Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

PRESS RELEASE

Industry leaders collaborate to develop guidance on the safe use of Ammonia as a shipping fuel.

Lloyd's Register Decarbonization Hub and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping have joined forces with A. P. Moller-Maersk, MAN Energy Solutions, Mitsubishi Heavy Industries, NYK Line and Total in a new project to develop guidance around the safe use of Ammonia as a fuel to support the shipping industry's drive towards a decarbonized future.

Copenhagen, April 19th 2021

This week, Lloyd's Register's Decarbonization Hub, A.P. Moller-Maersk, MAN Energy Solutions, Mitsubishi Heavy Industries, NYK Line, Total and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping are joining forces in a new project with the purpose of guiding safe use of ammonia as a fuel for shipping.

Ammonia as a fuel is heavily debated as a suitable long term solution for maritime, as the industry transitions towards a zero- or low carbon value chain. Green ammonia can be produced from renewable power by electrolysis of H2O, ultimately making it a zero carbon fuel. However, due to the extreme toxicity of the fuel, it is critical to address the safety issues of Ammonia in order to mitigate risks for both people, assets and the environment.

To accelerate the safe introduction of Ammonia in maritime, it is critical to create clarity, assess the safety challenges and need for global standards. Part of this will include developing a mature and detailed understanding of risk and safety concerns, which will be assessed through a Quantitative Risk Assessment methodology in phase one of the project. This will ultimately lead to the development of best practices for safeguards in design and arrangements when using Ammonia as a shipping fuel.

The project will also determine the risk of fatality from unintended releases of Ammonia, as well as the risk contribution of key equipment and spaces dedicated to Ammonia storage. To illustrate the potential for risk mitigation measures, the project partners will assess alternate vessel designs, optimized to be fueled by Ammonia.

Funded by the participating partners, the project will be managed by the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping and is expected to run throughout 2021.

Commenting on the new project, Lloyd's Register Decarbonisation Programme Manager, Charles Haskell said*: "Shipping needs collaboration if the industry is to successfully meet the IMO 2050 targets, and this collaboration between the Lloyd's Register Maritime Decarbonisation Hub and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping is a significant milestone in this journey. We look forward to working with the project partners, who each represent different areas of the supply chain, in developing guidance, risk mitigation measures and best practice on using Ammonia so that we can support the safe uptake of the fuel."*

"In the eagerness to decarbonize the shipping sector proper risk management is critical and safety must not become an afterthought. This project will provide matured understanding of safety risk enabling industry guidance towards future safeguard design and adequate operational guidelines. Enabling safe and adequate

deployment of ammonia as marine fuel" - Says Claus Winter Graugaard, Head of Onboard Vessel Solutions, the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping.

"Safe operations of ammonia as a fuel is the most important prerequisite to successfully design and deploy ammonia powered vessels. At Maersk we see green ammonia as one of the fuels of the future. It emits no CO2 during combustion and offers a very promising scalability potential. Besides the technical challenges, ammonia's safety challenge is a main outstanding hurdle to solve for Ammonia to become a viable ship fuel, so we are very pleased to team up with leading players across the ecosystem in solving ammonia's safety challenge" - Says Ole Graa Jakobsen, Head of Fleet Technology, A. P. Moller - Maersk

Brian Østergaard Sørensen, Vice President and Head of R&D Two-Stroke Business at MAN Energy Solutions, said: *"We encourage industry-wide partnerships for decarbonizing the marine market and actively seek to collaborate with industry partners in furthering this goal. This is an important project as ammonia has a lot of potential as a clean, zero-carbon fuel but clearly requires a full appraisal of its characteristics on its path to becoming a widespread, commercial fuel. We look forward to adding our expertise to the discussion."*

"Energy transition is an unavoidable issue today. Safety concept will become the most important aspect for the design of commercial vessels and systems on board in consideration of alternative fuels to be used such as ammonia. Through the accumulative experience in Ammonia carriers and Ammonia production plants in MHI Group and by combining the knowledge and efforts with the great project partners, we are quite delighted to provide what we call 'Smell free concept' Says Tomoo Kuzu, Senior Executive Vice President, Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd

"Safety assessment is of paramount importance in integrating Ammonia as sustainable marine fuel into the design of commercial vessels. Going together with the leading partners through this project, the depth of knowledge on the safe use of Ammonia shall be accumulated and it should support to find a pathway toward zero carbon shipping" – Says Yasushi Yamamoto, General Manager of Technical Group, NYK LINE.

Shipping's road map to decarbonization

Global shipping accounts for around 3% of global carbon emissions, a share that is likely to increase as other industries tackle climate emissions in the coming decades.

