News from MHI-MME Offices Abroad

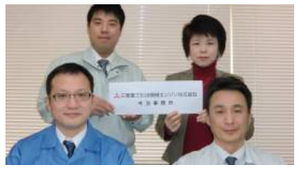
IMABARI Office

Head, Imabari Office-Tetsuya Yamamoto

The Imabari Office was established in 2012 to provide customer support for our products, and we are now entering our fifth year. We are located in Imabari, Ehime Prefecture, within the Hirobishi Sangyo Y.K. Imabari office and directly opposite Oshinden Park.

Imabari is famous throughout Japan for its Imabari towels, yakitori (grilled chicken served on skewers), and Barysan, the local mascot character. However, Imabari is also famous as one of the largest maritime cities in Japan and even on a worldwide level, where maritime related industries such as the shipping industry, shipbuilding industry, and the ship machinery industry have gathered. Imabari boasts approximately 65 companies in the ocean-going shipping business while the number of ocean-going vessels belonging to ship-owners in Imabari is said to amount to more than 30% of the total number of such vessels in Japan. Imabari is also one of Japan's leading shipbuilding hubs and altogether the group companies with bases in Imabari build more than 30% of the ships made in Japan.

With so many ship-owners and shipbuilding yards here in Imabari, we are able to take advantage of sharing the same location as so many of our clients. We engage with them directly, face-to-face, and take care to be thorough in our dealings with them. Every year we hold the Imabari User Conference and use it as an opportunity to exchange information with many clients. We intend to continue to support our clients by being a familiar presence to them.



(Left) Mr. Yamamoto, head of the Imabari Office

Imabari City Hall (Propeller made by MHI-MME)

Imabari Castle

Oshinden Park

190 Employees
A propeller manufacturing capacity of 6,000 tons per year

Changzhou Zhonghai Marine Propeller Co., Ltd

Changzhou Zhonghai Marine Propeller Co., Ltd (CZZH) is a company in Changzhou in China's coastal province of Jiangsu that started up as an ingot manufacturer in 1992. CZZH began making propellers from 2006. Seizing on the expansion of China's shipbuilding industry as an opportunity to grow, CZZH began operation of its new factory in 2014. Currently the company has 190 employees and a propeller manufacturing capacity of 6,000 tons per year.

For MHI-MME, propellers are the product with the longest history. In 1904 we became the first company in Japan to start the manufacture of propellers and since then we have produced and delivered more than 5,000 propellers to our clients.

In October 2014, MHI-MME and concluded a licensing agreement for the manufacture and selling of propellers. Through the combined effect of our company's technology and CZZH's competitive edge in manufacturing, orders in China have been piling up since just after the agreement was concluded. We have succeeded in expanding sales of the Mitsubishi Heavy Industries Marine Machinery and Engines brand. We intend to aim for further expanding sales of propeller products and strengthening our brand power in the Chinese market through our excellent partnership with CZZH.

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Only One to the Seas of the World

PROJECT MEET NEWS

Mitsubishi Marine Energy & Environment Technical Solution-System

09
9th Issue
April 2016

TOPICS

Hybrid MET Turbocharger Receives an Award of Excellence for Energy-Efficiency

JMF President's Award of the Energy Efficient Machinery Awards
Hosted by the Japan Machinery Federation

Launching Challenges.

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Technology Supporting IMO Tier III NOx Emission Requirements

Low-Pressure EGR / Low-Pressure SCR

SPECIAL FEATURES 2

MHI Products Celebrating Anniversaries

Electro-Hydraulic Steering Gears (80th Anniversary)
UE Engines (60th Anniversary)
MET Turbochargers (50th Anniversary)

Interview

Clarksons Research (U.K.)
Mr. Stephen Gordon

MITSUBISHI HEAVY INDUSTRIES
MARINE MACHINERY & ENGINE CO., LTD.

MHI GROUP MITSUBISHI HEAVY INDUSTRIES

Innovation in Hybrids.

Our mission was to develop hybrid turbochargers—which generate electricity using exhaust gas—for large ships. In essence, this meant overcoming issues related to speed, power and size. In other words, it meant the development of an efficient power generator capable of high-speed rotation and a large power output in a compact design. The unprecedented challenge was realized by downsizing the power generator and changing the structural design of the turbocharger. It was innovative technology in which the generator was built into the turbocharger. The world's first practical hybrid turbocharger, MET83MAG, is currently installed on seven bulk carriers. The MET66MAG-VTI, our latest hybrid turbocharger with electro-assist function and variable turbine inlet (VTI), is in operation on six state-of-the-art car carriers. The innovation in hybrids began with challenging the unknown.

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Mitsubishi Marine Energy & Environment Technical Solution-System

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108-0075 (Mitsubishi Heavy Industries Building)

C O N T E N T S

MHI / GROUP MITSUBISHI HEAVY INDUSTRIES

Message
from the President and CEO

It is because the market is unstable that we will make sure to give attention to the basics.

The shipbuilding market is expected to experience a slowdown in new orders for the near term. This is an adverse effect of the last-minute demand that was created before the enforcement of Tier III NOx emission limits in January this year as well as the slowdown of the Chinese economy. There are also concerns that international political and economic upheavals may occur, such as a euro crisis, refugee crisis or terrorism.

