

THE TECHNICAL SEMINAR ON THE USE OF AMMONIA AS MARINE FUEL



Safe and Practical Ammonia-Fueled Vessels: A Japanese Perspective on Enabling Wider Adoption

17 September 2026

NYK Line



NYK LINE
NIPPON YUSEN KAISHA



Company Overview



» Trade Name

Nippon Yusen Kabushiki Kaisha (NYK Line)

» Established

September 29, 1885

» Main Activities

Liner & Logistics Business (Liner Trade, Logistics), Automotive Business, Dry Bulk Business, Energy Business, and Others Business

» Paid-in Capital

JPY144,319,833,730

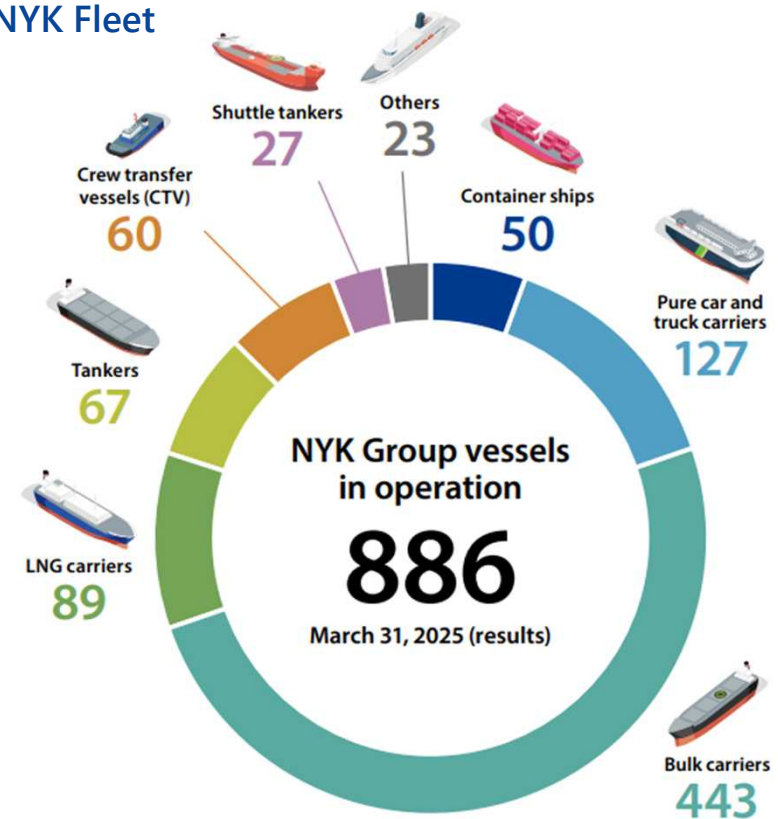
» Employees

35,230 (consolidated)
1,336 (non-consolidated)

