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PROJECT

MEET NEWS

Mitsubishi Marine Energy & Environment Technical Solution-System

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Special Feature The Path to Decarbonization of the Maritime Industry

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on Production and Sale of MET Turbochargers**

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Achieved 100 units of Retrofit Propeller Order

Installation of an EPL System on a Steam Turbine for EEXI Compliance



Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd.

MOVE THE WORLD FORWARD  **MITSUBISHI
HEAVY
INDUSTRIES
GROUP**

Special Feature

The Path to Decarbonization of the Maritime Industry - Season 4 -

Participation in COP26

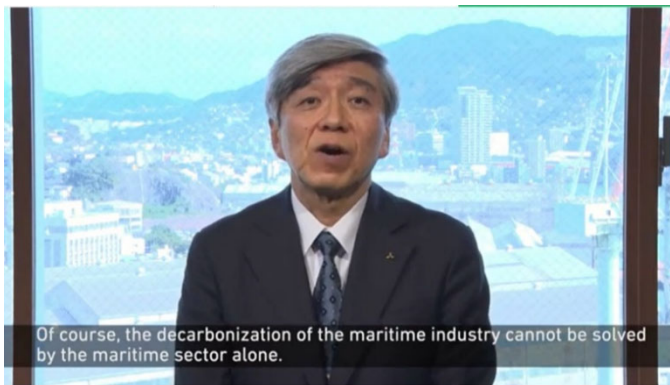
Mitsubishi Heavy Industries participated in the 26th UN Climate Change Conference of the Parties (COP26) held in November 2021 in Glasgow, Scotland, UK, and introduced MHI's initiatives to fight climate change, which is a global challenge.

At COP26, MHI exhibited at the COP26 Japan Pavilion hosted by the Ministry of the Environment. Specifically, MHI introduced as Japan's state-of-the-art environmental technologies, "hydrogen gas turbine technology for the decarbonization of thermal power generation" and "MHI initiatives for building a CO₂ ecosystem and CO₂ capture technology."

The MHI Group has made the "Mission Net Zero" declaration toward the achievement of carbon neutrality in 2040, appealing the Group's commitment to continue engaging in efforts to transition to the utilization of green energy toward the achievement of a carbon neutral society of the future by mobilizing the technologies and resources that the Group has developed to date.



Prime Minister Fumio Kishida at MHI booth in COP26



Video message by MHI-MME President & CEO
Toshiaki Hori at COP26



Video message by MHI-MSB President & CEO
Toru Kitamura at COP26

MHI Group's efforts toward the decarbonization of the maritime industry were shown through video messages entitled "Call to Action" from MHI-MME President Hori and Mitsubishi Shipbuilding (MHI-MSB) President Kitamura at the Sustainable Innovation Forum venue, which was set up adjacent to the COP26 main venue.

<https://www.youtube.com/watch?v=WpGMGcQrXIE>

The video messages described MHI's long-term vision and strategy for the achievement of carbon neutrality by the maritime industry. Also, as there can be no delays in the reduction of CO₂ emissions, measures which can be provided immediately as short-term measures were introduced.

As environmental consciousness increases globally, the application of LNG fueled vessels, with their smaller environmental footprint, is also being promoted around the world. While the use of LNG as marine fuel helps to reduce CO₂ emissions, an issue has been that some of the unburned methane in the fuel is expelled into the air (i.e., methane slip). Methane is a GHG that has a bigger impact on global warming than CO₂. However, with an eye to reducing GHG emissions, measures to reduce the methane slip have been progressing, and then after the transition to carbon neutral fuel is now becoming more realistic and feasible scenario from a long-term perspective.

Appealed was the MHI Group's commitment to making a global contribution, not only on land but also in the maritime industry.

Furthermore, there were many events related to the decarbonization of the maritime industry held at COP26. On November 8, a panel discussion was held under the theme of : Decarbonization in Shipping in line with the Paris Agreement, what will it take? Representatives from the maritime industry as well as companies involved in decarbonization technologies participated in the discussion.

Discussed were items such as, in moving toward achievement of the 2050 goal, how far would we be able to progress by 2030 in technology adoption and the preparation of an infrastructure, including the manufacture and storage of alternative fuel; what is the role of the regulations?, and furthermore, what should the thinking be regarding the incentives, etc., for first movers who will be making a challenge for the aforementioned?