It is because the market is unstable that we will make sure to give attention to the basics this year.

First, there is customer-centricity. It is the customer that is the most important to us, and we will make sure that sufficient follow-up will be carried out to ensure that the products and services we delivered to our customers are proving useful. We will also visit our customers more than ever to hear their comments and opinions, which we will feed promptly back into our operations.

Then, there are our technological capabilities. The value of our existence is to continually stay one step ahead of our competitors in terms of the performance and reliability of our products. We will share technological capabilities with the comprehensive machinery manufacturer, Mitsubishi Heavy Industries, and commit to new product and technology development as well as the further boost of the performance and reliability of our products.

We are happy to report that the first 6UEC 50LSH, a new engine that was launched last year, is operating extremely well in service. Onboard testing of the low-pressure EGR that meets Tier III requirements is also going well, and the low-pressure EGR is awaiting the arrival of future business opportunities.

It is because the market environment is unstable that we will give attention to the basics, listen to the opinions of our customers and work tirelessly to improve and enhance our technological capabilities. This is the course that MHI-MME should follow at this time.

President & CEO
Kazuo Soma

Technology for IMO NOx Tier III

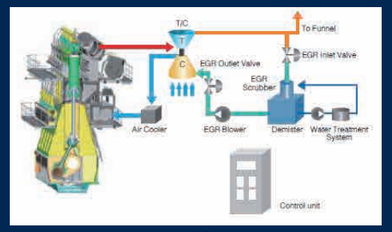
Technology Supporting IMO Tier III NOx Emission Requirements

IMO NOx Tier III is a set of emissions requirements applied to vessels whose keels are laid on or after January 1, 2016, that has taken effect in Emission Control Areas (ECAs). NOx ECAs have so far been established only in North America and parts of the Caribbean Sea. However, Europe and other areas where Sox ECAs are established are being considered for future addition. It is an extremely major environmental regulation that may also become a requirement for ships operating outside of North America. It requires the reduction of NOx emissions by approximately 76% in comparison to Tier II requirements.
MHI-MME has been developing two solutions to deal with IMO NOx Tier III: low-pressure EGR and low-pressure SCR. The following is an introduction of our efforts in regards to these two technologies supporting IMO NOx Tier III emission requirements.

The World's First Low-Pressure EGR System Installed in a Bulk Carrier Built by Hakodate Dock; Currently Undergoing Durability Testing

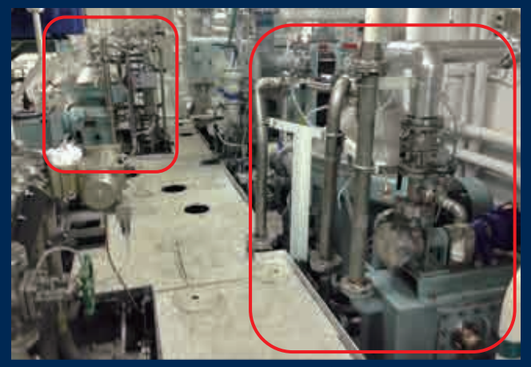
In a low-pressure EGR system, a portion of the exhaust from an engine is recirculated to the engine. It suppresses the generation of thermal NOx by changing the engine's internal combustion conditions.
MHI-MME's EGR system was developed with support from ClassNK's Joint R&D with Industries and Academic Partners scheme. It recirculates low-pressure exhaust from an engine turbocharger outlet to the turbocharger intake gas. It has a simpler system configuration and is more compact than a high-pressure EGR system, which utilizes the high-temperature, high-pressure exhaust that has not passed through a turbocharger. Other advantages are that it keeps both initial and running costs lower.
Reduction of NOx emissions to Tier III levels were thought extremely difficult to achieve using only an EGR system. However, it has been confirmed possible during development using a test engine. In April 2015, the MHI-MME EGR system was installed on a 6UEC 45LSE-Eco-B2 engine at Kobe Diesel Co., Ltd. for shop testing. Confirmation was made that the desired performance could be achieved as planned. This included NOx emission levels and a less-than 1% loss of fuel efficiency as compared with the Tier II version. The engine received a certificate of conformity to Tier III requirements.
In August 2015, test installation was made on the 6UEC 45LSE-Eco-B2 engine of the 34,000 DWT bulk carrier Dream Island (shipowner: Shikishima Kisen K.K.) built by The Hakodate Dock Co., Ltd. Confirmation was made in onboard testing that the desired performance could also be achieved as planned.
This is the first time worldwide that a Tier III-certified low-pressure EGR system for low-speed marine diesel engines was installed on a ship. In regards to the long-term durability testing currently taking place, verification is also being made of the system's actual operability (e.g. logistics and operation) with the cooperation of Shikishima Kisen K.K., NYK Bulk & Projects Carriers Ltd.—which operates the ship—and Nippon Yusen Kabushiki Kaisha. Overall optimization of the system will be carried out in preparation of future business talks.