» Revenues

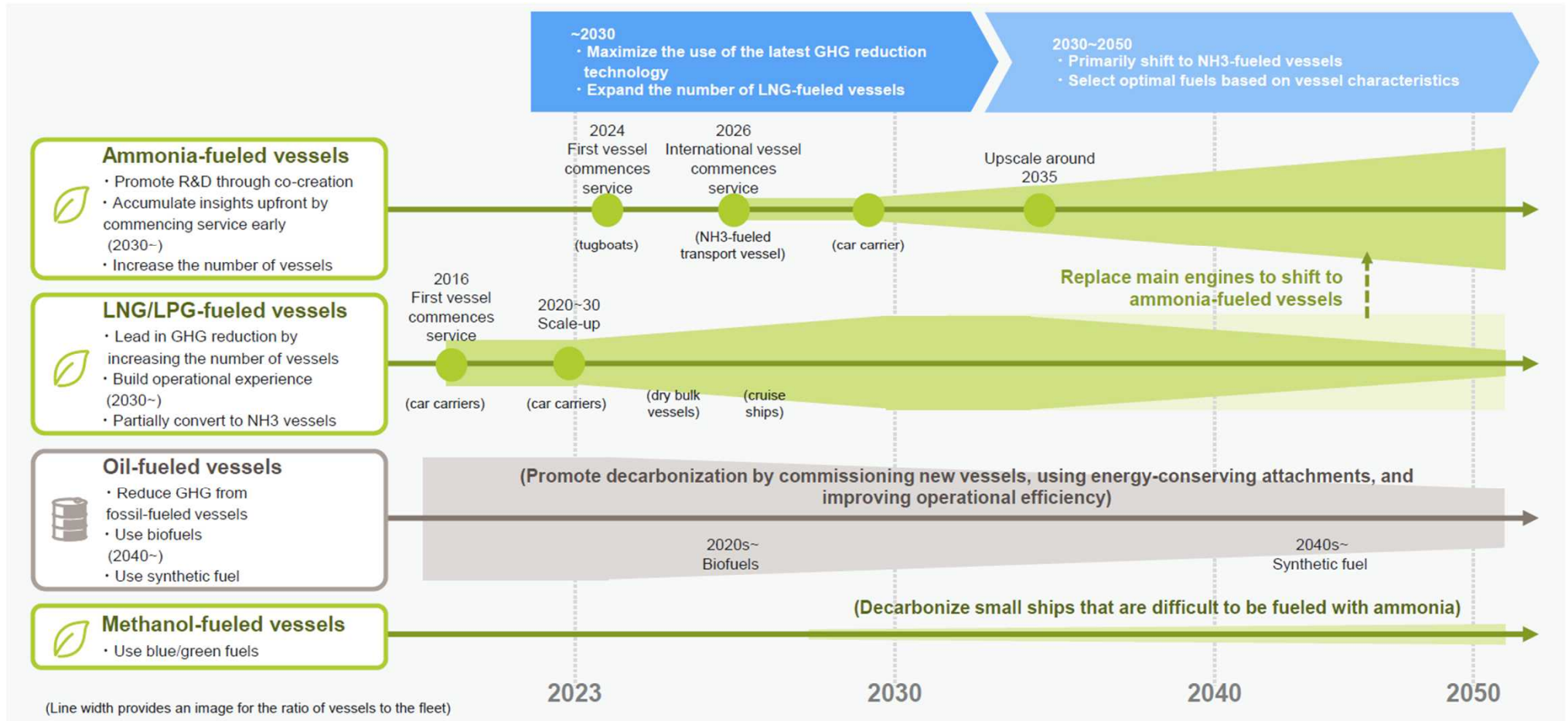
JPY 2,423 billion

» NYK Fleet



NYK Line is a global shipping and logistics company headquartered in Japan.

