NYK Line
IHI Power Systems Co., Ltd.
Nihon Shipyard Co., Ltd.
Nippon Kaiji Kyokai (ClassNK)

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Maritime Consortium Successfully Completes Ammonia Co-Firing Test Using Cutting-Edge Ammonia-Fueled Engine

– Towards the Realization of GHG Reduction through the Use of Fuel Ammonia in a Domestic Ship Engine –

NYK Line, IHI Power Systems Co., Ltd. (IHI Power Systems), Nihon Shipyard Co., Ltd. (Nihon Shipyard), Japan Engine Corporation, and Nippon Kaiji Kyokai (ClassNK) (hereafter, “the consortium”) are pleased to announce that the world's first four-stroke ammonia-fueled engine has successfully completed a land-based test for the stable combustion of fuel ammonia having an 80% co-firing ratio as part of a demonstration project for the commercialization of vessels equipped with a domestically produced ammonia-fueled engine.

Overview

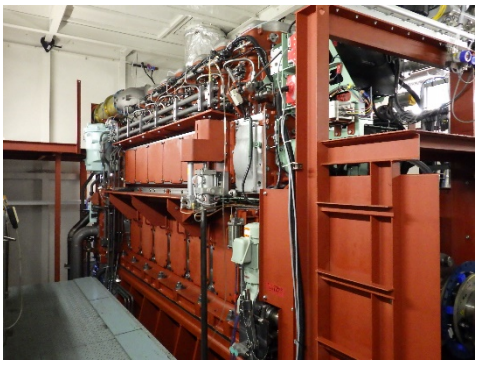
This initiative concerns the development of vessels equipped with a domestically produced ammonia-fueled engine. It was initiated in October 2021 by NYK, Japan Engine Corporation, IHI Power Systems, and Nihon Shipyard as part of the Green Innovation Fund Project* of the New Energy and Industrial Technology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

In April 2023, IHI Power Systems commenced operational tests at its Ota plant (Gunma Prefecture) on a 280 mm bore** four-stroke ammonia-fueled marine engine for the main engine of coastal vessels (i.e., ammonia-fueled tugboats, hereafter “A-Tug”).

Ammonia does not emit CO_2 during combustion and is therefore expected to be a next-generation fuel that contributes to combating global warming, but it is a difficult substance to handle due to its toxicity. This time, while thoroughly ensuring safety, a test increased the mixing ratio of fuel ammonia within the engine to 80%, and tests were conducted on the

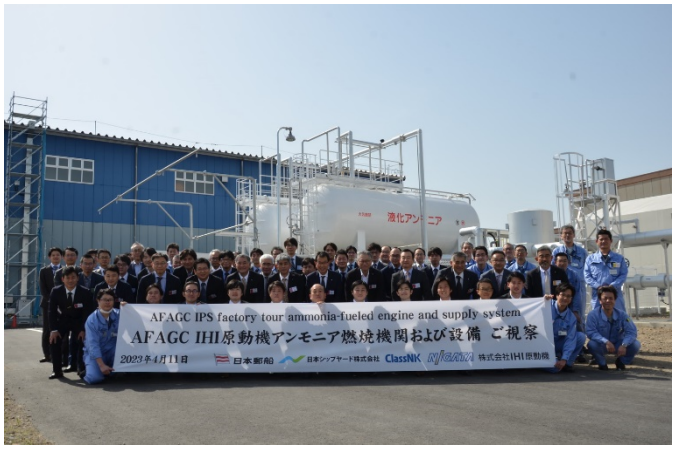
exhaust gas aftertreatment devices and fuel supply systems, etc., and the stable integrated operation of these systems was successfully achieved for the first time.

The tests also confirmed that emissions of dinitrogen monoxide (N_2O), which has a greenhouse effect about 300 times greater than carbon dioxide (CO_2), and unburnt ammonia were virtually zero, and there was no ammonia leakage from all demonstration equipment during operation and after shutdown.



Ammonia-fueled engine

Prior to the test, a demonstration equipment inspection and technical review meeting were held on 11 April at IHI Power Systems' Ota plant by NYK, IHI Power Systems, Nihon Shipyard, and ClassNK. Keihin Dock Co., Ltd., which is responsible for the conversion of the A-Tug, and Shin-Nippon Kaiyosha, which is responsible for the operation and management of the vessel, also participated in the inspection of the demonstration equipment to confirm the technologies involved in its construction and operation.