Development Concept
- To develop an unrivalled low-pressure EGR system
- To recirculate low temperature, low-pressure exhaust gas exiting the turbocharger; to recommend gas branch on the rear flow side of the exhaust gas economizer
- To realize the simple configuration and control enabled by a low-pressure system; to attain maximum downsizing
- To achieve overwhelming superiority over other systems through the low initial costs and running costs that a simple system makes possible
- To realize low costs in the water treatment system for purifying scrubber water through maximum utilization of conventional technology
- To enable installation in not only UE engines but also engines manufactured by other companies



Low-pressure EGR system (concept diagram)


As installed on the bulk carrier


Installed water treatment system

<Glossary>
IMO: International Maritime Organization
NOx: Nitrogen Oxides
ECA: Emission Control Area
EGR: Exhaust Gas Recirculation
SCR: Selective Catalytic Reduction
SOx: Sulfuric Oxides

A NOx Removal Efficiency of 80% of all Exhaust Emissions Achieved Onboard Testing for Low-Speed Two-Stroke Marine Engines Completed

Unlike the EGR system, which suppresses the generation of NOx by changing an engine's internal combustion conditions, the low-pressure SCR system uses a catalyst to carry out after-treatment (denitration) of NOx in engine exhaust.
Since 2007, MHI-MME participated from the beginning in the Super Clean Marine Diesel (SCMD) R&D Project, until the conclusion of onboard testing in 2012. The Project was initiated and overseen by the Japan Ship Machinery & Equipment Association, promoted by The Nippon Foundation and led by the Ministry of Land, Infrastructure, Transportation and Tourism. MHI-MME fully incorporated the denitration technology cultivated by Mitsubishi Heavy Industries in its land-based plants, etc., and installed a low-pressure SCR system, which carried out denitration of all exhaust gas, on an 88,000 DWT coal carrier (main engine: 6UEC 60LS II) built by Oshima Shipbuilding. A denitration rate of over 80% under full-load conditions in E3 mode was confirmed through the onboard testing.
Long-term operation of the system, comparable to actual onboard operation, was later carried out using a land-based test plant to carry out quantitative development related to durability and catalyst life. The low-pressure SCR system for low-speed, two-stroke marine engines was completed by integrating the results of such development.
A certificate of conformity to Tier III requirements has not been obtained because the IMO requirements were still u
nder discussion and being formulated during the SCR system's development under the SCMD R&D Project. However, it was the first time in the world that a low-pressure SCR system was installed on an onboard low-speed engine.
As for the UE engine, application on small engines with relatively high exhaust gas temperature is intended, and we are primarily dealing with inquiries in China.


Onboard installation during SCMD development

The low-pressure EGR and low-pressure SCR systems introduced here can, of course, be installed on the UE engines developed by MHI-MME. What is more, the simplicity of the systems enables installation on the brand engines manufactured by other companies.
MHI-MME will contribute to the preservation of the global environment by widely popularizing the excellent performance of the low-pressure EGR and low-pressure SCR systems. We will also continue to work towards further enhancement of the performance and reliability of the systems as well as expand sales. Our commitment is to ensure that MHI-MME will meet the expectations of customers around the world.

2015 saw the slowdown in the bulk carrier, container ship, and offshore markets due to China's trade decrease and the fall of the fuel oil price. A severe outlook in the markets continues overall in 2016-2017.

[CLARKSONS RESEARCH]

Managing Director

Mr. Stephen GORDON

Interviewee: Mr. Stephen GORDON

Managing Director, Offshore and Energy, Shipping and Trade, Valuations at CLARKSONS RESEARCH.

Clarksons Research is the part of the Clarksons Group, the world's largest provider of shipbroking and banking services through Clarksons Platou.

— Today, we would like to ask you several questions about market status. We understand that year 2015 was historical tough market for new shipbuilding contracts. Could you tell us statistics easily showing the status of the year 2015?

Mr. Stephen GORDON: In 2015, there was 37 million CGT of deliveries, up marginally from 35.1 million CGT in 2014 but down 30% from a peak of 53.1 million CGT in 2010. China (35.1%) re-took top position in CGT terms from Korea (34.6%) followed Japan (18%).

In terms of ordering, we had a total of 1,306 vessels, 98 million DWT and 33.8 million CGT down from 121 million DWT in 2014 and 178 million DWT in 2013. From my perspective, last year was the lowest ordering year since 2009 and quite a challenging year.

Particularly, it was a very challenging year for bulk carriers. The bulk carrier market has shown a strong slowdown because of the continued delivery of ships following orders booming in 2014 and also because of the slowdown in the trade, specifically China. In China, coal imports were down around 30%. More interesting statistics which have just been released show that Chinese steel production in the last year fell for the first time since 1981.

The container ship market also experienced a significant slowdown, particularly in the second half of the year. The start of the year was quite busy and a lot of large post-Panamax container ships were ordered. So, actually, the annual total of ordering in tonnage terms was up quite significantly for the first half of the year. However, it did slow down towards end of the year. This slowdown was caused by concerns from the demand side about the world economy such as a decelerating in international trade, and a declining charter and freight rate.

Tanker ordering was steady. In fact, the tanker market was up by around 70% in dead weight terms and in numeric terms up by around 70 orders to just over 450. This was driven by the growing international oil trade because of low oil prices, and so the tanker market had its best year since 2008 with a significant amount of cash coming to ship owners.

Offshore markets which had been good business for shipyards in the previous 3 or 4 years took a significant hit because of the slump in the price of oil. That resulted in utilization of rigs globally dropping from around 95% to 73% of the end of the last year and very limited number of ordering in offshore markets.