NYK's pathway to Net-Zero Emission by 2050

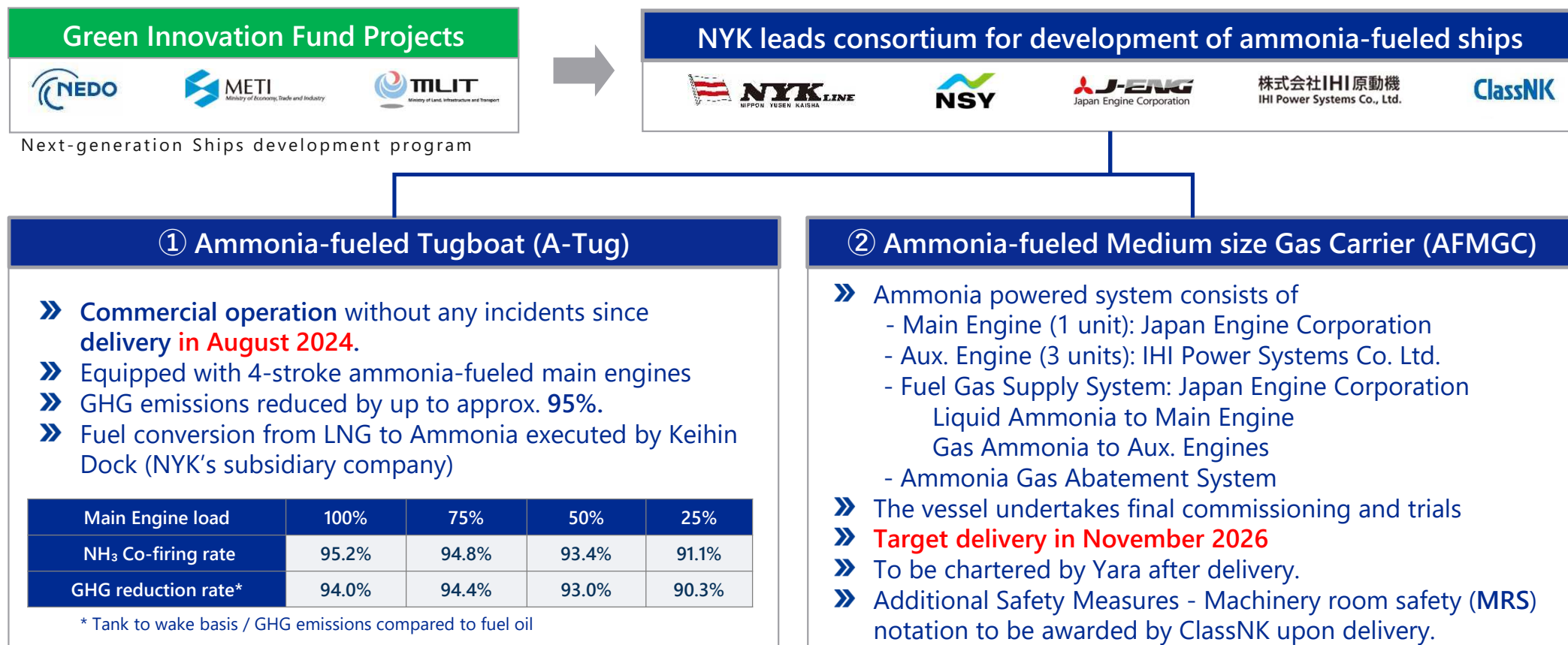


LNG and biofuels bridge the near term; ammonia leads the long term.

Development of Ammonia-fueled vessels



» Since **2021**, NYK has been developing two (2) ammonia fueled vessels



The A-Tug proves ammonia at sea; the AFMGC scales it to ocean-going trade

Principles behind the ammonia fueled vessel project

Ownership

» Leadership

As the owner and operator, NYK drives development from user's perspective, not as a downstream adopter.

» Safety

Safety comes first, always and without exception, because our crews sail with these vessels.

» Operational Reality

Every design decision is validated against day-to-day operation and maintenance.

People – Engineers' Commitment

» NYK engineers' recommendations

NYK's engineers, responsible for operating and maintaining the vessel, have shown strong commitment — helping launch the project and serving as a key driving force.

Their hands-on recommendations have been incorporated into the design and manuals to achieve safe operations.

Foundation – Japan's Maritime Capability

» An integrated domestic supply chain

Engine makers, shipyards, and the classification society worked as one consortium to bring both vessels from concept to delivery.

» From national projects to global adoption

Both vessels were developed under the Green Innovation Fund, and the safety knowledge gained — including the MRS notation established with ClassNK — will contribute to the global adoption of ammonia as fuel.



