PROJECT MEET NEWS

Mitsubishi Marine Energy & Environment Technical Solution-System

27
Apr.2025 Vol.27

The Path to Decarbonization of the Maritime Industries – Season 9 –

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MITSUBISHI HEAVY INDUSTRIES

MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

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

Special Feature

The Path to Decarbonization of the Maritime Industries

- Season 9 -

Efforts Toward Decarbonization

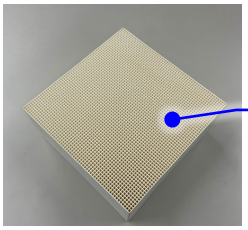
New Product Development Initiatives

The IMO (International Maritime Organization) has set the goal of achieving net zero GHG (greenhouse gas) emissions by around 2050, and its target for 2030 is to reduce GHG emissions by 20% (compared to 2008 levels).
The IMO Mid-Term Measures, which are GHG-related regulations, are scheduled to be approved at MEPC83 (the 83rd session of the Marine Environment Protection Committee) to be held in April 2025, and shall come into effect in 2027.

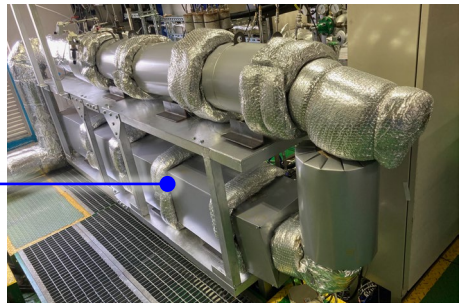
Prior to the IMO Mid-Term Measures, the EU introduced the EU-ETS (European Union Emissions Trading System) for shipping in 2024, and the Fuel EU Maritime (a regulation to set the upper limit of GHG intensity for fuels used on ships) in 2025.
The regulation sets an upper limit for the GHG intensity of fuels used on board ships and covers not only CO_2, but also slip methane (unburned methane) and N_2O (nitrous oxide) emitted from engines.
We, Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd. (MHI-MME), have supplied turbochargers for LNG, ammonia, and methanol-fueled engines. Also, we have been developing waste heat ORC (*1) to reduce fuel consumption of ships.
In addition, we are developing LNG fired engine aftertreatment equipment, ammonia fueled engine aftertreatment equipment, and fuel reforming equipment for institutions that can convert to alternative fuels such as LNG and ammonia.
The LNG-fueled engine aftertreatment system (*2) oxidizes slip methane (GWP (*3): 28) emitted from LNG-fueled engines. We are developing this system with the goal of reducing slip methane emissions by installing an oxidation catalyst.
We are also developing an ammonia-fueled engine aftertreatment system that can simultaneously treat unburned ammonia, N_2O (GWP: 265) and NOx emitted from ammonia-fueled engines.
At the same time, we are conducting basic research on the fuel reformer, a pretreatment unit, for LNG fuel reforming and ammonia cracking.
In LNG fuel reforming, part of the fuel is converted to hydrogen, with the goal of reducing methane in the fuel and reducing slip methane by improving combustion.
We will continue development so that we can make timely proposals in response to regulatory trends.

(*1) ORC: Organic Rankine Cycle ⇒ Power generation system using organic medium of low boiling point
(*2) Joint research product of Mitsubishi Shipbuilding Co., Ltd. and Daihatsu Diesel Co., Ltd.
(*3) GWP: Global Warming Potential ⇒ Global warming potential based on CO_2

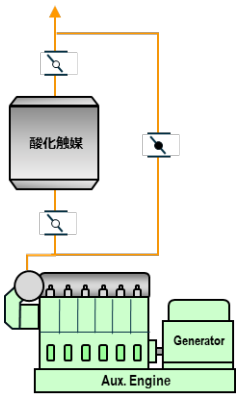
LNG/Ammonia-fueled Engine Aftertreatment Device (*3)



catalyst element sample



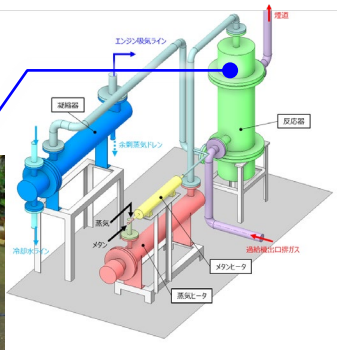
In-House bench test equipment



(*3) Different catalysts are used for LNG and ammonia fuels.