Ro-Ro ferry/Cruise Business had a positive year, particularly for the cruise section. We had a record order book both in terms of tonnage and value for cruise markets.

Gas related markets were both tough and good depending on the vessel type. As for LNG, although there were some projects, the volume was smaller than the previous year. LPG gas also experienced a slowdown in ordering. However, VLGC is still performing very well, and had a very large order book. So, in terms of contracting, I think that it was quite a challenging year over all.

One point we would make is that there was a lot of additional ordering, particularly in the second half of the year, in response to the Tier III standards to meet the deadline. Moreover, we expect that there some more orders were made before the Tier III deadline which have not yet been reported. However, this is one of the reasons why we expect that this year will be quiet in terms of ordering, particularly the first half.

— I think that Japanese yards are doing well securing their contracts in 2015. What is your overall forecast for new shipbuilding contracts for 2016/17?

Mr. Stephen GORDON: For 2016, we would expect probably a lower volume than 2015. We think the first half of 2016 will be very quiet and overall volume for the year will be below 2015. Of course shipbuilding is always unpredictable, but that seems to be the consensus at the moment. We do expect a recovery in demand in the long term but the timing is very uncertain. It will take time for the shipping market to recuperate, and also to adjust global shipping capacity, which is the challenge for the industry.

In 2015, Japan was the only one of the 'big three' shipbuilding nations to see ordering volumes increase year-on-year, up 10% million GT terms to 19.7 million GT. Japan was the largest ordering nation from an owner perspective, particularly for bulk carriers, and of course they have many loyal clients both internationally and domestically. Also, the currency rate changes were helpful for Japanese yards last year.

— Regarding the fuel oil price, we are experiencing very low prices and it is affecting the new shipbuilding market and offshore markets so much. Do you think that the current situation will continue for several more years?

Mr. Stephen GORDON: We expect the oil price to recover in the medium to long term. However, in terms of offshore cycle, we do not expect a bounce in terms of the recovery. It seems that it may take several years to recover because of the oil price and also there is global surplus capacity. These are our main challenges.

— Regarding oil prices, some people say that $60/Barrel or $70/Barrel will be the break even point.

Interview

The issue of Tier III is to be solved by ship owners and shipyards together. China is moving into a more mature economy, rather than the recession, after the development. Such economy will create new opportunities, such as in the cruise sector.

Do you think it will be recovering in that area?

Mr. Stephen GORDON: I think the oil price is inherently volatile. We would expect the recovery to a level significantly above today's price, but the timing and scale are very difficult to anticipate. It is a very complicated issue, considering shale oil production in US, Saudi Arabian production output level, Iranian sanctions, and the global demand. So I think that an accurate forecast of oil prices is not possible, but certainly we would expect recovery from the current level.

— Regarding Tier III regulations, I think some ship owners seem very reluctant for higher CAPEX and OPEX as result of this regulation. What do you feel for this regulation?

Mr. Stephen GORDON: CAPEX should be considered of course, particularly in the current challenging market.

In today's market, CAPEX is always an issue; ship owners and shipyards will need to discuss and move forward with the correct solutions.

— Do you think that this additional cost from Tier III should be reflected in freight rates?

Mr. Stephen GORDON: That is a difficult question, because there are a lot of issues. There are many factors for setting freight rates, such as the market cycle from the demand side, circumstances around the negotiation, commercial terms as well as technical competitiveness. Since there are so many issues which need to be taken into consideration, it is very difficult to anticipate freight rates in a very specific element of commercial framework.

— It's a very difficult issue as to who should absorb this additional cost. So, this is challenging in any sector such as ship owner, as well as shipyard, machinery side. Do you think that there might be some kind of answer for this issue?

Mr. Stephen GORDON: Historically, things are changing all the time. Currency price, market cycle, supply demand, steel prices, interest rates, all of the factors for price are changing all the time. I think that the price will recuperate accordingly over time in relation to those factors and it is difficult to predict the price by those specific issues.

— I would like to change the topic.
Iranian sanctions will be released. What could you imagine as the impact on new shipbuilding orders from this?

Mr. Stephen GORDON: There are ranges of forecast regarding the Iranian oil production, from additional output in the short medium terms 2-300,000 barrel/day up to close to a million/barrel. Also, there are a number of large shipping companies in Iran which will require new building. Although it is still relatively early to quantify the potential of the Iranian impact, generally speaking, there are clearly opportunities for marine and oil & gas business internationally.

— Could we expect some more orders in tankers sector?

Mr. Stephen GORDON: Certainly the fleet strategy of large shipping companies in Iran will go forward and we would expect that there will be some new building activities.

— If we include Iranian crude oil, the quantity will be increased. Considering current low price of oil and new Tier III regulations, what do you imagine for the scenario of fuel oil for the large vessels?

Mr. Stephen GORDON: The low oil price makes LNG as fuel less persuasive. However, in a long term view such as the next 10 years, or in the case of ships, over 20 to 25 years, oil and gas price may settle down. LNG as a fuel has a number of advantages and also has a number of disadvantages. Firstly I think it is important to take a long term view when we talk about fuel prices.

Secondly, I think regulation regarding emissions globally is something that will be on the political agenda over the next 10 to 20 years, and we feel that regulations including emissions will increase significantly in the long term.

— You mentioned that steel production in China is very low. The recession in China including steel production is having a large impact on this market. Could you tell me some key factors or key words to recover the market from this situation?