AIP (Approval in Principle) obtained for AFMGC, September 2022

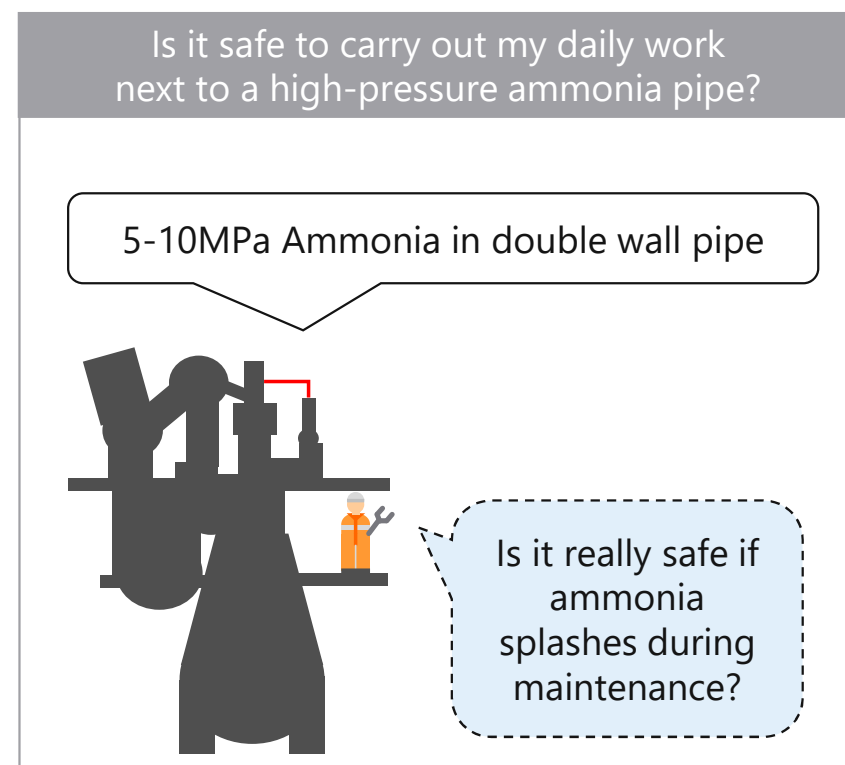
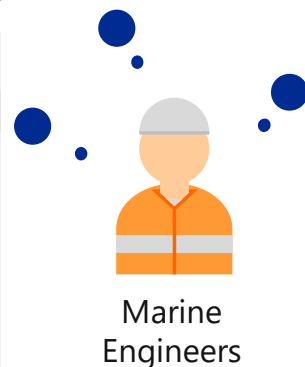
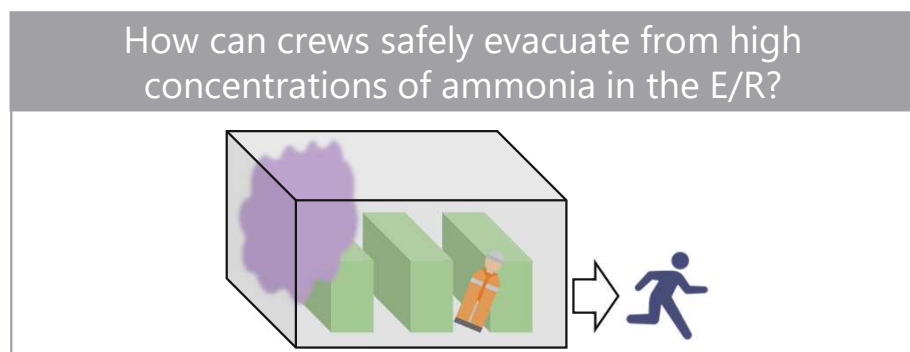
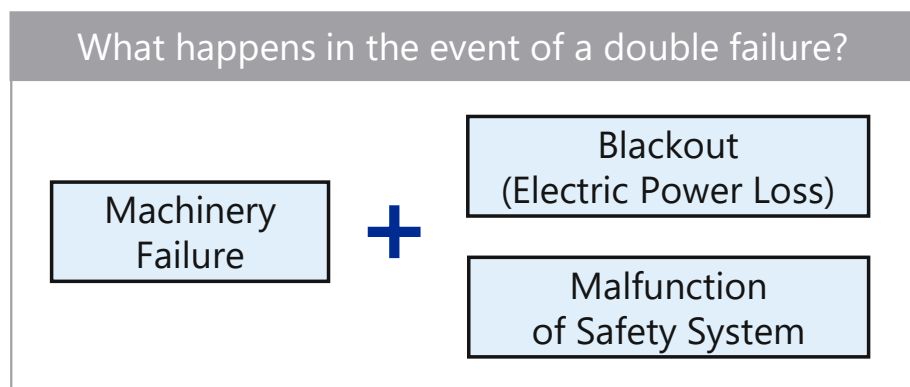


Contracts signed for the construction of the AFMGC, January 2024

Japanese industry provides the foundation; NYK and its engineers provide the direction

User-driven development in practice - considerations raised by NYK's engineers

- » Risks identified by NYK's engineers with extensive experience onboard gas carriers.
- » Risk mitigation measures have been developed with consortium members and reflected in the design.
- » ClassNK has established the **MRS** notation (※), which the AFMGC is to be awarded upon delivery.