The MHI Group was represented by Kentaro Hosomi, Chief Regional Officer, Europe, Middle East and Africa, and CEO of MHI-EMEA, who introduced, from industrial cross-sectoral and global perspectives, the importance of the technologies and systems that can be introduced at this point in time.



Commemorative photo after the panel discussion with representatives of Maersk Mc-Kinney Moller Center for Zero Carbon Shipping, A.P.Moller, MAN ES, Yara, etc. (MHI-EMEA's CEO Mr. Hosomi at far left)

Personnel Dispatched to the MMM Center Zero Carbon Shipping



Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping

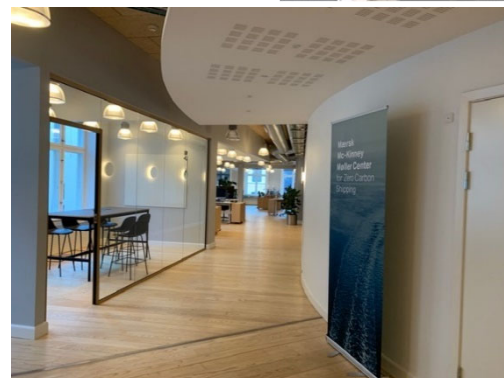
Since 2020, the MHI Group has been participating in The Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping (MMM Center) as a founding partner. Headquartered in Copenhagen Denmark, the MMM Center is a survey and research organization for the promotion of decarbonization of the maritime industry. In addition to MHI, 19 strategic partners and 8 knowledge partners collaborate, with a focus on the development of alternative fuels and their supply chains as well as new technologies for systems to be installed on ships, with the goal of achieving the decarbonization of the maritime industry by 2050. The MMM Center started with 15 individuals working as members at the time of establishment in 2020. It has now become an organization with more than 60 individuals working as members, and it is expected to become a large organization with over 100 individuals working as members by the beginning of next year.

MHI-MME had been scheduled to dispatch personnel to the MMM Center last spring but had been forced to participate in meetings remotely for a while due to the spread of the COVID-19 pandemic. However, with some decrease in infections, chief engineer Koichi Matsushita assumed his post at the MMM Center in November last year, (Deputy Manager Sato of MHI-MSB also assumed his post there in February this year.) In this issue we will take a look at what it is like there as well as MHI's activities.

Greetings from Koichi Matsushita, General Manager, on Assuming His Post

I arrived at my assignment at the MMM Center (Copenhagen, Denmark) in November last year. I had been working in London from 2018 as the Head Office General Manager of Mitsubishi Heavy Industries Europe, Ltd., and this assignment in Denmark is my second consecutive overseas posting following the U.K. This past winter, the number of new COVID-19 infections surged in Denmark as well, with the highest incidence rate in Europe per population. COVID-19-related restrictions were eased in February this year, and ordinary economic activities have returned. The MMM Center is now starting to engage energetically in activities. Engineers from companies in various countries, who are involved in the development of technology related to marine fuel, including its manufacture and transport, as well technologies installed on ships, are gathered at the MMM Center.

Here, engineers bring knowledge from their respective area of specialization to the table to address various issues related to decarbonization. The sight of us - who would ordinarily be divided into different positions, whether as client and supplier or as competitors - engaged in discussions as partners feels very strange. However, it shows that decarbonization is a major challenge that cannot be achieved without bringing together the technologies of various areas and industry as a whole. It is not just technology that is being addressed here. European authorities are being approached, with decarbonization classification societies involved, for creating mechanisms. People with various experiences in PR have also come to the Center. I will work hard at this time on the decarbonization project at this new location as well as create new decarbonization business for our company.



Inside the MMM Center

Concludes Licensing Agreement with Mitsui E&S Machinery on Production and Sale of MET Turbochargers



Presentation of commemorative gifts
(Mr. Hori, President of MHI-MME, Mr. Tanaka, President of Mitsui E&S Machinery)

MHI-MME has concluded a licensing agreement giving Mitsui E&S Machinery (Mitsui E&S Machinery Co., Ltd.) rights to manufacture and sell its MET turbochargers. The MET lineup are exhaust gas type turbochargers engineered for use with diesel engines.

