December 25, 2024

No. 2024073

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Notice Regarding Misconduct in the Testing of Marine Engines
(Submission of Report on Internal Investigation)

Kawasaki Heavy Industries, Ltd., announced today that it has collated the findings of its internal investigation into misconduct in the testing of marine engines—first announced in a press release published on August 21, 2024 ("Notice Regarding Misconduct in the Testing of Marine Diesel Engines")—and has compiled these results in a report, which has been submitted to Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The Company takes this incident very seriously and offers its assurances to stakeholders that it will take resolute steps to ensure that such misconduct does not happen again.

In addition to the information contained in the interim report submitted to the MLIT on September 27, 2024, the report includes information on the impact of this misconduct on compliance with regulations governing NOx emissions*1 and CO_2 emissions, namely, the energy efficiency design index (EEDI)*2 and the energy efficiency existing ship index (EEXI),*3 based on the Company's ongoing internal investigations, and an analysis of the root causes of this misconduct, as well as an outline of the actions the Company is taking to prevent recurrence. The following is a summary of the report. Please refer to the attached copy of the report for details.

On September 13, the MLIT completed an on-site inspection subsequent to the rectification of testing equipment, and shop trials commenced thereafter. On November 11, the Company obtained Engine International Air Pollution Prevention (EIAPP) certificates and shipments gradually resumed.

The Company is currently examining whether this matter will impact its financial results and will immediately issue notification should such an impact be confirmed.

*1 NOx emissions regulations for marine engines are based on Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL), which came into effect in May 2005, with the aim of preventing air pollution caused by exhaust emitted from ships. These regulations were applied retroactively to ships the keels of which were laid on or after January 1, 2000. Tier II and Tier III NOx emissions regulations, setting more stringent targets, came into effect for

engines installed in ships the keels of which were laid on or after January 1, 2011, and January 1, 2016, respectively. Tier III regulations apply only to the specified ships while operating in Emission Control Areas.

*2 The EEDI, which applies to new ships of 400 gross tonnage or above that will engage in international voyages, aims to reduce the CO_2 emissions and environmental impact of individual ships by assessing their energy efficiency.

*3 The EEXI is used to assess the energy efficiency of existing ships of 400 gross tonnage or above that are engaged in international voyages.

Summary of the Report

1. Findings of the investigation

The Company inspected 674 marine engines subject to NOx emissions regulations for marine vessels, manufactured by the Energy Solution & Marine Engineering Company (an internal company), which were installed on vessels constructed after January 1, 2000.

1.1 Areas in which misconduct in testing was uncovered

After confirming shop trial records and interviewing pertinent parties, it was ascertained that data had been altered for 673 two-stroke marine engines, out of a total of 674 marine engines inspected, and that misconduct in testing during shop trials was to satisfy the required customer specifications or compensate for the accuracy levels of testing equipment. Misconduct fell into one or more of five categories, as indicated below, with data including results from the investigation subsequent to the interim report of September 27, 2024.

Category		Number of engines (as of September 27, 2024) (interim report date)	Number of engines (as of December 25, 2024) (this report date)
(1)	Unauthorized alteration of fuel consumption test data	588	593
(2)	Unauthorized alteration of fuel consumption rate test data	565	569
(3)	Unauthorized alteration of exhaust gas temperature test data	309	309
(4)	Adjustment of amplifiers for water brake torque indicators subsequent to amplifier calibration	353	362
(5)	Unauthorized operation of turbocharger intake temperature adjustment function for other-than-intended purposes	14	14

1.2 Impact on NOx and CO_2 emissions

Recalculations using specific prototype engines (parent engines)*4, for which records regarding the alteration of fuel consumption rate test data existed, confirmed that the number of engines for which compliance with NOx emissions regulations were impacted was as indicated below.

Category	Total number of parent engines*4 (Japan-registered vessels in parentheses are included in the total)	Total number of member engines*5 (Japan-registered vessels in parentheses are included in the total) (member engines related to parent engines in the left column)
A	1 (1)	0 (0)
B*6	200 (10)	465 (17)
C	0 (0)	0 (0)
D	2 (0)	6 (0)

A: No alteration of data was found and actual measured values did not deviate from NOx emissions regulation values.
B: Alteration of data was found, but actual measured values did not deviate from NOx emissions regulation values.
C: Alteration of data was found and actual measured values deviated from NOx emissions regulation values.
D: Further investigation is required, owing to difficulties in confirming actual measured values.

Reference: Status of confirmation as of September 27, 2024

Category	Total number of parent engines (Japan-registered vessels in parentheses are included in the total)	Total number of member engines (Japan-registered vessels in parentheses are included in the total) (member engines related to parent engines in the left column)
No alteration of data was found and actual measured values did not deviate from NOx regulation values	1 (1)	0 (0)
Alteration of data was found and compliance with NOx emissions regulations is currently being calculated	157 (9)	357 (10)
Actual measured values do not exist	45 (1)	114 (7)

In addition, because fuel consumption rates used in NOx emissions verification tests are also used for calculations to determine compliance with CO_2 emission regulations, namely, EEDI and EEXI, after verifying NOx emissions regulations, the Company continued to probe the impact of the unauthorized alteration of test data, adjustment of amplifiers for water brake torque indicators subsequent to calibration and unauthorized operation on compliance with CO_2 emissions regulations, which confirmed the appropriateness of water brake torque indicators. Accordingly, trial EEDI calculations were performed in cooperation with classification societies, shipyards and other relevant organizations. Calculations for all 139 engines that may be subject to EEDI (of which five were installed in Japan-registered vessels) revealed a low likelihood of exceeding these regulations.