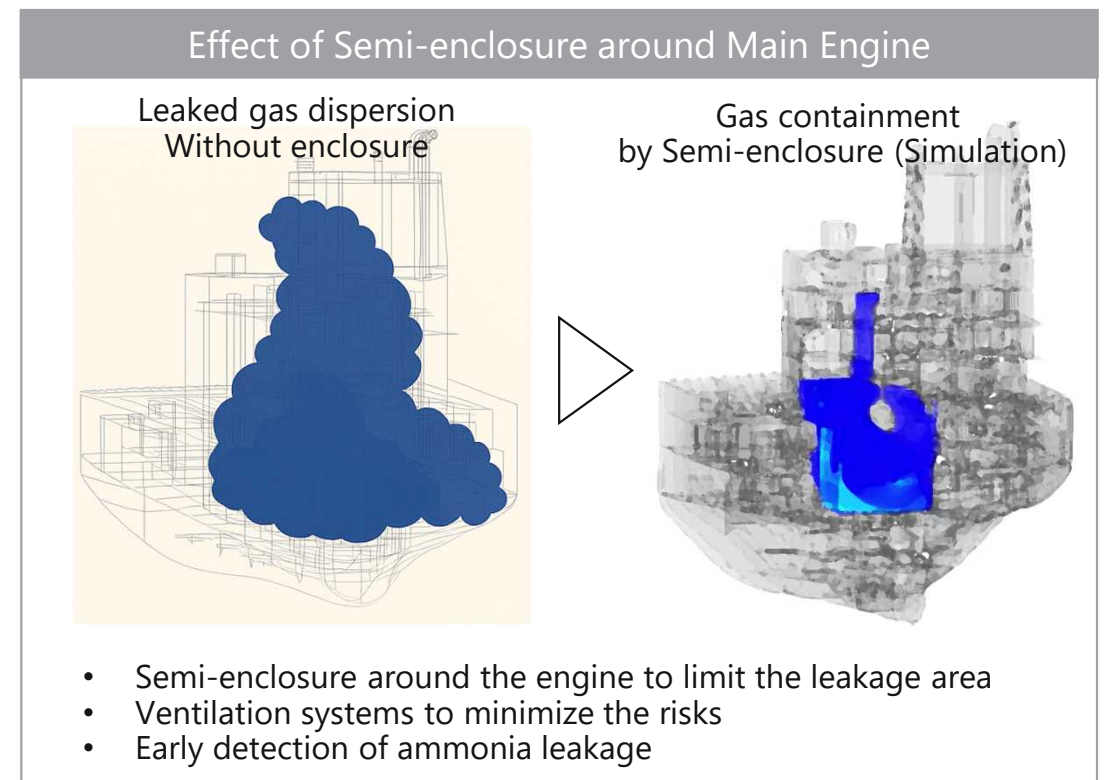
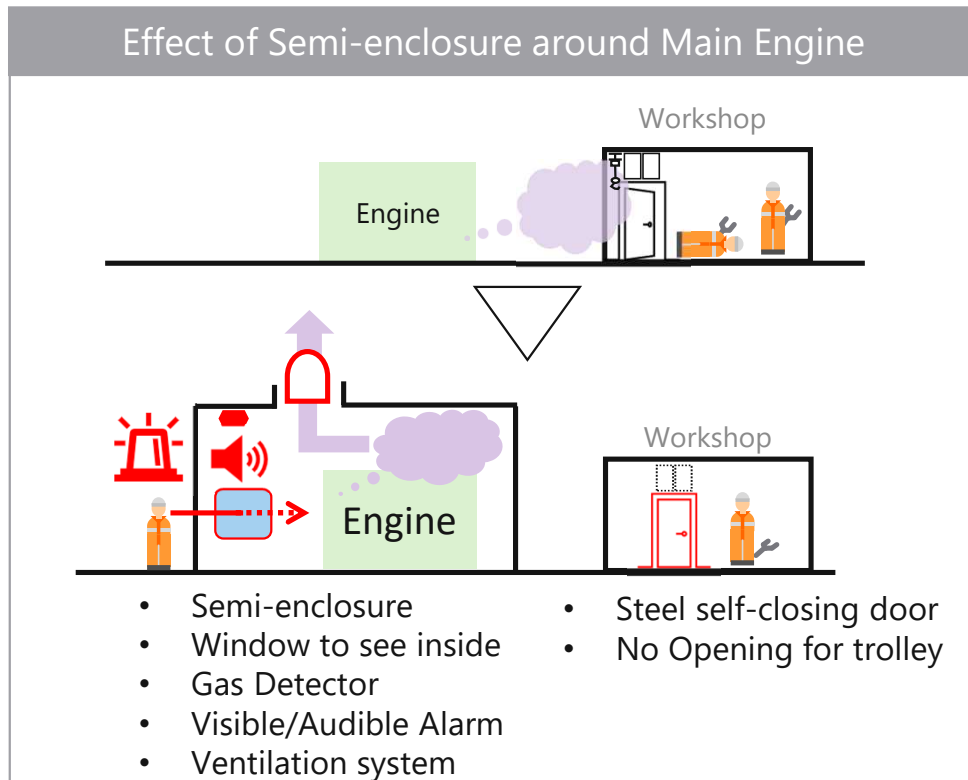