The newly concluded licensing agreement allows Mitsui E&S Machinery to manufacture in-house all models in the MET-MB and MET-MBII series of turbochargers used in two-stroke engines. Production will get underway with three models: MET-66MBII, MET-42MBII and MET-42MB. Plans call for the first unit to be completed early in 2023, with production to be expanded to other models when deemed appropriate.

Mitsui E&S Machinery has been manufacturing a single brand of large marine diesel engines ever since concluding a technical tie-up with B&W of Denmark (now MAN Energy Solutions SE) in 1926. In 2021 the company reached cumulative production of 110 million horsepower, with more than 7,000 units manufactured to date. These statistics make Mitsui E&S Machinery Japan's foremost engine manufacturer and a world leader in the industry.

MHI-MME began marketing water-cooled turbochargers in the 1950s, and in 1965 the company developed the world's first non-water-cooled turbocharger, precursor of the MET series. Since then, the lineup has been expanded to include numerous high-efficiency large-capacity models. Today, MHI-MME has a track record in MET turbochargers of more than 39,000 units in total, and the company accounts for a near 40% share of the global market for turbochargers for two-stroke marine engines(Note).

After concluding the new licensing agreement, going forward MHI-MME aims to strengthen its ties with Mitsui E&S Machinery in a quest to further develop business in marine engines and turbochargers for the needs of tomorrow taking into account of global warming issues.

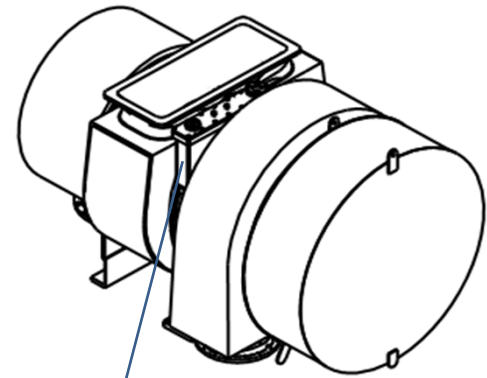
According to an in-house survey



MET turbocharger installed in an engine manufactured by Mitsui E&S Machinery

Recommendation for Ensuring Safer Operations: Cleaning and Inspecting the Bearing Pedestal Head Tank

MET Turbochargers have bearing pedestals containing a head tank to ensure that the supply of lubricating oil to the bearing is not interrupted even when the lubricating oil pump has stopped in an emergency. Using the turbocharger with sludge adhered to the bearing pedestal head tank can damage the bearings and create a malfunction risk. For this reason, we recommend that when inspecting the turbocharger, you also inspect and clean the inside of this tank in addition to inspecting bearings and other parts. This will help lead to even safer operations. If you have any questions related to cleaning and inspection or require specific pointers, please feel free to contact us (met-service@mhi.com) or the authorized repair agent closest to your location.



Bearing Pedestal Head Tank



Recommendation

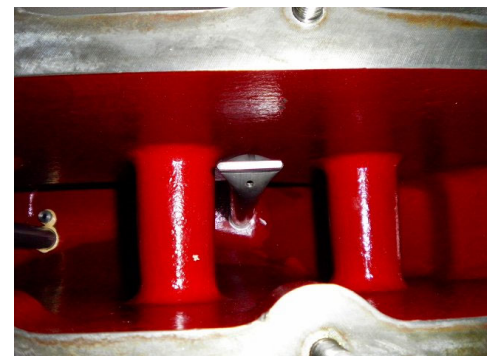
Inspection and cleaning of the bearing pedestal head tank during turbocharger inspection

Before cleaning



Accumulated sludge at the bottom of the tank

After cleaning



MET TURBOCHARGER FIRST SERVICE

MET-MBII Turbochargers in Operation on Ship

MHI-MME began delivery of MET-MBII Series turbochargers in 2020 and its first unit starts operation on ship.

All MBII Series has obtained approval of MAN ES (MAN Energy Solutions) and WinGD (Winterthur Gas & Diesel Ltd.).

It has already got favorable reputation in market by its technical advantage especially in compact design as well as ease of maintenance and lifecycle cost management.