*4, *5 When multiple engines are manufactured with the same specifications or with equivalent NOx emissions, a representative engine is chosen as the parent engine and is subject to NOx emissions verification tests and pre-shipment tests, and other engines are treated as member engines. Providing that specifications and modifications are identical, verified NOx emissions for the parent engine are applied to member engines.

*6 Category B included 31 parent engines (of which three are installed in Japan-registered vessels) and 61 member engines (none of which were installed in Japan-registered vessels) with numerical values that did not deviate from NOx emissions regulation values because steps were taken to shrink the operational tolerances (margins assuming engine adjustments and other factors that lead to higher NOx emissions) that affect NOx emissions as much as was feasible.

1.3 Verification of NOx and CO_2 emissions going forward

(1) Verification of Category B

Although internally calculated actual measured values did not deviate from NOx emissions regulation values, once the validity of those calculations is verified by relevant organizations (flag states and classification societies), NOx technical files are corrected and a request is made for the revision of EIAPP certificates.

(2) Verification of Category D

- Investigations continue with the aim of confirming actual measured values that make it possible for the Company to calculate NOx emissions. If no such values can be confirmed, the Company cooperates with relevant organizations to explore technical approaches to determining compliance with NOx emissions regulations.

  If confirmed actual measured values deviate from NOx emissions regulation values, discussions are held with relevant organizations, as well as with customers, on how to ensure compliance.

- In the absence of confirmed actual measured values, one possible approach to verification involves using actual measured values that are confirmed for engines with the same specifications or equivalent NOx emissions. If values thus yielded deviate from NOx emissions regulation values, consideration is given to immediately taking steps such as modifying maximum in-cylinder pressure and other performance parameters.

The Company also continues to recalculate EEDI and EEXI with the cooperation of classification societies, shipyards and other relevant organizations. If any vessel is found not to comply with the regulations, the Company responds promptly by consulting with relevant ship owners and ship management companies to determine the optimum steps to achieve compliance as quickly as possible.

2. Status of efforts to analyze causes and prevent recurrence

2.1 Analysis of causes by the internal company

Based on an analysis of the results of interviews with pertinent parties, the internal company has classified the root causes of this misconduct as (1) internal company organizational system–related issues, and (2) corporate culture– and mindset–related issues, and has identified the essential contributing factors as follows:

(1) Internal company organizational system–related Issues

(a) Systems for documenting processes for, and the basis of, decision making were deficient.

(b) Procedures at the shipping stage were lacking, with trade-offs made between competing priorities, i.e., quality and delivery time, or quality and cost.

(c) Systems and frameworks to ensure compliance were insufficient.

(d) Rather than a function-based organization, the internal company continued to deploy a product department organization, with authority in this particular situation concentrated in marine engine departments, meaning that quality assurance and other functional departments were unable to perform internal checks.

(e) When the internal company's automatic measuring system was created, oversight functions failed to recognize that specification data could be tampered with or to rectify this problem.

(f) In marine engine departments, the personnel rotation system did not work effectively, making it possible for misconduct involving a limited number of employees to continue undetected.

(2) Corporate culture– and mindset-related issues

(a) The corporate culture discouraged the acknowledgment or reporting of incidents, even if they were recognized as a compliance violation (a culture of following precedent), and instead priority was accorded to issues of delivery and profit over quality.

(b) Compliance awareness (crisis recognition) on the part of executives and department heads was lacking.

(c) The corporate culture was such that the falsification of quality records was justified in order to avoid having to explain discrepancies to customers.

(d) The corporate culture encouraged a self-contained, insulated approach to resolving issues and problems that eschewed assistance from other departments or third parties.

2.2 Wide-ranging efforts by the internal company to prevent recurrence

The internal company will implement the following measures to prevent recurrence based on the analysis of the results of the internal investigation .

(1) Measures to prevent the recurrence of internal company organizational system–related issues

Measures to prevent the recurrence of internal company organizational system–related issues will be incorporated into the quality management system so that prevention becomes an intrinsic component of related processes. The specific measures to be implemented, some of which are already in place, are as follows:

(a) Regulations will be established to preserve records pertaining to decision-making in order to deter the justification of testing misconduct, while regular sampling audits will be conducted to confirm the effectiveness thereof.

(b) Regulations regarding quality confirmation procedures for products at the shipping stage, which had involved trade-offs between competing priorities, will be revised.

(c) Unlike in 2010 and 2014, when a Companywide investigation failed to uncover testing misconduct, the compliance configuration has now been modified so that compliance-related personnel are full-time, rather than concurrently assigned to business departments, thus ensuring their independence. In addition, the compliance reporting and consultation system now includes an anonymous whistleblowing channel to external legal experts.