Engineers asked what could go wrong; the design and MRS notation answer it

(※) Class notation demonstrating a ship is equipped with excellent ammonia safety measures for the machinery room.

Additional safety measures applied for AFMGC

» Reducing the risk of exposure, minimizing impact by leaks, and preparing for double failures.



Semi-enclosure contains any leak; ventilation and detection keep the crew out of harm

More Safety Features Than We Can Cover Here — See the AFMGC in Video



» Explore further safety features of the AFMGC

<https://www.youtube.com/watch?v=y6cjlwN3W5f0>



Main dimensions

LOA : 180 m, Beam : 32 m, Depth : 18 m Cargo Tank : Abt. 40,000 m³
Flag : Japan, Class : ClassNK

Ship Designer : NSY (Nihon Shipyard), Builder : Japan Marine United – Ariake works
Main Engine : Japan Engine Corporation (2 stroke), Generator Engine : IHI Power Systems (4 stroke)

NYK's Crew Training Program for ammonia-fueled vessels

- » The program developed based on the **IMO Interim Guidelines*** and **flag administrative framework**.
- » Ensure that crews fully understand the hazards and properties of ammonia, as well as safe handling procedures.

* STCW.7/Circ.27 - Interim guidelines on training for seafarers on ships using ammonia as fuel

Mandatory Training

Ammonia Properties Training

All seafarers

1 Ammonia Safety Management System Familiarization



Classroom Lecture



Gas Tight Suit

2 Practical Ammonia Training (Odor Recognition & PPE)

3 Ammonia Fuel Basic Training (IMO KUP Table 1)



Field Study

4 Ammonia Fuel Advanced Training (IMO KUP Table 2)

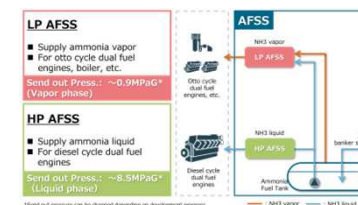


Gas Detector

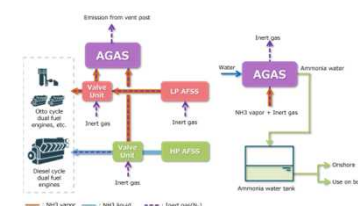
NYK Additional Training Program

Plant Training

Engine Officers

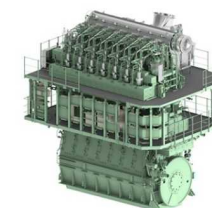


AFSS/AGAS Plant Simulator



OEM Training

Engine Officers



J-ENG
Japan Engine Corporation



株式会社IHI原動機
IHI Power Systems Co., Ltd.

