

Introduction to the Special Feature on “Zero-Emissions Ships”

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Special Feature Articles on Zero-Emissions Ships

(Invited Lead-off Article)

Efforts of the Planning and Design Center for Greener Ships (GSC)

..... *Planning and Design Center for Greener Ships (GSC) Ryutaro KAKIUCHI*..... 3

Since the Planning and Design Center for Greener Ships (GSC) was established in October of 2020, the GSC has promoted surveys and analyses of domestic and overseas trends, etc. with the aim of reducing GHG emissions from international maritime shipping, and also conducted a study on the ideal form of ships in the transition period leading to net-zero carbon in 2050 to promote the development of environmental ships from the viewpoint of how international shipping can achieve a smoother transition to net-zero carbon. This paper introduces representative efforts of the GSC in connection with regulatory trends and trends in new fuels related to decarbonization that will affect ship design, and the development of next-generation ships that respond to requirements for reduction of GHG emissions and zero emissions from international shipping toward the achievement of net-zero carbon.

Development of onboard CO₂ Capture System

..... *Mitsubishi Shipbuilding Co., Ltd. Shinichi KAWAMATA, Yusuke WATANABE, Takashi UNSEKI*..... 15

As part of the energy transition strategy in Mitsubishi Heavy Industries Group, Mitsubishi Shipbuilding is engaged in the development of a “CO₂ capture system on the ocean” with the aim of reducing CO₂ emissions from ships. This paper introduces the CO₂ capture system of the marine demonstration project (CC-Ocean [Carbon Capture on the Ocean]), which was conducted in cooperation with Kawasaki Kisen Kaisha (“K” Line), Ltd. and ClassNK, under Japan’s Ministry of Land, Infrastructure, Transport and Tourism (MLIT), as the most recent of those efforts, and describes the future prospects for the development of this technology.

Prospects for Widespread Adoption of Next-Generation Standard EV Vessel ROBOSHIP

..... *e5 Lab Inc. Yuri JINNAI, Takehiko TSUCHIYA*..... 23

The coastal shipping industry is not only facing the longstanding challenges of both the aging of ships and seafarers and the limits to the succession of know-how, but also the issues of delayed implementation of environmental countermeasures and the resulting possibility of decreased corporate value in recent years. This paper introduces the features of the next-generation EV vessel ROBOSHIP as a realistic and practically possible solution to these problems, and its superiority and expandability in comparison with conventional ships. The paper also introduces the ship digitalization tool Marindows, which is planned to be provided as a response to delayed digitalization, which is also an issue in the coastal shipping industry.

ClassNK's Efforts to Reduce GHG Emissions from Ships

..... *Planning Division, Zero-Emission Transition Center, ClassNK*
Plan Approval and Technical Solution Division, Marine GHG Certification Department, ClassNK..... 31

The “EEXI regulation” and “CII fuel consumption rating system,” which are intended to reduce CO₂ emissions from ships in service, are to be introduced in 2023, and moves toward zero emissions are accelerating also in the maritime shipping business. This paper introduces the outlines of the “EEXI regulation” and “CII fuel consumption rating system,” ClassNK’s response to these programs and the outline of the “ClassNK Zero-Emission Transition Service” being developed by ClassNK.

Technical Topics

Future Fluidics Analysis and an AI Surrogate Model for Manufacturing

..... *Innovation Development Division, Renewables and Environment Department, ClassNK*..... 43

Expanded utilization of wind energy is being promoted to realize carbon neutrality. However, as the scale and investment cost of facilities increase substantially, dramatically faster fluidics engineering calculation is necessary in order to perform more precise structural safety design and performance estimation. This paper introduces an “AI surrogate model” using a virtual particle model adopted from the lattice gas method, and explains the concepts contributing to higher computational speed through the functions of fuzzy estimation and real-time learning.

Part C “Guidelines for the Safety of Ships Using Ammonia as Fuel” of Guidelines for Ships Using Alternative Fuels

..... *Plan Approval and Technical Solution Division, Technical Solution Department, ClassNK*..... 63

With the Paris Agreement entering into force in 2016 and the growing global momentum of decarbonization, the IMO adopted an Initial strategy on the reduction of GHG emissions at MEPC72 in 2018. Because ammonia produces zero GHG emissions, it has attracted attention as an alternative fuel, and the development of ammonia-fueled ships is being accelerated worldwide. To respond to that current situation, ClassNK issued “Guidelines for Ships Using Alternative Fuels Part C,” which presents guidelines for the safety of ships using ammonia as fuel. This paper provides an overview of the current status and explains the outline of Part C of the Guidelines.

Overview of Changes and Comprehensive Revision of Part C of the Rules for the Survey and Construction of Steel Ships

..... *Rule Development and ICT Division, Hull Rules Development Department, ClassNK*..... 75

The Society established five basic strategies in the five-year medium-term management plan which started in 2017, and began a comprehensive revision of Part C of the Rules for the Survey and Construction of Steel Ships, which is an original rule for the construction of ship hulls formulated by the Society, in a manner that corresponds to one of those strategies, “Promoting research and development activities.” The comprehensive revision of Part C is scheduled to be instructed around July of 2022. This paper explains the transition of the Society’s structural strength rules since they were first issued in 1921 and describes the positioning of this comprehensive review from the viewpoint of the transition to date.

Setting Corrosion Additions Based on Latest Thickness Measurement Data

.....*Rule Development and ICT Division, Hull Rules Development Department, ClassNK*..... 83

In the development of rules for hull structural strength, it is necessary to appropriately estimate the amount of the corrosion loss of the structural members of vessels over a period of 25 years. This paper introduces the results of estimation of corrosion loss using recent plate thickness measurement data in comparison with the probabilistic model for the process of the initiation and progress of corrosion that has been used conventionally. The corrosion additions provided in the rules were set based on the obtained corrosion loss results, and were compared with the corrosion additions provided in the Common Structural Rules of the IACS.

Evaluation of the Ship Operational Effect Based on Actually Encountered Sea States by Ships

.....*Research Institute, ClassNK*..... 93

In recent years, the Automatic Identification System (AIS) has made it possible to assess the sea conditions actually encountered by ships by linking the location and time information obtained by AIS and the oceanographic data calculated by wave hindcasting. Based on the actual sea conditions encountered by general merchant ships in the North Atlantic, in this paper, a quantitative assessment of the effect of actual sea conditions on ship operation was carried out based on the Table of Wave Occurrence Frequencies in the North Atlantic Areas in Recommendation No. 34 of the International Association of Classification Societies (IACS Rec. No. 34) for the ship motions, vertical wave bending moment and wave hydrodynamic pressure of the ships concerned.

CBM Life Cycle Maintenance.....*MTI Co., Ltd. Tsuyoshi TERA, Japan Engine Corporation Satoshi IIMA, Research Institute, ClassNK Takuya WAKO*..... 101

This study is joint research conducted for the purpose of “understanding bearing damage by monitoring the main bearing lubrication oil (LO) outlet temperature”. The study consisted of an actual ship onboard monitoring test and a simulation test. In the actual ship test, an analysis method that enables easier monitoring was also studied in addition of data monitoring, and damage items that cannot be measured on an actual ship were examined in the simulation test.

Recent Topics at IMO*Rule Development and ICT Division, External Affairs Department, ClassNK*..... 109

This article introduces recent topics discussed at International Maritime Organization (IMO). At this issue, a summary of the decisions taken at 77th Marine Environment Protection Committee (MEPC 77) and 104th Maritime Safety Committee (MSC 104) is provided.