Mr. Stephen GORDON: I think China is moving to a more mature phase of its economy. Rather than talking about the recession, we should be thinking that China is moving into a more mature economy, having gone through its developing phase.

In a more mature economy, new commodities and cargos will be needed, for example, the cruise sector in China is doing very well at the moment.

So, I think as China matures into a different type of economy, then that will create new opportunities for shipping although it might not be such aggressive growth for cargo.

I think there is still potential for growth in the market in the long term view, considering that 85% of all international trade is carried by ships and that there is totaled 10.8 billion tonnage which is equivalent to 1.5 tonnes of trade per single person on the planet. The world trade has grown quite consistently and steadily for nearly 50 years, experiencing only one or two interruptions, such as the financial crisis.

However, of course in the short term, we have a business cycle to deal with, some surplus capacity and the Chinese economy maturing. These are causing a decline in growth rates in certain economies or certain trades and making the markets challenging.

I think that shipbuilding surplus capacity is a problem both in China, Korea and Japan and I think that is something challenging for the marine industry for this next couple of years.

— From a broking or funding point of view, can you find some good signs for the future?

Mr. Stephen GORDON: I think that there are a lot of challenges across the markets.

However, we are seeing a lot of buying interests in capesize at the moment, a lot of well established and successful ship owners are investigating capesizes today. We have seen 15 to 20 more capesize sold in last 4 or 5 weeks.

This is because those owners believe that this is an attractive point in the cycle to acquire ships and they feel the market will recover in the long term, and I think that is a good signal.

Also, the financial landscape in the shipping world is very different today from pre-financial crisis. It is very different in terms of the number and types of banks involved, and terms and nature of lending are different from pre-financial crisis.

— What is the biggest difference between today and pre-financial crisis?

Mr. Stephen GORDON: I think we have smaller number of banks, more conservative terms, more regulations, more focus on certain top tier owners, more export credits, and less private equity which was very active in 2013 and 2014.

— My last question is about the current over-capacity situation. Do you think this can be regulated in 2 or 3 years?

Mr. Stephen GORDON: Clearly the market is very challenging today, however, marine industry plays an incredibly important role in the world economy. If you believe in long term development of world economy and globalization, then the marine industry will continue to have an important role to play. However, the cycle of timing is very difficult.

Apart from that, I think there are a lot of exciting opportunities in the marine industry, particularly from technology, IT, automation, and the innovation perspective, such as the advancement seen in IT and satellite connections. We feel that there are a lot of exciting opportunities for innovation that can be driven by the marine equipment sector as well as other parts of the shipping industry. Those are exciting opportunities in the short term when the fleet market is challenging.

MHI-MME has a great potential as one of the worldwide technology provider, and we believe that you have a great opportunity in this field, too.

— Thank you, Steve san.

Shipbuilding surplus capacity is a problem both in China, Korea and Japan. Believing in long term development of world economy and globalization, there will be much opportunities for innovation and growth that can be driven by the marine equipment sector.

Hybrid Turbocharger Receives External Award

"JMF President's Award" of the Energy-Efficient Machinery Awards
Hosted by the Japan Machinery Federation

MHI-MME's hybrid turbocharger for large ships received the JMF President's Award in the 2015 Energy-Efficient Machinery Awards hosted by the Japan Machinery Federation. In the 36th hosting of this authoritative award, our hybrid turbocharger was selected after rigorous examination of 28 machines that were entered for award consideration. The hybrid turbocharger developed by MHI-MME was recognized for its superior energy-efficiency, operational track record and progressiveness, all proven through actual installation and use on ships.

The hybrid turbocharger couples MHI-MME's large-size MET series turbocharger with a high-speed generator-motor. It utilizes engine exhaust gas from a marine propulsion diesel engine for efficient power generation. During low-load operation of the engine, the hybrid turbocharger can be used as an electric motor, doing away with the need of conventional auxiliary blowers. It can improve engine performance at the same time.

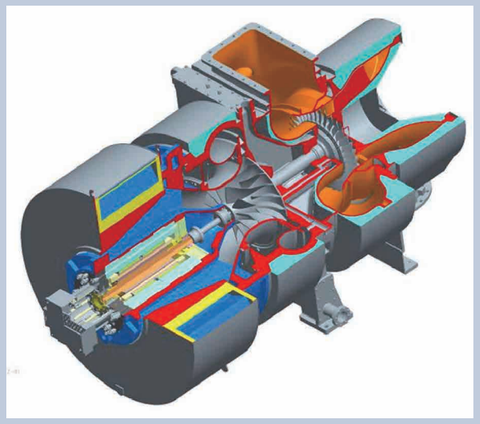
Development of the MET83MAG, the world's first and unrivalled practical hybrid turbocharger, was achieved with the generous support of ClassNK, Nippon Yusen Kabushiki Kaisha (NYK Line), Japan Marine United Corporation and Hitachi Zosen Corporation. The hybrid turbocharger has been installed on seven large bulk carriers built by Japan Marine United Corporation.