Achieving the long-term target of decarbonization requires new fuel types and a systemic change within the industry. Shipping is a globally regulated industry, which provides an opportunity to secure broad-based industry adoption of new technology and fuels.

To accelerate the development of viable technologies a coordinated effort within applied research is needed across the entire supply chain. Industry leaders play a critical role in ensuring that laboratory research is successfully matured to scalable solutions matching the needs of industry. At the same time, new legislation will be required to enable the transition towards decarbonization.

About the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping

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for Zero Carbon Shipping

The Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping is a not-for-profit, independent research and development center, it works across the shipping sector with industry, academia and authorities. A highly specialized, cross-disciplinary team will collaborate globally to create overview of viable decarbonization pathways, facilitate the development and implementation of new technologies; build confidence in new concepts and their supply chains; and accelerate the transition by defining and maturing viable strategic pathways to the required systemic change.

For more information go to www.zerocarbonshipping.com

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About Lloyd's Register

Lloyd's Register Group and Foundation

Lloyd's Register (LR) and the Lloyd's Register Foundation (LRF) have a shared mission to engineer a safer, more sustainable world. LR is the world's first marine classification society, created more than 260 years ago to improve the safety of ships and has a long-standing reputation for keeping assets and businesses safe, sustainable and secure through technical excellence. The surplus LR generates funds its shareholder, LRF, an independent global charity which aims to reduce risk and enhance the safety of critical infrastructure that modern society relies upon. LRF does this by supporting research, innovation, education and skills to make the world a safer place. LRF and LR are proud to stand alongside other world and industry leaders to aim for a cleaner, more sustainable world, using its long-standing foundations in technology, innovation and corporate values.

Lloyd's Register Maritime Decarbonisation Hub

The Maritime Decarbonisation Hub, a joint initiative between Lloyd's Register Group and Foundation, brings together thought leaders and subject matter experts with the skills, knowledge and capability to help the maritime industry design, develop and commercialise the pathways to future fuels required for decarbonisation. A steering group of external stakeholders is in place to ensure the hub focuses on the challenges that matter to industry.

Through collaboration, producing and sharing evidence-based research, the Maritime Decarbonisation Hub helps steer charterers, owners and operators, financiers, ports, yards, fuel suppliers and regulators among others through the technically complex decision-making and investment uncertainty through this transition towards industry transformation.

About A.P. Moller - Maersk

A.P. Moller - Maersk is an integrated container logistics company working to connect and simplify its customers' supply chains. As the global leader in shipping services, the company operates in 130 countries and employs around 80,000 people.

About MAN Energy Solutions

MAN Energy Solutions enables its customers to achieve sustainable value creation in the transition towards a carbon neutral future. Addressing tomorrow's challenges within the marine, energy and industrial sectors, we improve efficiency and performance at a systemic level. Leading the way in advanced engineering for more

than 250 years, we provide a unique portfolio of technologies. Headquartered in Germany, MAN Energy Solutions employs some 14,000 people at over 120 sites globally. Our after-sales brand, MAN PrimeServ, offers a vast network of service centres to our customers all over the world.

About Mitsubishi Heavy Industries

Mitsubishi Heavy Industries (MHI) Group is one of the world's leading industrial groups, spanning energy, logistics & infrastructure, industrial machinery, aerospace and defense. MHI Group combines cutting-edge technology with deep experience to deliver innovative, integrated solutions that help to realize a carbon neutral world, improve the quality of life and ensure a safer world. For more information, please visit www.mhi.com or follow our insights and stories on www.spectra.mhi.com.

About NYK Line

Nippon Yusen Kabushiki Kaisha (NYK) was founded in 1885 and is one of the world's leading transportation companies. At the end of March 2020, the NYK Group was operating 784 major ocean vessels, as well as fleets of planes and trucks. The NYK Group is based in Tokyo, employs about 35,000 people worldwide, and has regional headquarters in London, New York / New Jersey, Singapore, and Shanghai. On February 3 2021, NYK announced the NYK Group ESG Story, which aims to further integrate ESG into the company's management strategy. In order to continue to be a corporate group that remains essential to society and industry, the NYK Group aims to be a sustainable solution provider that creates new value while maximizing profits and achieving social and environmental sustainability from a long-term perspective.

For more information go to www.nyk.com

About Total

Total is a broad energy company that produces and markets fuels, natural gas and electricity. Our 100,000 employees are committed to better energy that is more affordable, more reliable, cleaner and accessible to as many people as possible. Active in more than 130 countries, our ambition is to become the responsible energy major.