Fuel Reformer Equipment

LNG reforming reactor



LNG reforming demonstration test facility

Participation in Global Conferences

Participation in the GMF(※) Annual Summit

From October 15 to17, 2024, the GMF Annual Summit was held in Tokyo, following the one held in Athens in 2023. Approximately 200 representatives from partner companies and organizations participated in the summit, including the MHI group.

The International Maritime Organization (IMO) also attended the summit, and many leaders from finance, insurance, and the maritime industry (ship companies, classification societies, ports, seafarers' organizations, non-profit organizations, etc.) gathered. They were divided into multiple working groups to promote decarbonization and digitalization, and to promote DEI (Diversity, Equity and Inclusion) across the maritime industry, and deepened discussions on various issues.

The content reaffirmed the importance of the IMO Mid-Term Measures to be approved by the MEPC83 (83rd session of the Marine Environment Protection Committee) in April 2025, such as transparent and equitable use of funds generated by the charging system, the early establishment of new regulations and standards, the role of AI and the upgrading of the working environment for seafarers.

The next summit will be held in Antwerp in 2025.

（※）GMF (Global Maritime Forum): International non-profit organization headquartered in Copenhagen.

Annual Summit (GMF HP)

MHI-MME Licenses Manufacturing and Sale of MET Turbochargers to Leading Chinese Marine Machinery Manufacturer

◆ Jiangsu Masada Heavy Industries granted license for manufacture and sale of MET Turbochargers
◆ Aiming to use licensing to further penetrate the Chinese market with high-quality products and services

Tokyo, October 24, 2024 - Mitsubishi Heavy Industries Marine Machinery and Equipment Co., Ltd (MHI-MME), a part of Mitsubishi Heavy Industries (MHI) Group, has concluded a licensing agreement with Jiangsu Masada Heavy Industries Co, Ltd. (Jiangsu Masada), a privately owned marine machinery manufacturer in China, for the manufacture and sale of MET Turbochargers, its exhaust gas turbine type turbochargers for two-stroke marine engines.

With the conclusion of this agreement, Jiangsu Masada plans to start manufacturing MET Turbochargers in 2025, focusing principally on assembly, and gradually expanding to full-scale production including processes other than assembly. MHI-MME's aim with this licensing agreement is to further penetrate the Chinese market with high-quality products and services.

Jiangsu Masada has a long relationship with MHI Group, and has previously concluded licensing agreements for deck cranes in 2008, and steering gears and deck machinery in 2012. At present, Jiangsu Masada is a leading manufacturer of marine machinery, boasting the largest share in the Chinese market for deck cranes, deck machinery, and steering gears.

MHI-MME developed the world's first non-water cooled turbocharger, the forerunner of the MET series, in 1965. High-efficiency, high-capacity models have since been added to the lineup, and today MET Turbochargers are one of the global standards for exhaust gas turbine types. Total cumulative production volume of MET Turbochargers has now reached 45,000 units, accounting for more than 40%(※) of the global market (in fiscal 2023) for units used in marine two-stroke engines.

Going forward, MHI-MME will continue to maintain and develop a positive cooperative relationship with Jiangsu Masada, and further proactively develop and market MHI brand marine machinery.

(※) Source: MHI-MME

Signing Ceremony

World's First Test Operation Starts of Large-Bore Low-Speed Ammonia Dual Fuel Engine Equipped with MET Turbocharger

Mitsubishi Heavy Industries Marine Machinery and Equipment Co., Ltd. (MHI-MME) delivered a MET turbocharger for large-bore low-speed ammonia dual fuel engine (MAN ES 7S60ME-C10.5-LGIA-HPSCR) manufactured by MITSUI E&S Co., Ltd. (MITSUI E&S) in November 2023.