(d) In terms of organizational structure, whereas quality assurance departments were previously part of individual product divisions, in April 2021 they were separated out to create an independent division, clarifying responsibility for overall quality assurance and facilitating the provision of internal checks. The internal company will also conduct in-depth audits of processes and will encourage the horizontal deployment of this practice for other products.

(e) Rules will be established to verify the soundness of the automatic measurement system, ensuring that specification data cannot be tampered with and that related checks do not fail.

(f) Beginning in 2021, the internal company set a limit on the term of service for line managers at five years and is implementing personnel rotations that prevent employees becoming entrenched in one place.

(2) Measures to prevent the recurrence of corporate culture– and mindset-related issues
In response to issues identified through the internal investigation, the internal company will implement a thorough review of its corporate culture and foster a new culture as follows.

(a) Executives and managers will seek to build closer relations with employees, as well as to promote more open communication.
(b) Measures will be implemented to foster a compliance-first mindset on the part of executives and managers.
(c) Employees will be encouraged not to conceal mistakes, but rather to acknowledge them without fear, with the understanding that the act of honestly revealing any mistakes will be commended and that they are not solely responsible for rectification.
(d) Employees will be urged to speak up about issues in their own departments. Moreover, rather than viewing issues in other departments as someone else's problem, they will be encouraged to recognize the potential for similar issues in their own department, and to express their views and raise constructive points.

The Special Investigative Committee for Marine Engines created to probe this specific incident, which comprises neutral third-party experts, continues to examine the details and will advise the Company going forward regarding its analysis of causes and recommended measures for preventing recurrence. Taking into account causes cited by this committee, as well its recommendations for measures to ensure such misconduct does not happen again, the Company will take decisive steps to prevent recurrence along with the above actions.

3. Groupwide measures
Cognizant of the gravity of this and other recently identified incidents of misconduct, the Company has established the Special Compliance Promotion Committee, which is chaired by Representative Director, President and CEO Yasuhiko Hashimoto. This committee is working diligently not only to clarify and eradicate the problems that led to these specific incidents, but also to prevent recurrence by scrupulously reforming the Company Group's compliance and governance framework through the building of systems that prevent misconduct, strengthening of detection capabilities and reform of its corporate culture.

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Kawasaki Heavy Industries, Ltd.

KPQ-2024-180

December 25, 2024

Ocean Development and Environment Policy Division,
Shipbuilding and Ship Machinery Division,
and Inspection and Measurement Division,
Maritime Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Kawasaki Heavy Industries, Ltd.

Report on Internal Investigation into Misconduct in the Testing of Marine Engines

This report has been translated from the original Japanese for reference purposes only.

In the event of any discrepancy between this report and the original Japanese, the original Japanese shall prevail.

Contents

1. Overview

On July 5, 2024, Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) requested that Kawasaki Heavy Industries, Ltd., conduct a fact-finding investigation into whether there had been misconduct in nitrogen oxide (NOx) emissions verification tests*1 for its marine engines. The Company responded by launching an internal investigation of such engines, which are subject to International Maritime Organization (IMO) Tier I and other regulations governing NOx emissions from marine engines. This investigation uncovered misconduct—namely, the alteration of data—during shop trials, including in verification tests for NOx emissions.

This report includes information on (1) the impact of this misconduct on compliance with regulations governing NOx emissions*2 and CO_2 emissions, namely, the energy efficiency design index (EEDI)*3 and the energy efficient existing ship index (EEXI),*4 (2) corrective measures implemented in areas in which misconduct was uncovered, and (3) an analysis of the root causes of this misconduct based on the findings of the internal company's investigation, as well as measures that the internal company is taking to prevent recurrence. The Special Investigative Committee for Marine Engines, which was created to probe this specific incident, continues to analyze causes and recommend measures for preventing recurrence. The findings of that independent investigation will be announced separately. There have been no confirmed cases of this misconduct having impacted the safety of these engines during sea trials or actual use.

*1 NOx emissions verification tests are conducted with the aim of obtaining Engine International Air Pollution Prevention (EIAPP) certificates.

*2 NOx emissions regulations for marine engines are based on Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL), which came into effect in May 2005, with the aim of preventing air pollution caused by exhaust emitted from ships. These regulations were applied retroactively to ships the keels of which were laid on or after January 1, 2000. Tier II and Tier III NOx emissions regulations, setting more stringent targets, came into effect for engines installed in ships the keels of which were laid on or after January 1, 2011, and January 1, 2016, respectively. Tier III regulations apply only to the specified ships while operating in Emission Control Areas.

*3 The EEDI, which applies to new ships of 400 gross tonnage or above that will engage in international voyages, aims to reduce the CO_2 emissions and environmental impact of individual ships by assessing their energy efficiency.

*4 The EEXI is used to assess the energy efficiency of existing ships of 400 gross tonnage or above that are engaged in international voyage.

