted ABS Consulting as one of the first organizations to introduce Industrial Security Operations Centers (ISOC) to the maritime industry.

ADDRESSING THE GLOBAL FPSO MARKET FROM AGING ASSETS TO NEW CONSTRUCTION

ABS Consulting developed risk-based inspection programs to support entire assets, conducted engineering analysis for life extension to help ensure the safe operation of floating production storage and offloading vessels (FPSOs) approaching end-of life, and performed gap analyses for regulatory compliance to help ensure operators were in compliance. In addition, ABS Consulting developed risk studies for shipyards and operators to help ensure technical risks were identified and mitigated prior to the delivery of FPSOs.

In 2022, ABS Consulting had success in supporting Brazilian Regulatory Compliance (BRC) consultancy globally. In the last two years, ABS Consulting was awarded more than nine FPSO-related projects to perform Brazilian Regulatory Framework assessments during the design, construction and operations of both new and existing vessels.

ABS Consulting's practical understanding of the regulatory framework and scope of requirements are of high value to companies considering an investment, and equally those with current investments, in Brazil. ABS Consulting continues to strengthen and enhance its extensive BRC unit of multi-disciplinary experts, combining the best of its global experience with local knowledge and perspective, helping to ensure its clients' successful compliance with the Brazilian Regulatory Framework.

SUPPORTING THE SAFETY MISSION OF GOVERNMENT PARTNERS

ABS Consulting is a leading provider of government solutions, leveraging expertise in risk management and risk-informed strategies to improve the risk posture of government agencies and advance the resilience of private sector critical infrastructure owners

CREATING A BLUEPRINT TO OPTIMIZE ASSET PERFORMANCE MANAGEMENT

ABS Consulting partnered with Itus Digital to provide clients with a powerful end-to-end asset management solution that maximizes performance and longevity while minimizing maintenance costs based on asset criticality. The platform is enabled by an asset library that contains more than 200 asset twin models covering common industrial equipment classes, including base failure rates. This alliance combined ABS Consulting's extensive suite of asset reliability services with Itus' cutting-edge application performance monitoring (APM) software to operationalize asset strategy via existing data, ultimately providing a clear path to asset management excellence. This data-driven APM solution redefines how organizations of any size can manage assets and operational risks by providing a systematic and affordable process, supported by technical experts that continue to lead the development of key industry guidelines.

ASSISTING CISA WITH THE DEVELOPMENT OF CROSS-SECTOR CYBERSECURITY PERFORMANCE GOALS

ABS Consulting assisted the Cybersecurity and Infrastructure Security Agency (CISA) with the development of Cross-Sector Cybersecurity Performance Goals. Driven by the task of creating a National Security Memorandum on Improving Cybersecurity for Critical Infrastructure Control Systems, ABS Consulting, along with other security experts from across the nation, delivered extensive input. The Cross-Sector Cybersecurity Performance Goals strive to address the ongoing need for practical cybersecurity resources to guide organizations across the spectrum by providing an approachable common set of IT and OT cybersecurity protections that are clearly defined, straightforward to implement, and aimed at addressing some of the most common and impactful cyber risks.



and operators. With over 20 years of experience working with both civilian and military agencies, ABS Consulting brings decades of experience in risk management, safety and compliance. ABS Consulting is committed to helping its government partners achieve their safety goals by leveraging the organization's expertise in risk and its knowledge of federal regulations and best practices.

The company's core capabilities align well with recent priorities from the U.S. federal government, including transportation, climate resilience and cybersecurity. ABS Consulting is also committed to working with MBE/SBE businesses, as demonstrated by the organization's Snow Eagle Group (SEG) joint venture with the Confederated Salish and Kootenai Tribes (S+K), which recently won a contract to develop and evaluate Safety Management Systems (SMS) for public transportation systems across the country.

SUPPORTING LEADING AGENCIES WITH NATURAL HAZARDS RISK MANAGEMENT

ABS Consulting continues to support the federal government in evaluating natural hazard risks and post-disaster loss analyses. ABS Consulting was instrumental in helping the Federal Emergency Management Agency (FEMA) develop and release the National Risk Index (NRI), an online tool that utilizes data to identify communities that are most vulnerable to natural disasters. In 2022, the U.S. House of Representatives passed the bipartisan Community Disaster Resilience Zones Act to make the NRI permanent and officially established community disaster resilience zones (CDRZs) to designate the communities across the nation that are most in need of mitigation projects.