On February 10, 2025, MITSUI E&S started the world's first test operation of large-bore low-speed ammonia dual fuel engine at its Tamano Factory. This engine is equipped with a MET66MBII optimized for ammonia dual-fueled engines.

In the field of international shipping, the reduction of greenhouse gas (GHG) emissions is becoming an important issue, and the development of ammonia-fueled engines, which enables the reduction of CO_2 emissions to zero, is a major step towards the realization of a carbon neutral society.

MHI-MME will continue its efforts as a turbocharger manufacturer to contribute to the realization of a carbon neutral society by providing our customers with optimal, environmentally friendly solution.

Large-bore low-speed ammonia dual fuel engine with MET66MBII turbocharger

First Order for MET Turbocharger for WinGD Ammonia-Fueled Engines

Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd (MHI-MME) has received an order for MET48MBII turbocharger, which will be installed on the WinGD ammonia fueled large low-speed engine "6X52DF-A1.0" for HD Hyundai Heavy Industries.

MHI-MME has already secured orders for turbochargers for ammonia-fueled large low speed two stroke engines from the MAN ES/UE brand, and with this latest order, it has achieved orders for ammonia-fueled engines from all three of the world's major engine licensors.

This engine will be installed on a 1,400 TEU container ship being built in China, which is scheduled to be in service by 2026. In light of the tightening of emissions regulations for ships, the development of new fuel engines is accelerating. MHI-MME already has extensive experience with methanol-fueled engines and will continue to provide optimal solutions for ammonia-fueled engines, which are gaining attention as the one that do not emit carbon dioxide (CO_2).

MET Turbocharger Outstanding Certified Repairer Award

In 2024, MHI-MME awarded three certified repairers (ARA) as outstanding repairers for their outstanding performance in after-sales service for MET turbochargers.
The following are the names of these repairers. (In alphabetical order)
Through the global ARA network, MET turbochargers are equipped to provide prompt and appropriate service anywhere in the world. (As of April 1, 2025: 63 companies)
You can check the ARA website.(https://www.mhi.com/group/mhimme/services/ara.html)

CENTRAL MARINE ENGINEERING CO., LTD. (Taiwan)

Mr. Lin Shih-Hung,
Vice President

URL	https://www.central-marine.com.tw/en-us/home

We would like to express our heartfelt gratitude for receiving the MET Turbocharger Certified Repair Company Award 2023.
The valuable partnership in MET turbochargers with MHI Marine Machinery is very important to our company's business.
We are very pleased to be recognized for our efforts to become the best authorized repair company for MET turbochargers.

GULF TURBO SOLUTIONS FZC (UAE)

Mr. Rehan Karanjia,
Founding Partner

URL	https://www.gulfturbo.com

We are very honored to receive the MET Supercharger Certified Repairer Award for two consecutive years in 2023 and 2024.
In particular, our company is the only ARA to achieve this honor, which is a testament to our team's unwavering dedication, hard work and commitment to quality.
This recognition empowers us to pursue higher levels of service quality and parts sales, and we will continue to strive to get this award again this year.
We would like to express our sincere gratitude to the MHI-MME team for their continued and tremendous support.

JONGHAP MARINE Engineering Inc. (South Korea)

Mr. Soon Woo Lee,
CEO

URL	http://www.jonghap-jme.co.kr

We are very honored to receive the 2024 MET Turbocharger Certified Repairer Award.
This recognition is the result of the hard work, passion and commitment of all involved.
We will continue to strive for superior quality and provide the best service to our customers. Thank you from the bottom of our hearts for this great honor.

Shipment of the First Self-Fleeting Cable Engine

Mitsubishi Heavy Industries Marine Machinery & Equipment Co., Ltd. delivered the first self-fleeting cable engine (※1) in February 2025.

Research and development of a self-fleeting cable engine began in 2020, and the first model has now been completed after thorough preliminary verification using a 3D model and simulation equipment.