Meanwhile, MET66MAG-VTI, the latest hybrid turbocharger with electro-assist function and variable turbine inlet, was developed with the generous cooperation of Mitsui Engineering & Shipbuilding Co., Ltd. and Kobe Diesel Co., Ltd. This hybrid VTI turbocharger has been installed on six large, state-of-the-art car carriers built by Shin Kurushima Dockyard Co., Ltd. and Imabari Shipbuilding Co., Ltd., and operated by NYK Line.

This was the second time that MHI-MME won this award, following the Waste Heat Recovery Systems in FY2010. MHI-MME will continue to contribute to increasing the efficiency of ship operation and protection of the global environment through the provision of energy-efficient equipment solutions.

優秀省エネルギー機器

Energy-Efficient Machinery Awards
JMF President's Award
Japan Machinery Federation, FY2015



Cutaway view of the MET83MAG hybrid turbocharger

Lower-half shell housing
The generator installed in the lower-half shell housing

MET37SRC Electro-Assist Turbocharger Completed

In the October 2014 6th Issue of Project MEET News, we reported that in an operational test carried out with the cooperation of Akasaka Diesels Limited, verification was made that an electro-assist turbocharger mounted on a 4-stroke engine was effective in reducing smoke during engine start-up and lowering fuel consumption during low-load operation. In this test, a high-speed motor was connected to the rotor of a MET22SRC turbocharger.

With the aim of commercializing this function, we recently developed an electro-assist turbocharger, with a high-speed motor coupled to a MET37SRC turbocharger.

The newly designed high-speed permanent magnet motor requires the use of neither lubricant nor cooling water. It can easily be retrofitted on a standard turbocharger.

Stand-alone operational testing of this turbocharger was completed in February this year, and onboard testing began in March with the electro-assist turbocharger mounted on a marine diesel engine.

Remote Monitoring of the Condition of Engines by LC-A

MHI-MME proactively supports customers' operation control through land-based remote monitoring of the condition of engines at sea.

For example, as the remote monitoring system for our UE engines, we have a partnership with Diesel United, Ltd. using the LC-A (LifeCycle Administrator) service developed by the company. It has already been adopted for use by 15 vessels.

In addition to engine operational data, such as temperature and pressure levels, the system also routinely acquires and analyzes data on piston underside drain oil, etc. Functions include predictive diagnosis of problems and troubleshooting, and enable timely evaluations to be made onboard. It also allows the land-based remote monitoring of the condition of engines at sea by way of a data server.

MHI-MME is leveraging the knowledge and technical expertise it has cultivated over the years to routinely analyze data accumulated from engines to provide various advice related to main engine performance. Concrete measures are proposed when signs of problems are detected. Furthermore, when mechanical problems arise, causes are swiftly investigated and reported, suppressing the lifecycle costs of ships. The support of ship operation is carried out to ensure that our customers can feel at ease in using our UE engines for many years.

The land-to-sea network environment has been rapidly improving over recent years. MHI-MME will proactively incorporate environmental protection regulations-related technology and other new solutions for further enrichment of the remote monitoring system. We will continue to be committed to the provision of quality services to our customers.

“Passengers’ reactions have definitely changed”

Shipowner Interview, Vessel Retrofitted with a Retractable Fin Stabilizer

Mr. Panagiotakis, Owner, Theologos P,
FAST FERRIES, (Greece)

With Rafina in the Aegean Sea as its home port, the FAST FERRIES company uses its three ferries to operate regular services to outlying islands including Andros, Tinos, and Mykonos. Of its three ferries, two are fitted with MHI-MME’s fin stabilizers. Those two ferries are both second-hand vessels made in Japan and one of them, the FAST FERRIES Andros was retrofitted with the stabilizers last year. Visitors can choose from other companies with jetfoil boats operating on the same routes as FAST FERRIES, or the option of taking a plane, so during the tourist season in summer there is always a battle amongst these companies to win customers. We spoke with Mr. Panagiotakis, who is in charge of the technical division of the FAST FERRIES company. (Interviewer: Mr. Suzuki from the Marine Machinery Equipment Section)

Thank you for your time today. I’d like to ask you some questions about the project carried out last year to retrofit fin stabilizers.

Q1. What was the reason that made you decide to retrofit fin stabilizers on the FAST FERRIES Andros?

FAST FERRIES owns one boat (Theologos P) fitted with MHI-MME’s fin stabilizers so the deciding reason was that I already knew about their powerful ability to control the roll of a ship. I think that fin stabilizers are one marine product that is a necessity for passenger ships.

Q2. Have you asked passengers and staff working on the FAST FERRIES Andros for their response or opinions comparing the Andros with vessels not fitted with fin stabilizers?

The response from passengers is clearly different. Vessels without fin stabilizers are also in service on the same routes as the Andros. Passengers who have ever been on the Andros, or those who have heard about it, realize about our vessels either having the fin stabilizers or not. So, of course, they purchase tickets for ferries with fin stabilizers so that they can enjoy a pleasant and relaxing voyage.

I’d like to share with you a certain anecdote. One day on our normal service in the Andros when the seas were a bit rough, we decided experimentally to stop using the fin stabilizers. As the effect of stopping the roll of the ship dropped off, as was to be expected, the ship started to take on a sideways roll. Because of this, the passengers began to wonder what had happened and everyone immediately started looking outside at the ocean. In other words, the effect of the fin stabilizers was so good that even the passengers noticed it immediately. Another time, we wanted to compare what it was like using the fin stabilizers and not using them. When we stopped using them, the roll was about ± 10 degrees but when we were using the fin stabilizers this was reduced to about ± 1 degree. At the time of the fin stabilizer project, we were told that the roll would be reduced by 90% but I could feel for myself that it was higher than that. So I am extremely satisfied with how wonderful the effect is for counteracting the roll of a ship.