Adding the MET-MBII to the MET-MB Series had been already existed in our product portfolio as axial flow turbocharger, we can strengthen turbocharger line up to provide most optimized unit for engines.

We will continue to provide turbochargers to meet market needs and obtain customer satisfaction.



MET53MBII

Development of a New Cable Drum Engine Model

MHI-MME completed the basic design of a self-fleeting (*1) cable drum engine toward its commercialization.

Since 1967, MHI has been delivering knife lining fleet-type cable drum engines (*2) for use on cable layers for the installation of submarine cables. However, in recent years, the diameters of the submarine cables have been reduced, and there is even greater emphasis now being placed on overall safety in relation to cable installation and maintenance operations. Development was launched to meet the increased demand for self-fleeting cable drum engines that are more suitable for reeling in and feeding out reduced diameter cables. The basic design was recently completed following the consideration of motion analyses using 3D models and verification utilizing a simulation test apparatus. This past December, a tour of the simulation test apparatus was also held for our clients who have adopted the use of MHI-MME cable drum engines. Going forward, we will proceed with the commercialization of self-fleeting cable drum engines toward full-scale sale from 2023.



Simulation test apparatus for the new cable drum engine

(Note *1)

A method in which the function of fleeting the cable (ensuring that the cable being reeled onto the drum surface does not overlap) is contained within the drum main unit. The self-fleeting mechanism is set up on the drum surface.

(Note *2)

A method in which an external device (fleeting knife lining) is pressed up against the drum to prevent overlap while reeling the cable onto the drum surface.

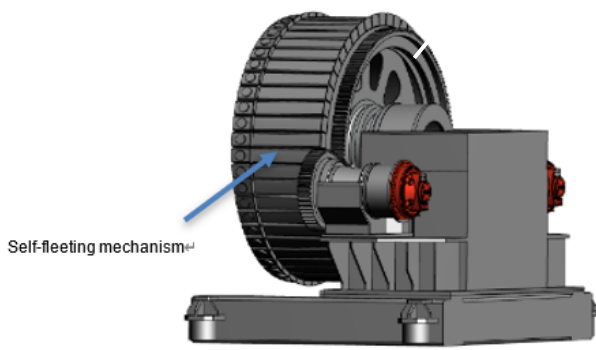


Illustration of a self-fleeting cable drum engine

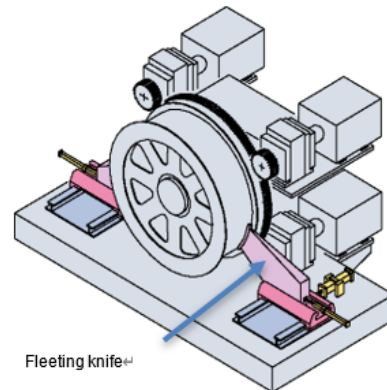


Illustration of a knife lining type cable engine

BOILER RECOMMENDATION

Promotion of Pre-inspection Activities for Auxiliary Boilers

MHI-MME is sequentially distributing a pre-inspection check sheet for the MAC-B Series to clients owning the roughly 900-plus vessels installed with the marine auxiliary boiler. By filling out the check sheet and submitting it to MHI-MME, a diagnosis of the state of the auxiliary boiler will be sent back together with information on the appropriate maintenance part(s) to be used, along with a servicing proposal.

What is more, MHI-MME is distributing a list of maintenance parts and an after-sales services menu and is recommending preventive maintenance.

Through such activities, MHI-MME will be proactively promoting the provision of services for the secure, long-term operation of its auxiliary boilers.

We recommend that clients with MAC-B Series auxiliary boilers installed on their vessels actively utilize the pre-inspection check sheet so that they can understand the state of their boilers and receive the proposal of services that will enable the even more secure use of the auxiliary boilers.



Auxiliary Boilers

Achieved 100 units of Retrofit Propeller Order - Contribute to GHG Reduction by Improving Fuel Efficiency

MHI-MME has achieved order 100 units of the retrofit propeller, which began delivery since 2013.

MHI-MME began producing propellers for the first time in Japan on 1904, and has a long history of more than 100 years. MHI-MME has continued producing and developing high performance propellers on the basis of a proven track record, which now the production record is over 6,000 units.