Zero Incident

Since the delivery in August 2024

> 90%

GHG Reduction Percentage*



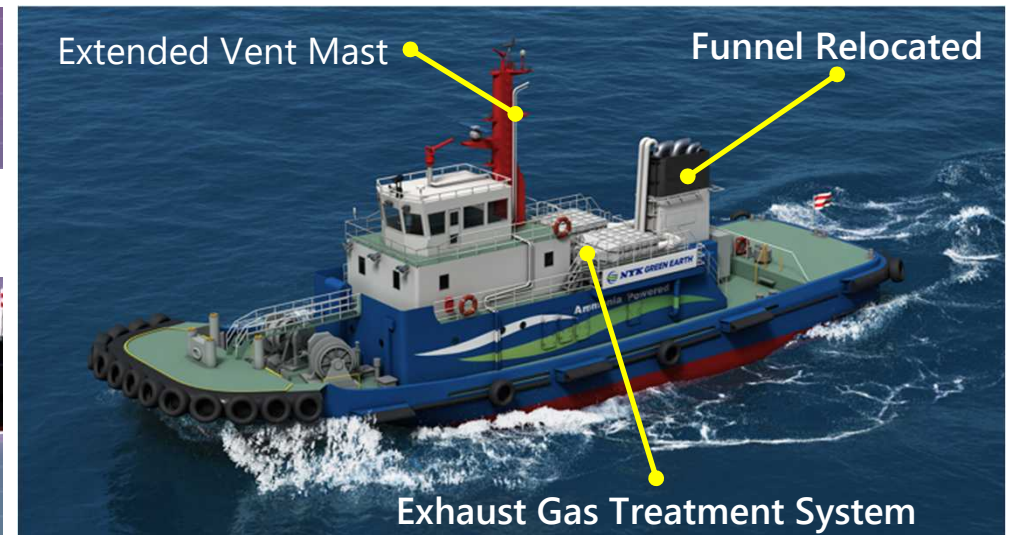
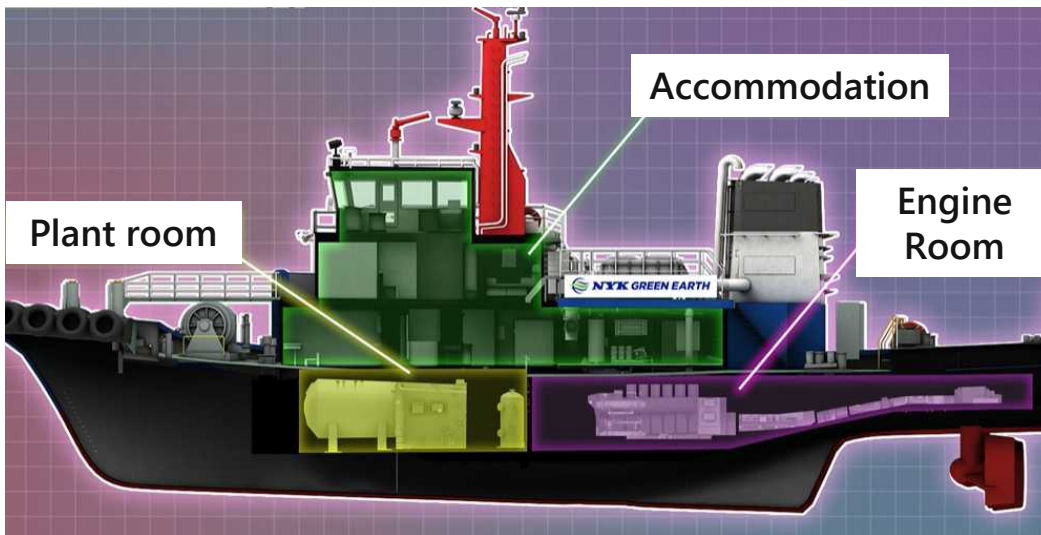
Truck to Ship Bunkering



