

NYK Line  
Japan Engine Corporation  
IHI Power Systems Co., Ltd.  
Nihon Shipyard Co., Ltd.

September 7, 2022

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## **Ammonia-Fueled Ammonia Gas Carrier Obtained AiP from Classification Society ClassNK**

*-- Moving closer to zero-emission vessels with risk assessment for world's first approval of an alternative design --*

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On September 7, NYK Line, Japan Engine Corporation, IHI Power Systems Co., Ltd., and Nihon Shipyard Co., Ltd. (the "Consortium") received approval in principle (AiP) from ClassNK for an ammonia-fueled ammonia gas carrier (AFAGC).

At present, there are no international regulations for the use of ammonia as marine fuel. Therefore, the Consortium have been conducting research and development to ensure that the AFAGC has the same safety features as vessels using existing fuel oil or LNG (liquefied natural gas) fuel.

The Consortium conducted a HAZID\* risk assessment of the safety of using ammonia as marine fuel in anticipation of obtaining approval of an alternative design,\*\* which is indispensable for realizing a demonstration operation in fiscal 2026. The Consortium then received an AiP from Japanese class society ClassNK after concluding that safety can be ensured. This is the first time that a risk assessment has been conducted and an AiP obtained not only for a concept but also an alternative design.

### **Background of AFAGC development**

Since ammonia does not emit carbon dioxide (CO<sub>2</sub>) when combusted, it is expected to be a next-generation fuel that contributes to the global warming

measures and is expected to be in demand for mass transportation in the future. In addition, by transporting ammonia as cargo and using it as fuel during voyages, it will be possible to significantly reduce greenhouse gas (GHG) emissions during voyages.

This initiative is the development of vessels equipped with a domestically produced ammonia-fueled engine, which was initiated in October 2021 by NYK, Japan Engine Corporation, IHI Power Systems Co., Ltd., and Nihon Shipyard Co., Ltd. as part of the Green Innovation Fund Project\*\*\* of the New Energy and Industrial Technology Development Organization (NEDO).

With the goal of early social implementation of next-generation fuel vessels, the Consortium are developing (a) a two-stroke ammonia-fueled engine for vessel propulsion, (b) a four-stroke ammonia-fueled engine for onboard power supply, and (c) a safe and environmentally friendly hull. The Consortium is working together to study the feasibility of construction and commercial operation of the prototype vessel in an integrated manner.

### **Basic design of prototype vessel completed and AiP obtained**

The main design issues when using ammonia as a fuel during development are as follows.

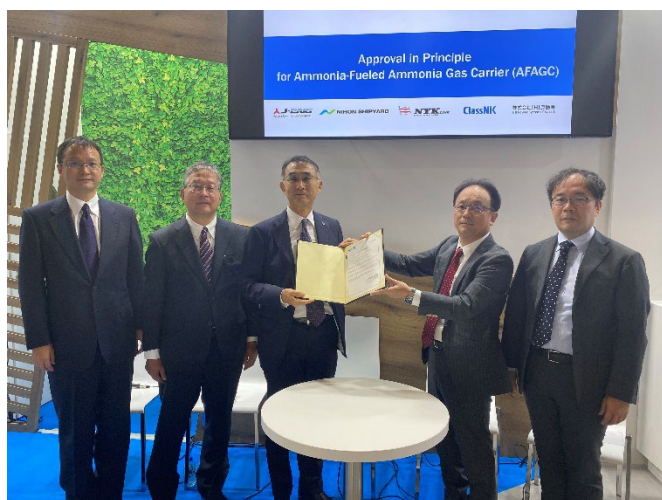
1. It is necessary to combust ammonia stably and operate the engine while increasing mixed combustion rate of ammonia, which is hardly-flammable and has low energy density.
2. Since the combustion of ammonia generates nitrous oxide (N<sub>2</sub>O: about 300 times the warming potential of CO<sub>2</sub>) instead of CO<sub>2</sub>, it is necessary to control the combustion to suppress the generation of nitrous oxide.
3. A design to prevent leakage of toxic ammonia and adequate safety measures in the event of leakage are needed. Safety measures based on risk assessments are necessary to ensure the same level of safety as conventional vessels.

The Consortium have established the development hull design for this project to

be an MGC (medium gas carrier, ammonia loading capacity: approx. 38,000 cubic meters or more), which is currently common size for marine transportation of ammonia, and have developed and selected main and auxiliary engines and onboard equipment while securing an ammonia-loading capacity equivalent or more than that of conventional vessels. The Consortium have completed the concept design of a prototype vessel that can cope with the above issues through the safe and practical installation of ammonia-fuel-related equipment in the limited space available in the vessel. The equipment layout has been devised, and the Consortium will work on further design optimization.



Image of AFAGC



Hand-over ceremony (Gastech2022, Milan, Italy)

From left, Tetsuya Yamamoto, Executive Officer, Japan Engine Corporation: Yoshinori Maeta, President, Nihon Shipyard Co., Ltd.: Akira Kono, Senior Managing Executive Officer, NYK Line: Hayato Suga, Executive Vice President, ClassNK: Yasuo Kino, Managing Director, Niigata Powers System (Europe) B.V.

※Face masks were removed immediately prior to the photo.

\* HAZID: Hazard Identification Study

HAZID is a safety assessment method that evaluates the impact of new structures and systems on human life, property safety, and the environment by identifying items based on potential risks, assuming various scenarios.

\*\* Approval of an alternative design

This refers to the process of obtaining approval from the competent authorities for the design of a vessel for which no international regulations have yet been established by proving that the design is equivalent to the safety requirements of the existing international regulations. The use of ammonia as marine fuel in ammonia carriers currently deviates from the provisions of the SOLAS (International Convention for the Safety of Life at Sea). On the other hand, if the design is equivalent to the safety requirements of the relevant chapters of the IGC Code (International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) based on the SOLAS, it is possible to design a vessel to use ammonia as a marine fuel. Now that the four companies have obtained the AiP for the AFAGC, the parties will work on a more detailed design and aim to obtain approval of an alternative design before the vessel's construction begins.

\*\*\* Green Innovation Fund project

A 2 trillion yen fund created in NEDO to significantly accelerate current efforts such as structural transformation of the energy and industrial sector and innovation through bold investment toward carbon neutrality by 2050. The fund provides continuous support from R&D and demonstration to social implementation for up to 10 years for companies that share ambitious and concrete goals with the public and private sectors and tackle them as management issues. NEDO provides support mainly in 14 priority areas for which action plans are being formulated in the green growth strategy.

**Related press release**

October 26, 2021, "Demonstration Project Begins for Commercialization of Vessels Equipped with Domestically Produced Ammonia-Fueled Engine"

[https://www.j-eng.co.jp/en/news/2021/te8a72000000m7b-att/J-ENGPressRelease20211026\\_EN.pdf](https://www.j-eng.co.jp/en/news/2021/te8a72000000m7b-att/J-ENGPressRelease20211026_EN.pdf)

### **Overview of each company**

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<Japan Engine Corporation>

Headquarters: Hyogo

President: Ken Kawashima

Website: <https://www.j-eng.co.jp/en/index.html>

<IHI Power Systems Co., Ltd.>

Headquarters: Tokyo

President: Masao Akamatsu

Website: <https://www.ihico.jp/ips/english/index.html>

<Nihon Shipyard Co., Ltd.>

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