Inspection and technical review meeting held on 11 April

CG image of A-tug

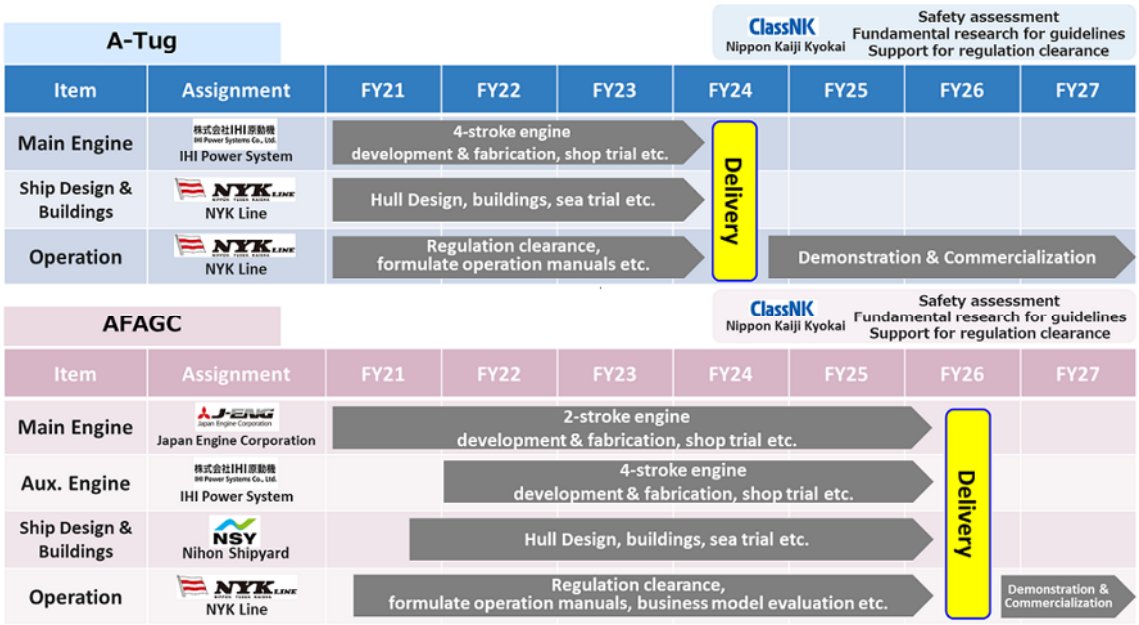
Future plans

The engine will be installed on A-Tug, which will be completed in June 2024, after further land-based testing of the engine to maximize greenhouse gas (GHG) reductions through further improvement of the co-firing rate.

Furthermore, based on this research and development for domestic vessels, efforts will be made to develop a 250 mm bore engine for the auxiliary engine of an oceangoing vessel. That auxiliary engine will be installed on an ammonia-fueled ammonia gas carrier (AFAGC, scheduled for delivery in October 2026) under joint development by NYK, Nihon Shipyard, Japan Engine, IHI Power Systems, and ClassNK.

Starting with the success of this demonstration test, the consortium will continue to work together to strengthen the international competitiveness of the Japan maritime cluster, with the aim of building the world's first ammonia-fueled ships and achieving safe navigation, including by contributing to the development of international rules.

Schedule



Overview of companies

<NYK Line>

Head office: Tokyo
President: Takaya Soga
Website: https://www.nyk.com/english/

<IHI Power Systems Co., Ltd.>
Head office: Tokyo
President: Takashi Murasumi
Website: https://www.ihi.co.jp/ips/english/index.html

< Nihon Shipyard Co., Ltd.>
Head office: Tokyo
President: Yoshinori Maeta
Website: https://www.nsyc.co.jp/en/

< Nippon Kaiji Kyokai (ClassNK)>
Head office: Tokyo
President: Hiroaki Sakashita
Website: https://www.classnk.or.jp/hp/en/index.html

<Shin-Nippon Kaiyosha>
Head office: Yokohama
President: Takeshi Kato
Website: https://www.snkaiyosha.co.jp/page/eng.html

< Keihin Dock Co., Ltd.>
Head office: Yokohama
President: Toshiya Kozawa
Website (Japanese): https://www.keihindock.co.jp/

* Green Innovation Fund projects
In order to significantly accelerate current initiatives such as structural transformation of the energy and industrial sectors and innovation through bold investment towards carbon neutrality by 2050, a 2 trillion fund has been created at NEDO to provide continuous support to companies and others who are working on management issues based on shared ambitious and specific targets in the public and private sectors. The fund system provides continuous support for up to 10 years, from research and development and demonstration to

social implementation. Support is provided mainly in the 14 priority fields for which action plans have been formulated in the Green Growth Strategy.

** Bore
The cylinder diameter in the engine.