2. Investigation of the Facts

2.1 Subject and Scope of the Investigation

The Company inspected 674 marine engines*1 subject to NOx emissions regulations for marine vessels, manufactured by the Energy Solution & Marine Engineering Company (an internal company), which were installed on vessels constructed after January 1, 2000. This investigation uncovered misconduct during engine shop trials, which include pre-shipment tests*2 and NOx emissions verification tests. The impact of this misconduct on compliance with NOx emissions regulations*2 and with CO_2 emissions regulations was also assessed.

*1 This encompasses 673 two-stroke engines manufactured under license and one four-stroke engine developed by the Company.
*2 Pre-shipment tests are conducted prior to delivery to confirm that an engine's performance, including the fuel consumption rate, satisfies customer specifications.

2.2 Configuration and Progress of the Investigation

As soon as it became aware of this misconduct in testing, the Company established an internal investigative committee under the direction of the Quality Assurance Division to examine the matter from a third-party perspective. The investigation was completed under a three-pronged configuration, as follows:

- Individual in charge: General Manager, Quality Assurance Division, Energy Solution & Marine Engineering Company
- Team investigating causes and formulating measures to prevent recurrence: 6 members
- Team investigating records and formulating technical responses: 10 members

Timeline of the investigation and related public announcements in 2024

July 10	Initial internal investigation carried out in response to a request received from the MLIT on July 5 identifies misconduct in testing
July 12	Preliminary information is conveyed to the president of the pertinent internal company (thorough internal investigation is launched)
July 19	Preliminary information is conveyed to the Company's President (scope of investigation is expanded to encompass the entire period from production forward)
August 21	Misconduct in testing is reported to the MLIT and disclosed publicly
August 22–23	The MLIT conducts on-site inspection
August 30	Notice is issued regarding initiatives to strengthen compliance and the establishment of the Special Investigative Committee for Marine Engines
September 13	The MLIT's Maritime Bureau conducts an on-site investigation subsequent to the rectification of testing equipment
September 27	The interim report is submitted to the MLIT's Maritime Bureau Press conference is held regarding misconduct in testing marine engines
November 11	EIAPP certificates are obtained
December 25	The latest report is submitted to the MLIT's Maritime Bureau

2.3 Investigative Methodology

2.3.1 Investigation of Internal Records

The team investigating records and formulating technical responses was tasked with probing whether there were records of data having been altered and, if so, to calculate values prior to alteration and recording in shop trial reports submitted to customers (hereinafter referred to as "actual measured values"), as well as to determine compliance or noncompliance with NOx and CO_2 emissions regulations.

2.3.2 Interviews with Pertinent Parties

Two rounds of interviews were conducted, the first by managers in the pertinent design, production and quality assurance departments, and the second by employees in the quality assurance department (individuals not directly involved with products) and the Compliance Department. In the first round, interviews were held not only with individuals currently in charge of shop trials and their predecessors, but also with individuals in related departments. These interviews focused on confirming whether data used to calculate the fuel consumption rates had been altered, ascertaining whether testing equipment had been manipulated, discovering whether records had been kept and identifying the motives behind this misconduct. The second round, which sought to confirm whether there were any systematic organizational handovers, began with current employees and continued with an expanded target pool that included senior executives, with a total of 38 individuals interviewed.

3. Findings of the Investigation

After confirming shop trial records and interviewing pertinent parties, it was ascertained that data had been altered and that there had been misconduct in testing during shop trials for the 673 two-stroke marine engines. Misconduct fell into one or more of five categories. No testing misconduct was found for the single four-stroke engine investigated.

The findings of this internal investigation, which examined data collection and processing systems, verified that data alteration is not possible in the systems utilized for land-use gas-fueled engines or for hydrogen dual-fuel engines currently under development.

3.1 Areas in Which Misconduct in Testing Was Uncovered

The investigation continued after submission of the interim report on September 27, 2024. It was ultimately confirmed that that the testing misconduct was either to satisfy customer specifications (via alteration of test data), or to compensate for the accuracy levels of testing equipment (via unauthorized adjustment of data subsequent to calibration for other-than-intended purposes). The results of this internal investigation are shown in Table 1.

Table 1: Identified Unauthorized Alteration, Adjustment and Unauthorized Operation

Category		Number of engines (as of September 27, 2024) (date of interim report)	Number of engines (as of December 25, 2024) (date of latest report)
(1)	Unauthorized alteration of fuel consumption test data	588	593
(2)	Unauthorized alteration of fuel consumption rate test data	565	569
(3)	Unauthorized alteration of exhaust gas temperature test data	309	309
(4)	Adjustment of amplifiers for water brake torque indicators subsequent to amplifier calibration	353	362
(5)	Unauthorized operation of turbocharger intake	14	14

	temperature adjustment function for other-than-intended purposes		

3.2 Motives behind the Misconduct

3.2.1 Motive behind the Unauthorized Alteration of Test Data

Based on the results of interviews conducted to date, it is believed that the main motive behind the unauthorized alteration of test data was to avoid having to explain discrepancies in fuel consumption and other performance-related issues by keeping engine fuel consumption values within the required range of customer specifications, and by reducing the discrepancies in fuel consumption performance and other performance.