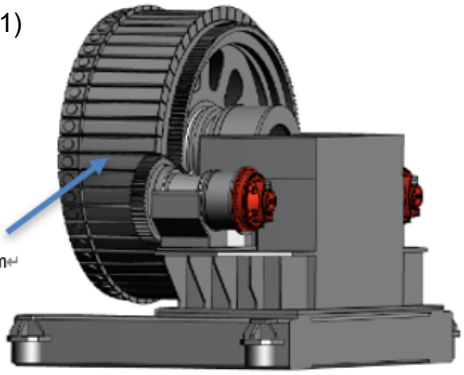
Conventional cable engines use the fleeting knife system (※2), and crew members operate the fleeting knife while constantly monitoring the cable wound around the drum on the machine side, requiring consideration for safety. In addition, because the fleeting knife is always in contact with the cable wound around the drum surface, there is a risk of damaging the sheath of the cable.

On the other hand, the current mainstream self-fleeting system eliminates the need to constantly monitor the cable on the machine side because the fleeting mechanism attached to the drum automatically fleets the cable wound around the drum.

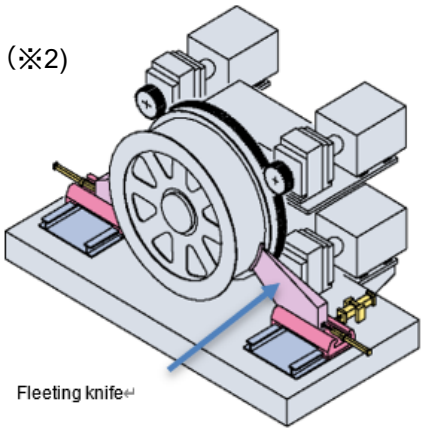
This improves operability and reduces the risk of damaging the cable.

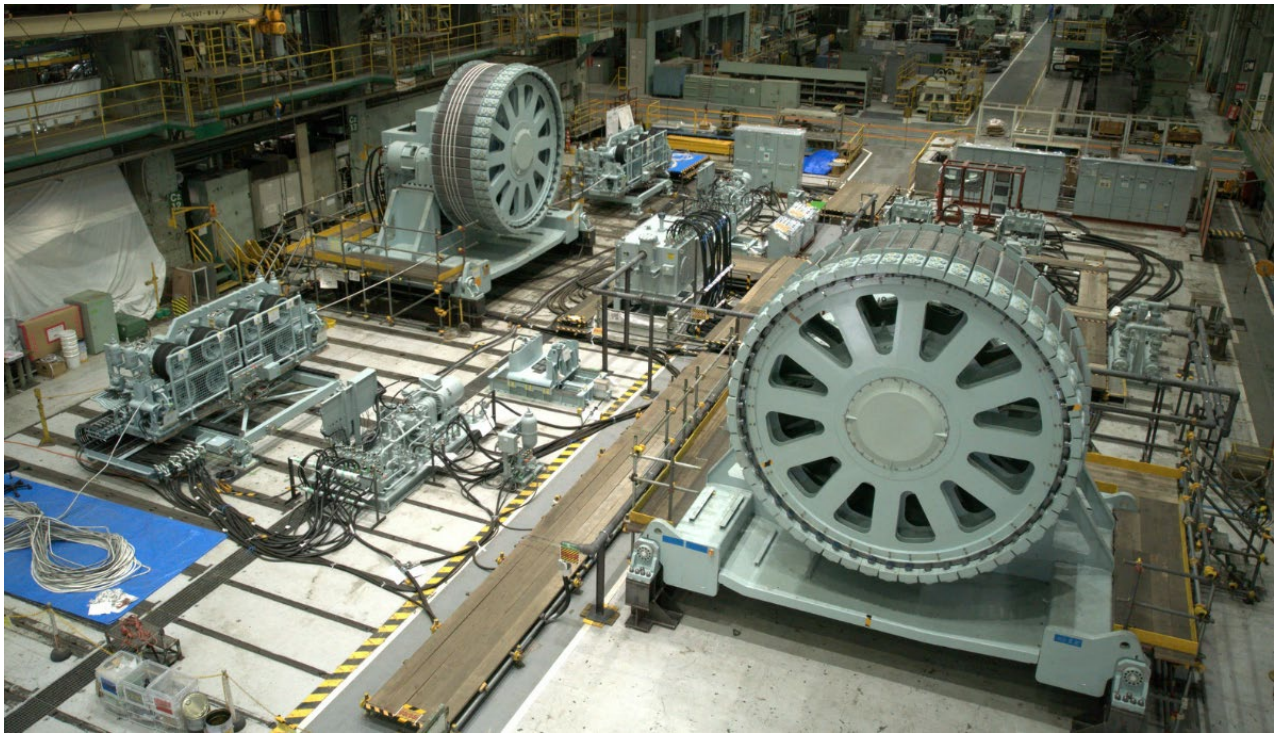
Our company will continue to work to provide products that meet needs throughout the world.