Q3. Since the retrofitted Andros has been back in service, has there been any malfunctioning of the fin stabilizers?

We are using the fin stabilizers every day but we have not had any trouble at all. If anything had occurred, I would have already contacted your company.

Q4. How does the FAST FERRIES company evaluate the retrofitting of the fin stabilizers this time?

Overall, we are of the opinion that it was a very efficient project that didn’t require too much effort. I mean, in the initial stages of the project we just provided the essential information and data about the hull of the ship and then left everything up to your company, so from the survey of the ship to the sea trial, all the work was completed. Things such as the positioning of the fins and the reinforcement surrounding the fin stabilizers are the kind of knowhow that usually a ship owner does not have, but your company’s support was such a help to us. I am extremely satisfied with the way the entire project went.

Q5. How many points would you award out of 100?

As I am extremely satisfied, I would like to say 100 but actually it is 98. The remaining two points are for further development and expectations, so I shall take off two points for that.

Q6. I see. So what do you seek from MHI-MME in the future?

I expect your company to continue to make high quality products as you have thus far, and also I expect the development of new ideas. And I also want you to continue to make us happy.

FY2016 Planned Exhibition List

MHI-MME intends to participate in the following shows this year.

SEA JAPAN 2016

The biggest maritime show in Japan

Host city: Tokyo

Venue: Tokyo Big Sight

Duration: April 13 (Wed) – 15 (Fri)

Booth position: JPN-150 (In the Japan Pavilion)

Posidonia

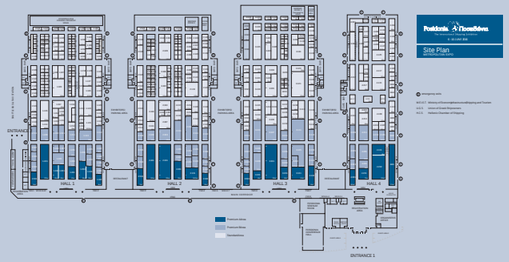
International maritime exhibition held in Greece, home to many ship owners

Host city: Athens

Venue: Metropolitan Expo

Duration: June 6 (Mon) – 10 (Fri)

Booth position: On the right side just after the main entrance (In the Japan Pavilion)



CIMAC

Engineers will present their papers

Host city: Helsinki

Venue: The Finlandia Hall

Duration: June 6 (Mon) – 10 (Fri)

Booth position: TBC

SMM Hamburg

The leading international maritime trade fair

Host city: Hamburg

Venue: Hamburg Messe

Duration: September 6 (Tue) – 9 (Fri)

Booth position: TBC

User Conference held in Imabari

On Thursday, March 10, the third User Conference was held in Imabari, and we gave the attendees information about products that would be helpful in operating ship services as well as our after-service lineup. A pre-conference survey was conducted to find out what clients were most interested in. On the conference agenda were items such as the UE engine, maintenance and checkup techniques for the MET Turbocharger, leading to a lively exchange in the Q&A. The User Conference gives us the unique opportunity to hear directly from our clients. The opinions and requests we receive are shared in the company and are essential for us to develop and expand on our products and services to answer our clients’ expectations. The second Tokyo User Conference is scheduled to be held in May, and we are hoping for a large attendance.

ANNIVERSARY PRODUCTS

MHI Products Celebrating Anniversaries

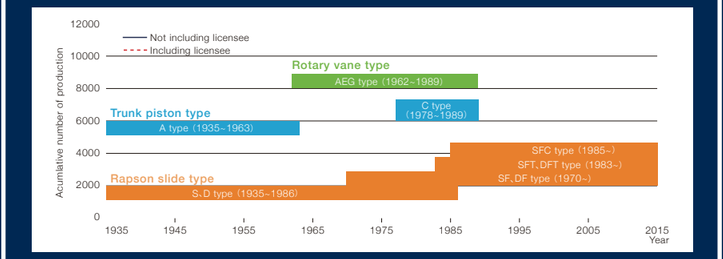
Last year in 2015, three core products, symbolic of MHI-MME's technological prowess, celebrated their 80th, 60th and 50th anniversaries respectively since development and commencement of manufacturing. This special feature looks back on their histories as well as the total number produced to date, current licensing and global market shares.

80th Anniversary of Development and Manufacture

Electro-hydraulic steering gears

MHI-brand Steering Gears Continues to Accumulate a Leading Global Track Record

Last year marked 80 years since Mitsubishi Heavy Industries first manufactured electro-hydraulic steering gear in 1935. Since the trunk piston (A type) and Rapson slide (S and D type) steering gear of the early days, MHI has been developing steering gear according to global needs. Between the 1960s and 80s, MHI manufactured Rotary vane (AEG type) steering gear, and since the 1970s, has been manufacturing the SF type and DF type (successors to the Rapson slide type steering gear) and other models. They are installed on a multitude of vessels, both large and small, as industry-leading MHI-brand steering gear. Today, manufacturing and sales license agreements have been concluded with Yoowon Industries Ltd. of South Korea and Jiangsu Masada Heavy Industries Co., Ltd. in China. MHI-brand steering gears continue to accumulate a leading global track record.