3.2.2 Motive behind the Adjustment Subsequent to Calibration or Unauthorized Operation

It is believed that the main motive behind the adjustment subsequent to calibration or unauthorized operation was to maintain and improve the accuracy of measurements despite the constraints imposed by existing measuring equipment.

3.3 Impact on NOx and CO_2 Emissions

Compliance with NOx and CO_2 emissions regulations was confirmed for specific prototype engines ("parent engines"),*1 for which records regarding the alteration of fuel consumption rate test data existed, based on the Company's calculations. (Subsequently manufactured engines based on a parent engine are called "member engines.")*1 The volume and rate of fuel consumption are necessary to calculate NOx and CO_2 emissions. The Company recalculated these figures after confirming actual measured NOx and CO_2 emissions values prior to the alteration of data. Moreover, since it is difficult to recalculate NOx and CO_2 emissions if engine output is inaccurate, the Company also investigated the impact of adjusting water brake torque indicators subsequent to amplifier calibration. As stated in 5.4 below, technical verification confirmed that appropriate engine output values were set in the shop trial report, so these values were used in the recalculation.

If NOx emissions are confirmed for the parent engine, based on the provisions of the NOx Technical Code, member engines are deemed to have the same NOx emissions and EIAPP certificates will be issued.

*1 When multiple engines are manufactured with the same specifications or with equivalent NOx emissions, a representative engine is chosen as the parent engine and is subject to NOx emissions verification tests and pre-shipment tests, and other engines are treated as member engines. Providing that specifications and modifications are identical, verified NOx emissions for the parent engine are applied to member engines.

That the number of engines for which NOx emissions were recalculated is as shown in Table 2.

Table 2: Number of Engines for Which NOx Emissions Were Recalculated

Category	Total number of parent engines (Japan-registered vessels in parentheses are included in the total)	Total number of member engines (Japan-registered vessels in parentheses are included in the total) (member engines related to parent engines in the left column)
A	1 (1)	0 (0)
B*2	200 (10)	465 (17)
C	0 (0)	0 (0)
D	2 (0)	6 (0)

A: No alteration of data was found and actual measured values did not deviate from NOx emissions regulation values.
B: Alteration of data was found, but actual measured values did not deviate from NOx emissions regulation values.
C: Alteration of data was found and actual measured values deviated from NOx emissions regulation values.
D: Further investigation is required, owing to difficulties in confirming actual measured values.

*2 Category B includes 31 parent engines (three of which were installed in Japan-registered vessels) and 61 member engines (none of which were installed in Japan-registered vessels) with measured values that did not deviate from NOx emissions regulation values because steps were taken to shrink the operational tolerances (margins assuming engine adjustments and other factors that lead to higher NOx emissions) that affect NOx emissions as much as was feasible.

For reference, at the time of interim report, the number of engines for which NOx emissions had been calculated is as shown in Table 3.

Table 3: Number of Engines for Which NOx Emissions Had Been Calculated as of the Date of the Interim Report

Category	Total number of parent engines (Japan-registered vessels in parentheses are included in the total)	Total number of member engines (Japan-registered vessels in parentheses are included in the total) (member engines related to parent engines in the left column)
A	1 (1)	0 (0)
X*3	157 (9)	357 (10)
D*4	45 (1)	114 (7)

*3 The impact on NOx emissions of “(4) Adjustment of amplifiers for water brake torque indicators subsequent to amplifier calibration” (see above: “3.1 Areas in Which Misconduct in Testing Was Uncovered”) was not clear as of the date of the interim report. This was subsequently clarified through detailed verification tests conducted in cooperation with the MLIT and these engines were reclassified as Category B, as shown in Table 2, with the exception of one parent engine (which was not installed in a Japan-registered vessel), which was reclassified as Category D because there was a need to confirm the accuracy of parameters used to calculate NOx emissions.

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*4 For engines classified in Category D, fuel consumption and fuel consumption rates were verified through internal pre-shipment tests and used to estimate actual measured values. NOx emissions were estimated using those values. One parent engine (which was not installed in a Japan-registered vessel) and six member engines (none of which were installed in Japan-registered vessels) remained classified as Category D because the parameters for recalculation of NOx emission still need to be verified, as shown in Table 2.

In addition, because fuel consumption rates used in NOx emissions verification tests are also used in the calculations to determine compliance with regulations governing CO_2 emissions, namely, EEDI and EEXI, after verifying NOx emissions regulation values, the Company continued to probe the impact of the unauthorized alteration of test data, adjustment of amplifiers for water brake torque indicators subsequent to amplifier calibration and unauthorized operation on compliance with CO_2 emissions regulations, which confirmed the appropriateness of water brake torque indicators. Accordingly, trial EEDI calculations were performed in cooperation with classification societies, shipyards and other relevant organizations.

Testing was conducted on 139 engines that may be subject to EEDI (five of which were installed in Japan-registered vessels). Calculations for all 139 engines revealed a low likelihood of exceeding those regulations.