(※1)



(※2)





cable engine before delivery

Recommendation of Auxiliary Boiler Control Panel Equipment Replacement

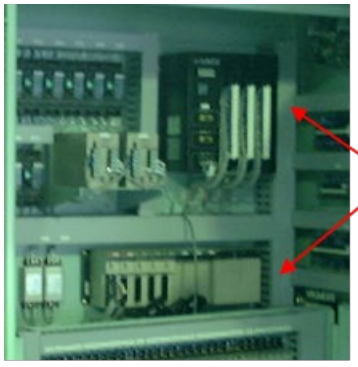
Mitsubishi Heavy Industries Marine Machinery & Equipment's auxiliary boiler (MAC-B type) provides steam to drive cargo pump turbines for cargo handling in tanker ships.
If a problem occurs in the PLC (Programmable Logic Controller) or other control equipment installed in the auxiliary boiler control panel and automatic operation becomes impossible, the cargo handling schedule is greatly affected.

For safe boiler operation, it is desirable to replace the control equipment and other equipment in the control panel on a regular basis. However, depending on the model number, some equipment is obsolete, and if there is no compatible equipment, it may become difficult to provide support.

For this reason, our company recommends that you replace any control equipment and parts that are no longer in production with the current model number so that you can receive ongoing support.
When replacing control equipment withcontrol system, the original functions are retained, and the operation panel is equipped with a touch panel to improve operability and facilitate understanding of boiler operation status. In addition, alarm logs and trend display functions are also installed.

To maintain stable marine transportation of energy resources both in Japan and overseas, our company is actively engaged in the maintenance and management of our product. Using the experience and technology our company has accumulated to date, it will provide solutions for the modification and replacement of control equipment to meet customer requirements.

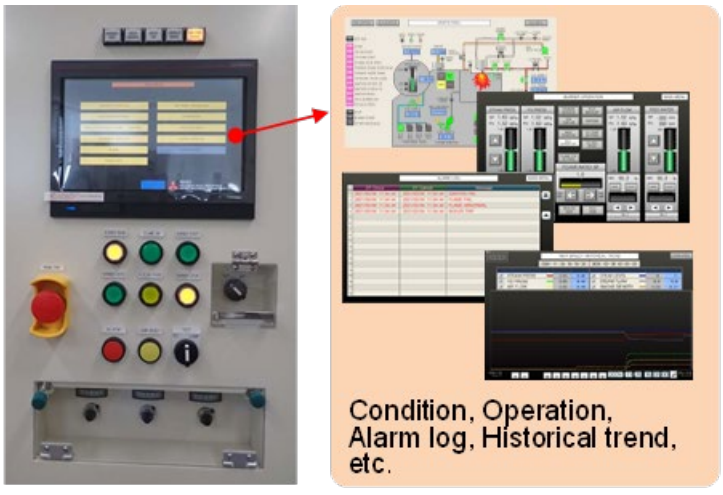
For inquiries marine.machinery.service@mhi.com.