The retrofit propeller is designed for slow steaming conditions by the limitation of engine load and MHI-MME shows the large effects for the improvement of fuel efficiency with applying the suitable design for slow steaming. The retrofit propeller efficiency improvement in a certain vessel reached about 8%, up to the limitation of engine load. Moreover, MHI-MME applies the design for the retrofit propeller to Mitsubishi Advanced Propellers (MAP) Mark-W, which propeller was launched in 2010 and can improve the propeller efficiency without sacrificing cavitation margin.

Many customers in Japan and overseas expect the benefits of retrofitting and have adopted our propellers for large containerships, LNG carriers and tankers, which are often applied in slow steaming.

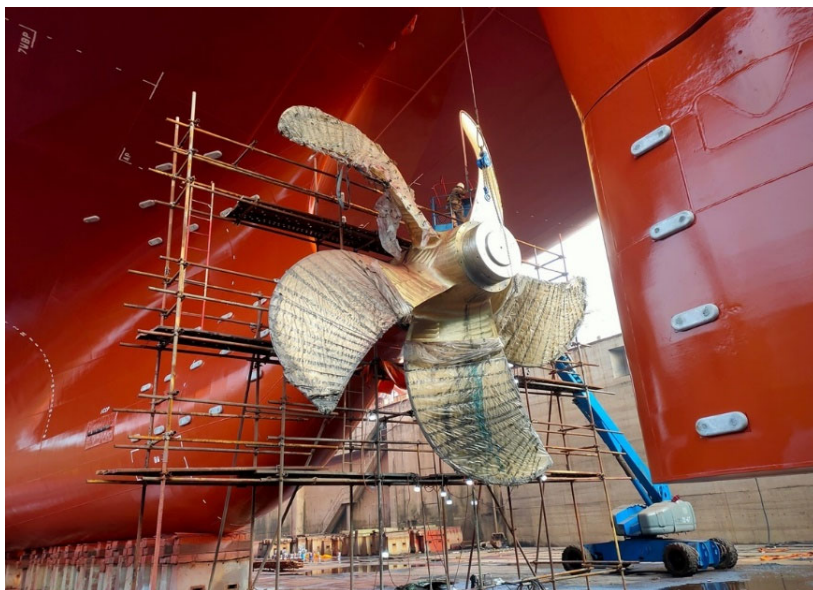
And orders for retrofit propellers have been increasing due to the need to comply with EEXI (Note1) regulations. Additionally, MHI-MME carries out the evaluation of the propeller efficiency improvement after propeller retrofitting and confirmed.

Furthermore, when retrofitting a propeller, MHI-MME also proposes to buy the propeller currently installed on the customer's vessel, thereby offering an opportunity for customers to reduce their initial investment.

MHI-MME will continue to propose the retrofit propeller for the needs of slow steaming.

Note1: EEXI = Energy Efficiency Existing Ship Index

IMO has adopted mandatory regulation at 76th session of MEPC held in June 2021 to achieve 2030 CO₂ reduction targets for existing ships.



Installation of an EPL System on a Steam Turbine for EEXI Compliance

MHI-MME offers a service menu for the installation of an Engine Power Limitation (EPL) system on main turbines, which many owners are planning to install on existing ships as a solution to meet EEXI Regulations (Note 1).

After January 1, 2023, ships currently in operation need to be EEXI compliant by its first annual, intermediate, or renewal survey of its IAPP Certificate, whichever comes first. This is resulting in an increase of inquiries on EPL systems. In the meantime, current shortage of semiconductors and resins has been causing prolonged delivery lead time of necessary parts for the installation.

In these circumstances, MHI-MME had started proposing EPL system to owners of approximately 90 ships that are powered by MHI main turbines in order to fulfill EEXI compliance of those ships by the deadline.

MHI-MME will continue to contribute to the reduction of carbon emissions by the maritime industry by further upgrading and expanding its menu for enabling compliance with the new regulations.

Note 1: EEXI (Energy Efficiency Existing Ship Index)

An index applied to existing ships. It is a reduction target of CO₂ emissions (grams) per ton of cargo per nautical mile. It is a regulation related to the energy efficiency of existing ships.