4. Verification of NOx and CO_2 Emissions Regulations Going Forward

Classifications into categories B, C and D above are based on internal calculations as of the date of this report. Further steps will be taken in collaboration with relevant organizations to finalize the classification into these three categories.

4.1 Verification of Category B

Although internally calculated actual measured values did not deviate from NOx emissions regulation values, once the validity of those calculations has been verified by relevant organizations (flag states and classification societies), NOx technical files will be corrected and a request made for the revision of EIAPP certificates.

Operational tolerances for 31 parent engines (three of which were installed in Japan-registered vessels) and 61 member engines (none of which were installed in Japan-registered vessels) were reduced through the process described above to a level facilitating reclassification as Category B. Approval of the reduced operational tolerances will be sought from relevant organizations (flag states and classification societies).

4.2 Verification of Category C

In cases where internally calculated values deviated from NOx emissions regulation values, once the validity of those calculations is verified by relevant organizations, discussions will be held with these organizations, as well as with customers, on how to ensure compliance. Possible approaches include taking steps to modify maximum in-cylinder pressure and other performance parameters that affect NOx emissions.

4.3 Verification of Category D

Investigations are continuing with the aim of confirming actual measured values that make it

possible for the Company to calculate NOx emissions. If no such values can be confirmed, the Company will cooperate with relevant organizations to explore technical approaches to determining compliance with NOx emissions regulations.

If confirmed actual measured values deviate from NOx emissions regulation values, discussions will be held with relevant organizations, as well as with customers, on how to ensure compliance.

In the absence of confirmed actual measured values, one possible approach to verification involves using actual measured values that are confirmed for engines with the same or equivalent specifications. If values thus yielded deviate from NOx emissions regulation values, consideration will immediately be given to taking steps, as described in 4.2 above, to achieve compliance.

The Company is also continuing to recalculate EEDI and EEXI with the cooperation of classification societies, shipyards and other relevant organizations. If any vessel is found not to comply with the regulations, the Company will respond promptly by consulting with relevant ship owners and ship management companies to determine the optimum steps to achieve compliance as quickly as possible.

5. Actions Taken in Response to Investigation Findings

Based on the findings of the internal company's investigation to date, implementation of the corrective measures outlined in 5.1 to 5.3 below in response to the motives behind the misconduct in testing described above in 3.2. has been completed. Regarding the adjustment of amplifiers for water brake torque indicators subsequent to amplifier calibration, the Company will continue to discuss corrective measures with relevant organizations, as indicated in 5.4.

5.1 Alteration of Data and Corrective Measures Implemented

5.1.1 Unauthorized Alteration of Fuel Consumption Test Data

Alteration

The gain dials of load cell amplifiers used to measure fuel consumption were adjusted subsequent to calibration.

Objective

This was done to prevent fuel consumption performance from deviating significantly from customer specifications.

Opportunity for unauthorized alteration

Load cell amplifiers could be adjusted subsequent to calibration and prior to measurement. Moreover, there was a lack of sufficient awareness of the impropriety of post-calibration adjustment.

Corrective measures

Load cell amplifier gain dials are now covered and sealed after calibration, and procedural manuals now specify that seals must be checked for irregularities before and after measurement. Each seal has an exclusive identification code and if the seal is removed, a message to that effect appears. Training has been introduced to reinforce awareness of the importance of calibration.

5.1.2 Unauthorized Alteration of Fuel Consumption Rate Test Data

Alteration

The computers used for measurement had a function that could be employed while fuel consumption rates were being measured. This function was used to alter measured fuel consumption rates.

Objective

This was done to prevent fuel consumption performance deviating significantly from customer specifications.

Opportunity for unauthorized alteration

The aforementioned function in the computers used for measurement existed from before the period covered by the investigation, but this had remained undetected and had not been corrected before now.

Corrective measures

The computers used for measurement were modified to remove the aforementioned function.

5.1.3 Unauthorized Alteration of Exhaust Gas Temperature Test Data

Alteration

The zero-point adjustment function for temperature correction was used for other-than-intended purposes, namely, to make variations appear smaller or to alter temperatures to desired levels.

Objective

This was done to make variations in performance appear smaller.

Opportunity for unauthorized alteration

While correcting temperature and other settings through the calibration of measurement devices is crucial, this function had the potential to be used by anyone for other-than-intended purposes.

Corrective measures

The computers used for measurement were modified to password-protect the correction value display screen and to create a record when logging in. Passwords are managed by the quality assurance department, which is now able to ensure that data is not being altered.

5.1.4 Adjustment of Amplifiers for Water Brake Torque Indicators Subsequent to Amplifier Calibration

Alteration

The gain dials of load cell amplifiers (mounted in control panel doors) used to adjust water brake torque were adjusted subsequent to amplifier calibration.

Objective

This was done to adjust displayed torque to reduce variations in water brake torque based on the engine output, which is estimated using, for example, in-cylinder pressure.

Opportunity for adjustment

Load cell amplifiers could be adjusted subsequent to amplifier calibration and prior to individual shop trials. Moreover, there was a lack of sufficient awareness of the impropriety of using another method of measurement after calibration.