Discontinued PLC

Current model PLC after replacement

Original operation panel



Operation panel after replacing PLC

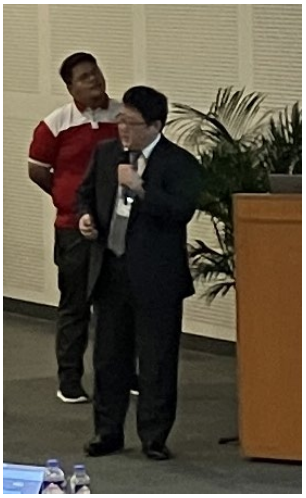
Participation in Seminars Hong Kong and Abu Dhabi

Mitsubishi Heavy Industries Marine Machinery & Equipment participated in the “HONG KONG SHIP MACHINERY & EQUIPMENT SEMINAR” hosted by the Japan Machinery and Equipment Association in Hong Kong on November 26, 2024 and the OSV & Maritime Business Matching Forum in Abu Dhabi, United Arab Emirates, on January 28, 2025.
The theme of our presentations was “Suggestions for Safe Operation and GHG Reduction.”
It was a valuable opportunity to directly interact with customers in Hong Kong and the Middle East.
Our company will strive to make proposals that meet market needs.

Hong Kong Seminar

Participation in Philippine Technology Seminar

Mitsubishi Heavy Industries Marine Machinery & Equipment participated in a seminar held in Manila, Philippines from February 11 to 13, 2025. Daihatsu Diesel Corporation holds this seminar regularly for ship crew training schools in the Philippines.
At NYK FIL MARITIME E-TRAINING, INC., MOL TRAINING CENTER (Phils.), INC., and “K” LINE MARITIME ACADEMY, our company introduced a variety of technical information about our products, focusing on maintenance of MET turbochargers. We received many questions from the audience, and we had a valuable opportunity to meet people who are responsible for ships’ safe operation.
There are ship crew training facilities in the Philippines, and we will continue our activities to deepen understanding of MET turbochargers and our other products through seminars and events.



Philippine Technology Seminar

Change of Representative in Singapore

the Singapore Strait where many ships anchor

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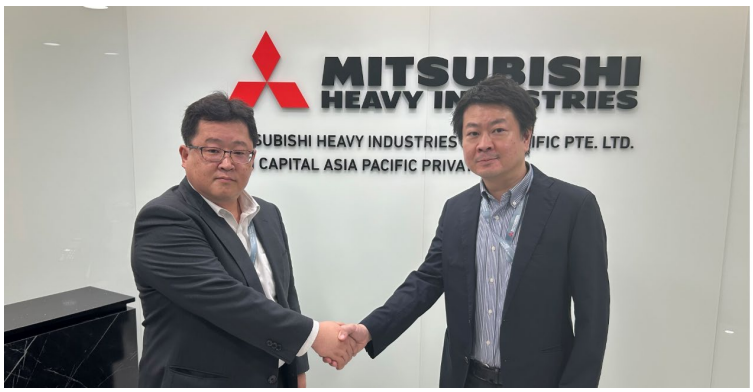
Our company has a marine machinery representative in Singapore, a key maritime traffic hub, who provides technical support and information gathering in Singapore, as well as in Asia Pacific and India. Our office is located in an office building in the Central Business District overlooking the Singapore Strait.

Hiroki Umezawa, New General Manager

I was appointed to the Singapore Office in April 2025.
In 2022, I was appointed to the After-Sales Service Division of Marine Machinery within the Nagasaki Shipyard & Machinery Works, and was in charge of planning and sales of after-sales service for Mitsubishi Marine Machinery (marine boilers, steering machines, etc.).
Specifically, I was in charge of a wide range of activities, mainly for shipowners and management companies in Japan and overseas, such as proposing maintenance, remodeling/replacement, and comprehensive contracts with a focus on preventive maintenance, informing and proposing pre-inspection sheets (product condition check sheets), and responding to troubleshooting. I have been engaged in my work under the motto of ‘close contact’.