In 2022, ABS Consulting provided support to the U.S. Department of State (DOS) – Bureau of Overseas Buildings Operations (OBO) Climate Security & Resilience (CS&R) Program. With over 26,000 properties in its active building inventory spread across nearly 300 posts, the goal of the CS&R Program was to reduce life safety risks, mitigate property loss and to enhance emergency preparedness for natural hazards that occur throughout the portfolio.

ABS Consulting was selected as one of four Indefinite Delivery, Indefinite Quantity (IDIQ) contractors to provide natural hazard engineering services in support of the OBO CS&R Program. The services included site-specific evaluation of structures at selected posts for different natural hazards, the refinement of natural hazard analysis tools and methodologies used in the CS&R Program, and assisting the OBO with the refinement of emergency preparedness and response plans for various natural hazards.

POWERFUL PARTNERSHIPS: MERGING ESTABLISHED EXPERTISE WITH CUTTING-EDGE SOFTWARE

In 2022, ABS Consulting invested in several new partnerships, combining its deep domain expertise with data-driven software to optimize asset performance for clients. ABS Consulting's robust history in asset integrity management (AIM), process safety management (PSM), and reliability laid the groundwork to support these emerging solutions from new alliances.

ABS Consulting paired its full suite of asset reliability services with Itus Digital's powerful end-to-end asset management solution that maximizes performance and longevity while minimizing maintenance costs based on asset criticality. This alliance provides data-driven APM solutions across the asset life cycle through a systematic and affordable process. The combination of ABS Consulting's reliability expertise, alongside the Itus platform, sets up clients for long-term success.

ABS Consulting also expanded upon its existing partnership with Metegrity, a global AIM software solutions company. By combining the organization's history of engineering expertise with Metegrity's Visions Enterprise and asset integrity process safety management (AIPSM) software solutions, clients were offered a solid foundation to deploy powerful and efficient AIM systems, giving them a clear competitive advantage.

NATURAL GAS LEAK DETECTION AND MAINTENANCE SERVICES FOR VARIOUS INFRASTRUCTURE

In 2022, ABS Consulting invested in natural gas leak detection and maintenance services, partnering with Gibson Gas Surveying (GGS) to offer full scope of work maintenance contracts to various industries in both commercial and government spaces. The alliance helped clients operate safer, longer, and with fewer repairs, all while meeting deferral standards outlined in Title 49 of The Code of Federal Regulations. This new collaboration offered owners and operators a comprehensive suite of AIM tools and services geared toward the natural gas distribution and midstream sectors.

GLOBAL INNOVATION: CREATING RISK MANAGEMENT SOLUTIONS CATERED TO THE EMERGING NEEDS OF CRITICAL INFRASTRUCTURE

As the world becomes more connected, the need to protect critical infrastructure has become increasingly important. From power grids to transportation networks, these assets are the backbone of modern society and must be protected from a variety of risks, most notably the rapid rise of cyberattacks. In response to

IMPROVING SEISMIC RESILIENCE FOR THE METROPOLITAN WATER DISTRICT HEADQUARTERS

ABS Consulting played an integral part in providing the Metropolitan Water District with a voluntary seismic retrofit and tenant improvement project. As the Structural Engineer of Record (SEOR) and A/E Team Lead, ABS Consulting was responsible for managing a large interdisciplinary team, including architects, interior designers, engineers (structural, geotechnical and civil), and various consultants. Design renovation drawings and specifications were prepared, which included structural strengthening and strengthening of non-structural cladding system connections to improve retention under inter-story seismic drifts. For this project, both ASCE 41 linear and non-linear time history structural analyses were performed, and structural beam and cladding specimen cyclical testing was conducted. Construction documents for this project included ABS Consulting's revolutionary fiber reinforced polymer (FRP) concrete strengthening concepts which have been the subject of several recently published technical papers.

this growing need, ABS Consulting expanded its existing cybersecurity portfolio, finding key synergies across commercial and government markets to help protect critical infrastructure industrywide, with a strong focus on chemical, energy, water and transportation industries.

NEW RISK-BASED SOLUTIONS FOR CONVERGING IT-OT SYSTEMS

Originally launched in 2021, ABS Consulting's Industrial Cybersecurity Managed Services uniquely focused on OT cybersecurity, positioning the organization as a leading industrial managed security service Provider (MSSP). ABS Consulting has since expanded its services, approaching industrial cybersecurity as a risk management function.

With new risk-based solutions that cover every stage of cyber defense for converging IT and OT systems, ABS Consulting offers industrial network security based on specific client needs and unique operating environments. ABS Consulting's comprehensive industrial cybersecurity program now includes supply chain risk management, OT cybersecurity for new construction, specialized cybersecurity consulting, and Zero Trust for OT (ZT4OT™).