* Reference: NYKLINE Website https://www.nyk.com/english/news/2025/20250328_02.html

A-Tug's safety design

- » M/V "SAKIGAKE" was converted from an LNG to Ammonia fueled tugboat.
- » When converted, the following design concepts were applied.
 - ✓ **Segregation:** The accommodation shall be completely separated from the ammonia handling space.
 - ✓ **Entry Restriction:** When operating in ammonia mode, any access to the ammonia high-risk area shall not be allowed
 - ✓ **Lower Exposure:** To prevent crews from being exposed to the ammonia slip, exhaust gas treatment system and additional vent mast were installed on deck.
 - ✓ **Operational Safety:** A safety manuals for operation, maintenance and the safety equipment, were developed.



Ammonia spaces fully segregated from the crew; exposure designed out, not managed around.

Operational feedback from the A-Tug's Captain



Shin-Nippon Kaiyosha



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Since the A-Tug's delivery...

Ensuring safe and practical operations while maximizing the effective use of ammonia-fueled engines.

» Operability of ammonia-fueled vessel

- » Toxicity concerns have been alleviated through adequate education and training.
- » Engine output and load response are comparable to conventional diesel engines.
- » Day-to-day operations have been conducted in the same manner as with diesel or LNG-fueled tugboats.

💡 With proper preparation, commercial operations are running as usual.

» Operational challenges

- » As a development vessel, challenges unknown prior to delivery were encountered.
- » Additional equipment and design requirements have increased onboard workload compared with conventional tugboats.
- » Trials of varied operating patterns are steadily building practical know-how.

💡 Real-world operation continues to advance the vessel's technical maturity, safety level, and operational efficiency.

Two years of operations give confidence that ammonia is a realistic path to net-zero emissions.

Operational feedback from the A-Tug's Chief Engineer



Shin-Nippon Kaiyosha



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C/E Takahashi



Experience

- 1997 : Joined Shin-Nippon Kaiyosha (NYK subsidiary)
- 2009 : Promoted to Chief Engineer
- 2015 : C/E for the delivery of Japan's first LNG-fueled tug
- 2024 : Took part in the design and commissioning of the A-Tug SAKIGAKE, serving as C/E since delivery

Since the A-Tug's delivery...

Responsible for operating the A-Tug's ammonia fuel system and continuously improving safe operations.

» Ammonia engine performance

- » As a single-component fuel, ammonia is comparatively straightforward to manage operationally.
- » In contrast, LNG is a mixed fuel, and its composition can vary depending on handling, affecting engine performance.
- » On the previous LNG-fueled tug, knocking caused frequent sensor failures.
- » No knocking has been observed under fluctuating engine load.



Ammonia engine performance is on par with that of diesel engines.

» Toxicity of ammonia

- » With appropriate safety measures (design and PPE) in place, no hazardous exposure has occurred to date.
- » No ammonia odor has been detected, even during operation in ammonia mode.
- » Maintenance work requires due care wherever contact with ammonia is possible.



Operational safety has proved satisfactory throughout service to date. Toxicity remains a genuine concern, but appropriate countermeasures keep it manageable.

**From an engineer's perspective,
ammonia is a highly promising next-generation fuel.**

Key Takeaways



- » A serious accident on an ammonia-fueled vessel could hinder wider adoption in maritime industries.
- » Building the **confidence** for the safe use of ammonia is essential to accelerate adoption.
- » Adoption requires **practical, reasonable standards** the industry can rely on.
- » Based on hands-on operation, the industry should continue reviewing standards—**pragmatically strict, but not overly conservative or relaxed**—for the time being.
- » Supported by the strong commitment of engineers, NYK has worked with Japanese partners to develop ammonia-fueled vessels with **high practical performance**, while keeping **safety as the top priority**.
- » With this experience and track record, NYK will support the industry in accelerating wider adoption of ammonia by contributing to **the establishment of future standards**, thereby **enabling decarbonized maritime transport**.

**Safety earns the industry's confidence;
practical standards turn that confidence into adoption.**



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