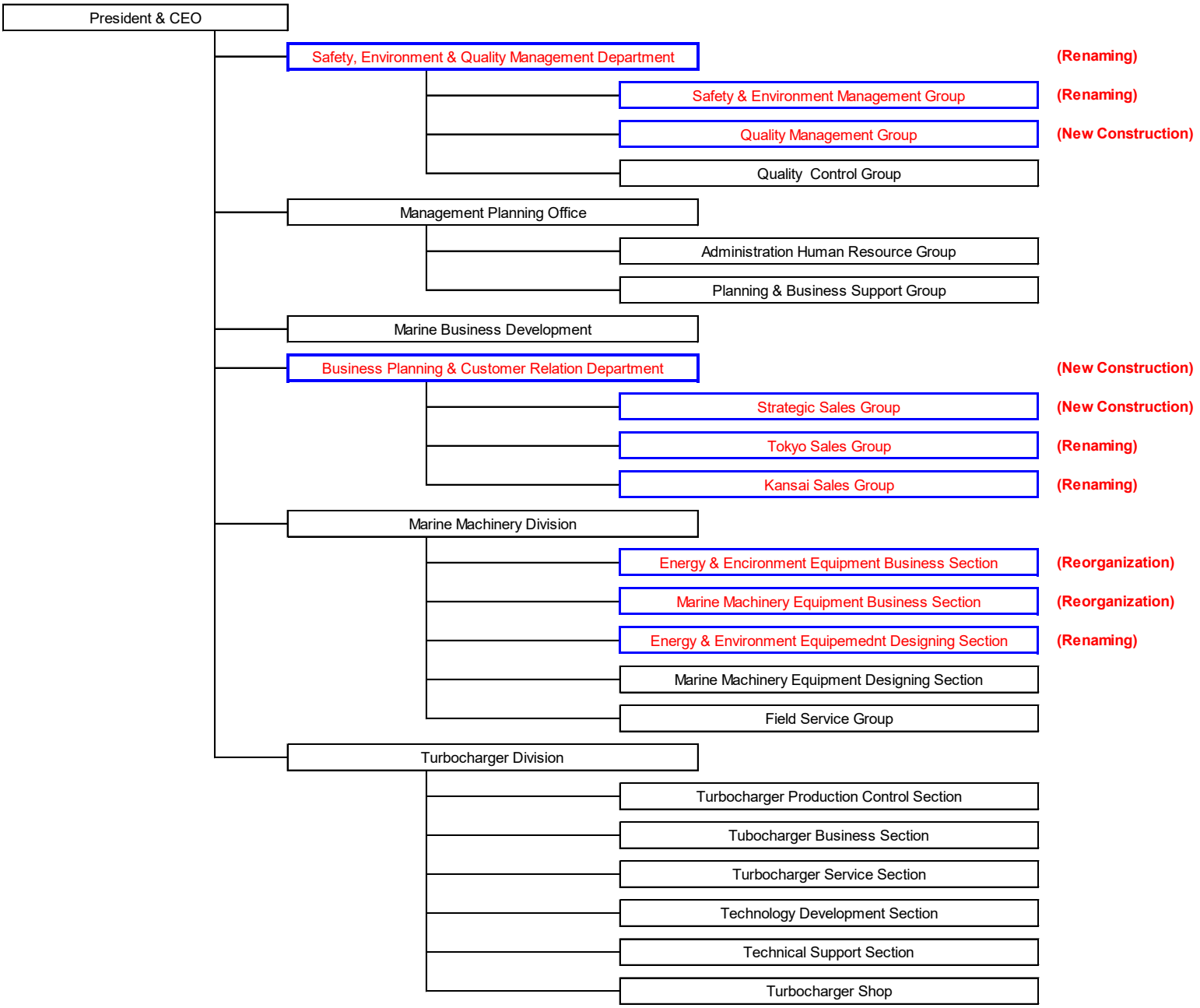
We will continue to strive to provide products and solution services that leverage the technological capabilities of our company and the comprehensive capabilities of the MHI Group to the Singaporean market, while keeping abreast of customer expectations and questions about MHI, as well as changes in the needs and environment associated with various regulatory changes. We will continue to work hard to ensure the continued patronage of our company's marine machinery.