ABS Consulting's portfolio continues to include deep domain OT knowledge and expertise for critical infrastructure operations with services to prioritize health, safety, environmental and operational risks. ABS Consulting's agnostic approach and dedicated partners, (including Obrela, Nozomi Networks, Tenable,



ASSURING CONFIDENCE IN U.S. GOVERNMENT SECURITY REQUIREMENTS: CYBERSECURITY CERTIFICATION SERVICES

In 2022, ABS Quality Evaluations, Inc. (ABS QE), a world-leading certification body and a subsidiary of ABS Group, launched new Cybersecurity Maturity Model Certification (CMMC) training and other services, including gap assessments for CMMC 2.0 compliance. These new services assist Defense Industrial Base (DIB) contractors in meeting mandatory cybersecurity requirements for handling Controlled Unclassified Information (CUI) and Federal Contract Information (FCI), ultimately protecting information assets against pitfalls created by information security threats, vulnerabilities, and bad actors.

ABS QE remains a C3PAO candidate and in 2022 became a Registered Provider Organization (RPO) certified by the CMMC Accreditation Body (CMMC-AB). This enables ABS QE to provide services to government contractors and other companies in preparation for their CMMC assessments, as well as assess the processes, procedures, and practices for compliance with CMMC Level 2. ABS QE continues to expand its cyber expertise market-wide, with services and certifications centered around cyber and information security assessments, including ISO 27000, ISO 9000 and ISO 20000.

ABS QE also strengthened its position and commitment to certify and guide organizations in critical areas such as health and safety, sustainability, corporate social responsibility, risk and asset management. ABS QE remains a global leader in assurance services, providing accredited management system certification audits, supply chain assessments and training in over 40 countries.

SAFETY LEADERSHIP IN A DECADE OF CHANGE

Dragos and others), allow for the integration of products and services into existing risk management programs, ultimately allowing clients to take control of not only their OT risk but their IT risk via ABS Consulting's trusted team of cybersecurity experts.

LEVERAGING GOVERNMENT PARTNERSHIPS TO SHAPE THE FUTURE OF OT CYBERSECURITY

As threats against critical infrastructure continue to expand, so does the need for strong cybersecurity policies to protect them. Although a large majority of critical infrastructure remains in the private sector, key government agencies are now setting regulations in place to help better protect individuals and organizations from cyberattacks.

In 2022, ABS Consulting assisted the Critical Infrastructure Security Agency (CISA) with the development of cross-sector cybersecurity performance goals to help enhance the protection of critical infrastructure. ABS will continue to leverage its longstanding partnerships with U.S. agencies, (including the CISA, the U.S. Coast Guard (USCG), the Transportation Security Agency (TSA), the Department of Energy (DOE), the Department of Interior (DOI), and the Department of Transportation [DOT]), to aid the development of cybersecurity regulations and use this knowledge to support compliance for commercial clients.

In addition, ABS Consulting was awarded a federal contract with the Department of Homeland Security (DHS) to enable better information sharing and analysis across the federal government.

DELIVERING WORLD CLASS TECHNICAL RISK SOLUTIONS TO SUPPORT CRITICAL INFRASTRUCTURE

As the world around us continues to change rapidly and the regulatory landscape evolves, ABS Group remains at the forefront of safety and risk management. Its renewed priority in protecting critical infrastructure from risk is not only a matter of national security but also of protecting the health and safety of people globally. As new risks emerge, ABS Consulting will continue to add value to the key industry verticals of marine and offshore, oil, gas and chemical, government, power and energy, and industrial.

CERTIFYING THE CITY OF MISSISSAUGA IN ISO 50001 ENERGY MANAGEMENT TO ADVANCE CONSERVATION AND SUSTAINABILITY FOR RESIDENTS

ABS QE awarded the Corporation of the City of Mississauga ISO 50001 certification for its Energy Management System, ultimately supporting the critical goal to improve energy performance. ISO 50001 supports organizations in developing an energy management system based on a model of continual improvement to ensure more efficient use of energy through the creation of policy and plan with fixed targets and objectives for improved decision-making about energy use. The certification showcases leadership in energy conservation and the commitment to a sustainable city for residents by demonstrating alignment with a long-term vision of becoming a "zero-carbon" city. The scope of the certification included community and recreation services at the Frank McKechnie Community Centre, making it the first municipal facility in Canada to achieve this certification.