Corrective measures

The use of water brakes that show large variances has been discontinued. In addition, load cell amplifier gain dials are now covered and sealed subsequent to calibration, and procedural manuals now specify that seals must be checked for irregularities before and after measurement.

5.1.5 Unauthorized Operation of Turbocharger Intake Temperature Adjustment Function for Other-than-Intended Purposes

Alteration

The zero-point adjustment function for temperature correction of computers used for measurement was used for other-than-intended purposes, namely, to alter temperatures to desired levels, based on past records.

Objective

This was done to avoid inconsistency between a single-point measurement data and a multi-point measurement result taken in advance. Additionally, this was used to make variations in data appear smaller.

Opportunity for unauthorized operation

The aforementioned function in the computers used for measurement existed from before the period covered by the investigation, but this had remained undetected and had not been corrected before now. While adjusting temperature and other settings through the calibration of measurement devices is crucial, this function had the potential to be used by anyone for other-than-intended purposes.

Corrective measures

The computers used for measurement were modified to password-protect the correction value display screen and to create a record when logging in. Passwords are managed by the quality assurance department, which is now able to ensure that data is not altered.

5.2 Reasons for the Failure to Detect Issues and Corrective Measures Implemented

Although a limited number of individuals were aware of the alteration of test data, as well as the adjustment of amplifiers subsequent to calibration or for other-than-intended purposes, as indicated in 5.1, the internal company failed to detect these issues or to take corrective action.

The alteration of test data, as well as the adjustment of amplifiers subsequent to calibration or for other-than-intended purposes, began because data obtained during shop trials failed to meet customer specifications. Moreover, shop trial reports were compiled and issued by the design department, while the quality assurance department only checked for deficiencies in the reports themselves, but did not perform in-depth checks of the shop trial process.

Going forward, the quality assurance department will confirm that there have been no opportunities for misconduct in the shop trial process, while shop trial reports will only be issued after the quality assurance department has verified the validity of data.

In addition, the Quality Assurance Division, which is independent from business activities, will oversee quality assurance across the internal companies. This body will conduct internal audits and take other steps to further strengthen the Company's ability to detect the alteration of test data, as well as the alteration of data subsequent to calibration or for other-than-intended purposes.

5.3 Confirmation of the Effectiveness of Corrective Measures

Auditors from the Quality Management Section—a subordinate entity of the Quality Assurance Division—who play no direct role in product inspections in the internal companies, confirmed implementation of the corrective measures outlined in 5.1 and 5.2 from a third-party perspective and verified the effectiveness thereof.

5.4 Supplementary Investigation of Water Brakes

The torque displayed by the water brakes varied across engines of the same model as a consequence of differences in the water brakes themselves. To reduce such variances, the water brakes were adjusted based on the engine output, which is estimated using, for example, in-cylinder pressure.

Regarding the handling of the engine data in which there was adjustment of amplifiers for water brake indicators, in subsequent shop trials this was compared with engine output measured through different means (for example, using a strain gauge to calculate torque). In cooperation with relevant organizations, it was confirmed that there were no significant discrepancies between engine output data contained in the shop trial report and actual engine output.

In future shop trials, the use of water brakes that displays that do not diverge will make it possible to record engine output in the shop trial reports without having to make any adjustment.

6. Status of Efforts to Analyze Causes and Prevent Recurrence

6.1 Internal Company Organizational System– and Corporate Culture–Related Issues

Based on the findings of the investigation to date, it is believed that the engine design department was under pressure to meet the fuel consumption performance of engines. The internal company was found to have committed misconduct in testing in relation to the performance testing for which it was responsible.

In the past, the issue of misconduct in testing had been raised by individuals in charge with their then-managers. When the Company conducted a Groupwide investigation into quality-related misconduct triggered by similar incident at a Group company in fiscal 2022, it was discovered that individuals involved in the design, manufacture and inspection of marine engines were aware of that particular misconduct. However, the internal company failed to fully grasp that this misconduct in testing was occurring or to take corrective action.

Based on an analysis of the results of interviews with pertinent parties, the Company has classified the root causes of this misconduct as (1) internal company organizational system–related issues and (2) corporate culture– and mindset-related issues, and has identified the essential contributing factors as follows:

(1) Internal company organizational system–related issues

(a) Systems for documenting processes for, and the basis of, decision making were deficient.

(b) Procedures at the shipping stage were lacking, with trade-offs made between competing priorities, i.e., quality and delivery time, or quality and cost.

(c) Systems and frameworks to ensure compliance were insufficient.

(d) Rather than a function-based organization, the internal company continued to deploy a product department–based organization, with authority in this particular situation concentrated in marine engine departments, meaning that quality assurance and other functional departments were unable to perform internal checks.

(e) When the internal company’s automatic measuring system was created, oversight functions failed to recognize that specification data could be tampered with or to rectify this problem.

(f) In marine engine departments, the personnel rotation system did not work effectively, making it possible for misconduct involving a limited number of employees to continue undetected.