Kazuyoshi Fujioka, Previous General Manager

I will be returning to MHI Marine Machinery after completing my assignment in Singapore at the end of March 2025. At the beginning of my assignment, due to the impact of the COVID-19 pandemic, I had difficulty starting my work as planned, but during the four years I was stationed there, I owe a great deal to our customers, partner companies, and many others.
It is with great regret that I will return to Japan after completing my assignment in Singapore, but I hope that my relationship with you will continue in some way even after my return to Japan.
In addition, I would like to ask for your continued support for MHI Marine Machinery products.
After my return to Japan, I will be involved in supporting sales and licensing activities for Marine Auxiliary Equipment (propeller, steering wheel, fin stabilizer, special equipment, etc.), providing products that take into account energy conservation and CO_2 reduction, and ensuring safe navigation.

New Organization



Mitsubishi Heavy Industries Marine Machinery & Equipment has implemented the following organizational reforms, effective from April 1, 2025.

(1) The Tokyo and Kansai branch offices were abolished and the Business Planning & Customer Relation Department and Strategic Sales Group, were established.

(2) The Sales and Service Sections of the Marine Machinery Division were reorganized into “Energy & Environmental Equipment Business Section” and “Marine Machinery Equipment Business Section”, and each handles both sales and after-service by product.
The Boiler & Turbine Design Section was renamed “Energy and Environmental Equipment Designing Section”, and the new product development function of Marine Business Development, was transferred.
Some functions and resources were reassigned to “Energy & Environmental Equipment Business Section” and “Field Service Group”.

(3) Safety and environmental management operations was transferred to the Quality Management Department from the Management Planning Office and "Safety & Environment Management Group" was established.
The Quality Management Department was renamed “Safety, Environment and Quality Management Department”.

The new organization was reformed, while keeping the advantages of the current two-division structure, to strengthen cross-functional activities in customer approach, and to reorganize the structure in response to changes in business and models of each product.

Greetings

Just 1 year ago, in issue 25 of this magazine, the rapid recovery of the new shipbuilding market and the expansion of its construction capacity, especially in China, was mentioned. In 2024, China's share of the world's new shipbuilding volume exceeded 50%, and some predict that it may exceed 60% soon.

On the other hand, shipyards in South Korea and Japan, are unable or not to increase their construction volume due to labor shortages, work style reforms, and the prolonged construction period of new fuel ships. Consequently, order intake seems to have reached 4 (four) years.

Geopolitical risks, such as in Ukraine and the Red Sea, remain a cause for concern, and while continuing to pay close attention to the impact on the market, I recognize that the shipbuilding industry‘s urgent issue is how to manage construction of the accumulated orders.

Our responsibility is to secure supply capabilities, including partners and sub suppliers, and meet delivery schedules. To this end, we will work to strengthen the supply chain and improve quality across our company brand, including our licensees.

Since becoming president in April last year, I have visited many shipowners, shipyards, and engine. Although each company is considering future fuel alterations, many of them said that LNG would be the mainstream fuel for the time being due to the availability and cost of alternative fuels.

In addition, the Trump administration, which was inaugurated this year in the United States, has emphasized energy self-sufficiency and announced policies to promote the use of fossil fuels that run counter to decarbonization, leading some to believe that the momentum of fuel conversion will slow down.

In light of this “uncertain” situation, our company will continue to develop technologies to cope with new fuels such as ammonia, while developing technologies to resolve methane slips, which is an issue when using LNG as fuel.

In addition to the development of new technologies, MHI will proactively develop proposals for energy-saving solutions utilizing MHI Group technologies and products, such as propeller retrofitting, for which we have received many orders in recent years, energy-saving devices on hull, and modification of main engines & turbochargers for performance optimization.

We will continue to be a company that customers need and trust, through the provision of high-quality products and services. We appreciate your continued patronage for MHI Marine Machinery products.

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

President CEO
Katsuhide Matsunaga

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