ABS GROUP OF COMPANIES, INC. BOARD OF DIRECTORS

Christopher J. Wiernicki
Chairman

T. Peter Pappas

Ryan P. Moody
President and Chief Executive Officer

Dennis M. Houston

ABS GROUP OF COMPANIES, INC. CORPORATE OFFICERS

Ryan P. Moody
President and Chief Executive Officer

James M. Clutterbuck
Treasurer

Robert C. Truhlar
Vice President, Finance

Erik D. Garza
Vice President
General Counsel and Secretary



SAFETY LEADERSHIP
IN A DECADE OF CHANGE

ABS
WAVESIGHT™



In 2022, ABS built on its leadership in the digitalization of the maritime industries with the creation of ABS Wavesight™, a new maritime software as a service (SaaS) company and the new brand for ABS Digital Solutions, LLC. Launched in November, ABS Wavesight is dedicated to helping shipowners and operators streamline compliance while maintaining competitive, more efficient, and sustainable operations.

While optimization of a vessel, fleet and operations has long been a means to deliver competitive advantage, 2022 saw digital technologies become increasingly central to delivery of decarbonization strategies. ABS Wavesight recognizes the challenges faced by shipowners and operators trying to juggle competitive operations with regulatory compliance and sustainability initiatives. The company unites the expansive offerings of ABS Nautical Systems® and the innovative performance and compliance tools of ABS My Digital Fleet™ into a single business, offering clients streamlined compliance while maintaining efficient, competitive and sustainable operations.

“Our vision for ABS Wavesight is to provide our clients with unmatched value through a suite of products that offer integrated solutions versus fragmented vendor offerings, open APIs versus closed systems that don’t share data, and a flexible architecture for easy system integration and maintenance versus costly upgrades every few years.”

PAUL SELLS
PRESIDENT AND CEO
ABS WAVESIGHT

KEY BENEFITS OF ABS WAVESIGHT

- A clear vision for maritime digital software with a broad, integrated product suite
- Company reliability and stability backed by 160 years of ABS experience
- Risk-based business intelligence with the ability to support predictive decision-making using artificial intelligence
- CII impact calculation and prediction to avoid risk and improve the score
- Deep insight into fuel spend while improving the efficacy of vessel routes
- Seamless integration of industry-trusted, third-party data into one single platform

In 2022, ABS Wavesight made significant enhancements across both ABS My Digital Fleet and ABS Nautical Systems focusing on voyage optimization, pioneering new ways to reduce fuel consumption and emissions through digital technologies and shaping the future of compliance.

ABS Wavesight is essential in helping clients navigate regulatory changes, including the Carbon Intensity Indicator (CII) regulation that went into effect on January 1, 2023. With an eye on that future, ABS Wavesight unveiled a game-changing CII monitoring and reporting tool. An integral feature within the ABS My Digital Fleet Environmental Monitor, the tool caters to vessel operators' need to adopt a continuous monitoring approach, allowing them to manage their fleet's carbon footprint proactively.

Enhancements made to the company's suite of products throughout 2022 laid an essential foundation as industry leaders quickly recognized ABS Wavesight's advanced capabilities going into 2023. This led to new client agreements with U.S. Military Sealift Command (MSC) and Chevron Shipping Company (CSC) and the expansion of an alliance program, widening access to new technology services for users of ABS My Digital Fleet and ABS Nautical Systems.

MSC initiated an agreement signed in early June to replace its existing human resources (HR) and payroll management systems with ABS Nautical Systems. The decision to switch to ABS Nautical Systems represented a substantial shift for MSC, which had used separate systems to handle its HR and payroll requirements since 2005. The new system will integrate multiple departments under the same platform, offering MSC civil service mariners (CIVMAR) easier, self-service access to critical HR and payroll-specific information, such as health and safety schedules, payroll information, travel support and more.



ABOUT ABS MY DIGITAL FLEET™

Since its release in 2020, ABS My Digital Fleet™ delivers real-time data-driven insights to help clients improve fleet efficiency, reduce costs and manage risks.