(2) Corporate culture– and mindset-related issues

(a) The corporate culture discouraged the acknowledgment or reporting of incidents, even if they were recognized as a compliance violation (a culture of following precedent), and instead priority was accorded to issues of delivery and profit over quality.

(b) Compliance awareness (crisis recognition) on the part of executives and department heads was lacking.

(c) The corporate culture was such that the falsification of quality records was justified in order to avoid having to explain discrepancies to customers.

(d) The corporate culture encouraged a self-contained, insulated approach to resolving issues and problems that eschewed assistance from other departments or third parties.

6.2 Wide-ranging efforts by the internal company to prevent recurrence

The internal company will implement the following measures to prevent recurrence based on the aforementioned analysis of the results of its investigation to date.

(1) Measures to prevent the recurrence of internal company organizational system–related issues

Measures to prevent the recurrence of internal company organizational system–related issues will be incorporated into the quality management system so that prevention becomes an intrinsic component of related processes. The specific measures to be implemented, some of which are already in place, are as follows:

(a) Regulations will be established to preserve records pertaining to decision making in order to deter the justification of testing misconduct, while regular sampling audits will be conducted to confirm the effectiveness thereof.

(b) Regulations regarding quality confirmation procedures for products at the shipping stage, which had involved trade-offs between competing priorities, will be revised.

(c) Unlike in 2010 and 2014, when a Companywide investigation failed to uncover testing misconduct, the compliance configuration has now been modified so that compliance-related personnel are full-time, rather than being concurrently assigned to business departments, thus ensuring their independence. In addition, the compliance reporting and consultation system now includes an anonymous whistleblowing channel to external legal experts.

(d) In terms of organizational structure, whereas quality assurance departments were previously part of individual product divisions, in April 2021 they were separated out to create an independent division, clarifying responsibility for overall quality assurance and facilitating the provision of internal checks. The internal company will also conduct in-depth audits of processes and will encourage the horizontal deployment of this practice for other products.

(e) Rules will be established to verify the soundness of the automatic measuring system, ensuring that specification data cannot be tampered with and that related checks do

not fail.

(f) Beginning in 2021, the internal company set a limit on the term of service for line managers at five years and is implementing personnel rotations that prevent employees becoming entrenched in one place.

(2) Measures to prevent the recurrence of corporate culture– and mindset-related issues

In response to issues identified through its investigation, the internal company will implement a thorough review of its corporate culture and foster a new culture through the following efforts:

(a) Executives and managers will seek to build closer relations with employees, as well as to promote more open communication.

(b) Measures will be implemented to foster a compliance-first mindset on the part of executives and managers.

(c) Employees will be encouraged not to conceal mistakes, but rather to acknowledge them without fear, with the understanding that the act of honestly revealing any mistakes will be commended and that they are not solely responsible for rectification.

(d) Employees will be urged to speak up about issues in their own departments. Moreover, rather than viewing issues in other departments as someone else's problem, they will be encouraged to recognize the potential for similar issues in their own departments, and to express their views and raise constructive points.

7. Disclosure to Customers and Relevant Organizations

The Company, acting primarily through its sales and design divisions, is providing an overall explanation of this incident of misconduct in testing, and is apologizing to customers and related organizations. The Company is also cooperating with relevant organizations to determine the impact of this misconduct on compliance with NOx and CO_2 emissions regulations.

The Company continues to receive inquiries, mainly regarding the impact of this misconduct on the navigation of vessels and investigation results, and remains committed to responding to these inquiries sincerely and to providing precise explanations to customers.

8. Groupwide Efforts to Reinforce Compliance and the Role of the Special Investigative Committee for Marine Engines

Cognizant of the gravity of this and other recently identified incidents of misconduct, the Group established the Special Compliance Promotion Committee, which is chaired by Representative Director, President and CEO Yasuhiko Hashimoto, and has as its members the vice presidents and business division heads. This committee is working diligently not only to clarify and eradicate the problems that led to these specific incidents, but also to prevent recurrence by scrupulously reforming the Group's compliance and governance framework through the building of systems that prevent

misconduct, strengthening of detection capabilities and reform of its corporate culture.

At the Board of Directors meeting held on August 28, 2024, the Company established the Special Investigative Committee for Marine Engines. As well as collaborating with the Special Compliance Promotion Committee, this investigative committee, which comprises neutral third-party experts, is charged with further examining and identifying incidents from an objective, professional perspective, including by investigating details, analyzing causes, formulating measures to prevent recurrence and uncovering any similar incidents.

Special Investigative Committee for Marine Engines
Chairperson: Makoto Hayashi (lawyer, Mori, Hamada & Matsumoto)
Member: Mugi Sekido (lawyer, Mori, Hamada & Matsumoto)
Member: Yasuhiko Fujitsu (lawyer, Mori, Hamada & Matsumoto)
Technical advisor: Akiko Masuda (National Maritime Research Institute)
Technical advisor: Yoichi Niki (National Maritime Research Institute)

The Company will continue to devise comprehensive measures to prevent recurrence of any such misconduct, in line with the causes identified, and the recommendations made, by the Special Investigative Committee. The findings and measures outlined in this report on the internal investigation will be discussed and then shared with that committee.