1935 The first Mitsubishi Electro-hydraulic steering gear was developed.
・Rapson slide type (S type, D type)
・Trunk piston type (A type)

1962 The technical cooperation about Rotary vane type steering gear with AEG in Germany. (AEG type)

1970 The Rapson slide type steering gear with compact-type power unit was developed.(SF type, DF type)

1978 The Trunk piston type steering gear was developed with clevis cylinder and vane pump.(C type)

1980's The line-up of Rapson slide actuator type steering gear was expanded.
・Torque motor control type(SFT type, DFT type)
・Solenoid controlled valve control type(SFC type)

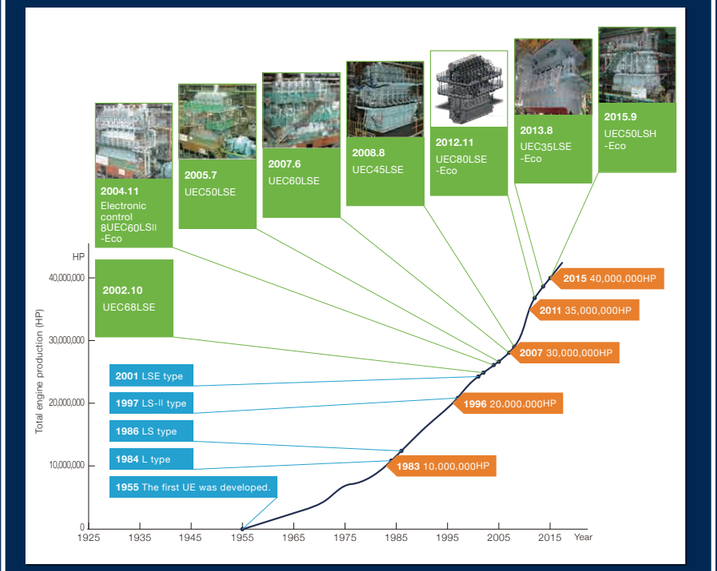
60th Anniversary of Development and Manufacture

UE Engines

State-of-the-art Electronically-controlled Marine Engines with Super Fuel-efficiency and Environmental Regulation Compliance to Meet Today's Needs

In 1955, Mitsubishi Heavy Industries succeeded in the development of a UE-type 2-stroke marine diesel engine using original technology. Known for its advanced technology and reliability, MHI has proudly manufactured and delivered a total of about 40-million horsepower's worth of the in-house developed UE engine series to power ships sailing in the seas of Japan and abroad (as of 2015).

In response to today's needs for IMO NOx Tier III compliant engines with super fuel-efficiency, MHI-MME completed its electronically-controlled engine lineup. The aforementioned standards were also applied to the latest engines in the LSH series. The first UEC50LSH-Eco engine went into service in September 2015 and has been accumulating good operational performance since then.
In regards to NOx Tier III compliance, we completed development of our exhaust gas recirculation (EGR) and selective catalytic reduction (SCR) systems. In August 2015, verification of the world's first low-pressure EGR system was carried out in onboard testing on the bulk carrier Dream Island (shipowner: Shikishima Kisen K.K.) built by The Hakodate Dock Co., Ltd. Steps are being promoted soundly toward commercialization.
To further our global development and expand our world share, we have expanded UE engine manufacturing to include licensees in South Korea, China and Vietnam in addition to our licensees in Japan.



50th Anniversary of Development and Manufacture

MET Turbochargers

High Performance and Reliability. Installed on a Multitude of the Main Engines of Small Ships and the Power Plants of Large Vessels

In 1965, Mitsubishi Heavy Industries manufactured the first non-water-cooled exhaust gas turbine turbocharger using its own technology. This launched the history of MET Turbochargers. In the beginning, they were manufactured exclusively for MHI's UE 2-stroke diesel engine. However, they were later applied to numerous B&W (now MAN Diesel & Turbo) and Sulzer (now Winterthur Gas & Diesel) 2-stroke engines, launching the entry of MET Turbochargers into the global market. Today, manufacturing and sales have been licensed to three engine manufacturers in South Korea and are expanding world market share.
With the high performance and reliability of MET turbochargers, the MET-SR radial turbine turbocharger series was developed and released in 1988 in response to strong market demand for application on 4-stroke engines. A multitude of turbochargers have been installed primarily on the main engines of small ships and as power plants for large vessels.
The hybrid turbocharger MET83MAG, which was developed by MHI-MME last year for large vessels, was recently awarded the JMF President's Award in the FY2015 Energy-Efficient Machinery Awards hosted by the Japan Machinery Federation. A new page has been added to the development and manufacturing history of MET turbochargers, which has now surpassed 50 years.

1965
The first MET turbocharger with non-water cooled, inboard bearing arrangement, type MET71 was developed.
Free from sulfuric acid corrosion.

1988
Radial turbine turbocharger MET-SR series was developed for smaller four stroke engines, started with MET30SR and 26SR. 30SR.
At present, it consist of MET37SRC, 30SRC, 26SRC, 22SRC and 18SRC.

2012
The world's first hybrid turbocharger with integrated generator for commercial application MET83MAG was developed.