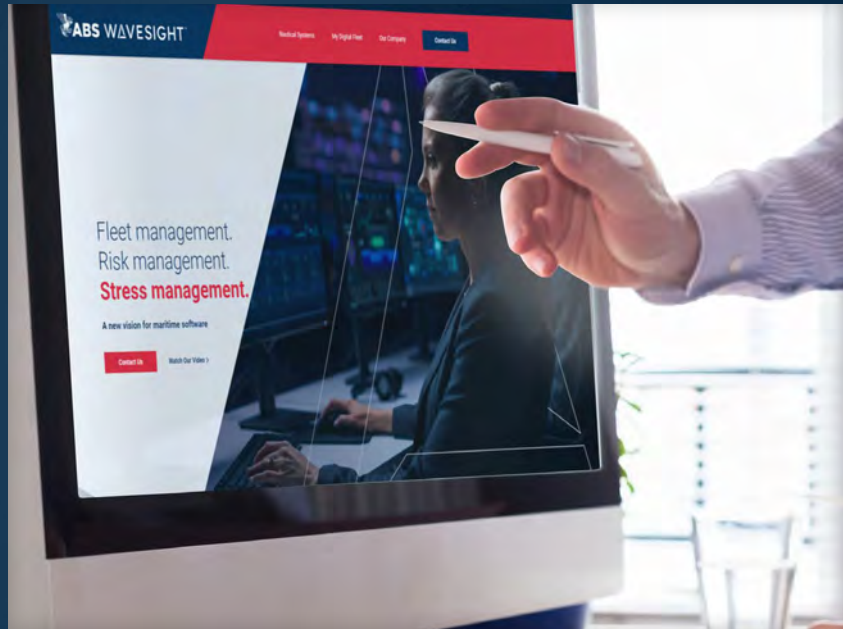
ABOUT ABS NAUTICAL SYSTEMS®

ABS Nautical Systems® is an industry-leading technical management platform with an installation base of more than 5,000 vessels, supporting day-to-day vessel and fleet operations through data management, automated work processes, analytics and reporting.



ABS DIGITAL SOLUTIONS, LLC REBRANDS AS ABS WAVESIGHT™

ABS Wavesight, a new software as a service (SaaS) company for the maritime industry, celebrated its unveiling as the new brand of ABS Digital Solutions, LLC at the International Workboat Show in New Orleans. Joined by John McDonald, ABS Executive Vice President and COO, Paul Sells, ABS Wavesight President and CEO, introduced the new company to an in-person and live-stream audience of maritime professionals, media and clients.



ABS Wavesight was later selected to provide greenhouse gas (GHG) and Sea Cargo Charter reporting services to CSC. ABS My Digital Fleet will be used to improve CSC's emissions reporting practices as it pursues lower carbon operations. CSC plans to use ABS Wavesight to streamline and consolidate existing GHG data collection practices and systems by creating a single repository to use in meeting the International Maritime Organization (IMO), European Union (EU), Sea Cargo Charter and other reporting requirements. ABS My Digital Fleet's ability to provide robust data collection, validation and verification will also allow CSC to make more informed, data-based, technical, operational and commercial decisions.

In August, ABS Wavesight hosted the 22nd Annual Nautical Systems User Conference (NSUC) in New Orleans. Attended by various leading operators in the maritime industry, the three-day event also included product experts from ABS Nautical Systems and ABS My Digital Fleet discussing the industry's challenges and product roadmaps. The event also featured cyber, risk and sustainability thought leaders and industry partners from ABS and its affiliated companies presenting strategies that respond to maritime transformation. Following NSUC, ABS Wavesight showcased its pioneering technology at the global trade fair for Shipbuilding, Machinery and Marine Technology (SMM) in Hamburg with presentations on ABS My Digital Fleet's decarbonization toolkit, including the new CII monitoring and reporting tool.

CHEVRON SHIPPING SELECTS ABS WAVESIGHT™ TO SUPPORT GHG AND SEA CARGO CHARTER REPORTING

Thanks to groundwork laid throughout 2022, ABS Wavesight and ABS My Digital Fleet were chosen by CSC to help improve the company's emissions reporting practices as it seeks to reduce its carbon footprint.

"The maritime industry is at a critical stage where access to real-time insights that can drive sustainable operations and reduce operational risks is essential," said Paul Sells, President and CEO of ABS Wavesight. "Chevron's decision to partner with ABS Wavesight speaks volumes about the company's commitment to meeting global decarbonization goals and setting a standard for operational excellence. We look forward to working closely with Chevron to make an impact and set the tone for shipping's next era."

ABS My Digital Fleet seamlessly integrates data to provide real-time insights that facilitate risk management and drive sustainable operations within the maritime and offshore sectors. Key benefits of ABS My Digital Fleet include optimizing voyage performance, capitalizing fuel-saving opportunities, improving asset risk management, and benchmarking capabilities. ABS My Digital Fleet leverages connected devices to make real-time data available on a unified platform, further improving communication and efficiency across organizations.

ABS WAVESIGHT™ BOARD OF MANAGERS

Christopher J. Wiernicki
Chairman

Paul Sells
President and Chief Executive Officer

Laura Fulton
Chief Financial Officer



2022

ANNUAL REVIEW

WORLD HEADQUARTERS
1701 City Plaza Drive
Spring, TX 77389 USA
P 1-281-877-6000
ABS-WorldHQ@eagle.org
www.eagle.org

© 2023 American Bureau of Shipping.
All rights reserved.