Safety Approach and Protocols applied in Ammonia Marine Fuel: Trials in the Port of Singapore

Maritime Port Authority of Singapore

Mr. Eric Chua, Chief Sustainability Officer, Director (Digital Strategy, Policy & Ecosystems)

16 June 2025









Ammonia as a Maritime Fuel

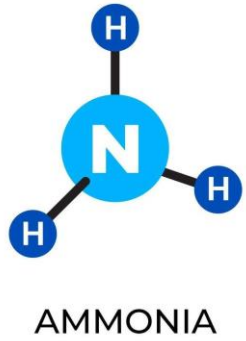
Energy Storage	MGO	LNG (Liquid, -162°C)	Methanol (CH_3OH) (65°C)	Ammonia (NH_3) (Liquid, -33°C)
Energy Content, LHV (MJ/kg)	42.7	50.0	19.9	**18.6**
Flammability (% air volume)	0.6-7.0	4 – 15	6.7 – 36	**15 – 28**
Flash Point (°C)	60	-188	11	**132**

Acute Exposure Guideline Levels (AEGL) limits to Ammonia Exposure	
	10 min
AEGL-1	30 ppm
AEGL-2	220 ppm
AEGL-3	2700 ppm

Reference: EPA Acute Exposure Guideline Levels

Considerations

1. **Safety**: Ammonia is highly toxic, hence major safety considerations for vessel design, operations, detection/sensors, crew training, etc.
2. **Environmental**: An ammonia spill could have serious environmental consequences as a toxic plume cloud to surrounding areas, and if absorbed into water on aquatic habitats and ecosystems.
3. **Emissions**: Although no carbon is emitted, the combustion of ammonia in engines can release NO_X and N_2O, so emission control technologies are required – e.g. after-treatment systems, selective catalytic reduction (SCR)



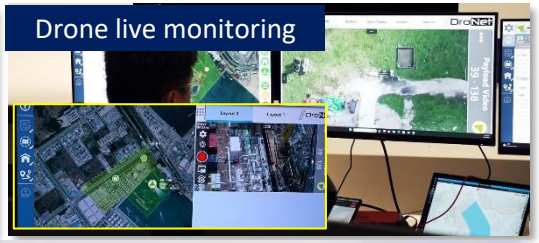
AMMONIA

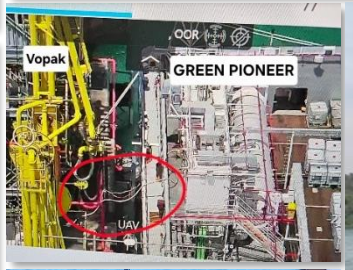
Fortescue Green Pioneer

World's 1st use of Ammonia as marine fuel operationally in Singapore

Preparation

Execute Plan





Advocacy

Industry briefing on ops after successful ammonia fuel loading

Presentation at IMO MEPC & MSC during lunchtime to share learnings and since then at many other events

Green Pioneer - Project Overview

1 DESIGN
Engine, Fuel Delivery and Safety Systems 2022

2 EQUIPMENT
Equipment HAZID/HAZOPs
December 2022 – January 2023

3 ENGINE TESTING
Commencement of testing at Hazelmere March 2023

4 REVALIDATION HAZOP
September 2023

5 CLASS (DNV) AIP
Approval in Principle
September 2023

6 CERTIFICATION
DNV Engine Product Certificate
September 2023

7 CONSTRUCTION
Conversion
July – November 2023

8 CREW AMMONIA TRAINING
Completion by
October 2023

9 COMMISSIONING
Engine, Fuel Delivery and Safety Systems
March 2024

10 SEA TRIALS IN SINGAPORE
MPA Flag State and DNV Approvals & Maneuverability trials
March-April 2024

First use of Ammonia as Marine Fuel Operationally in Singapore

Mitigation measures to ensure safe operations during ammonia fuel loading and trials

Live monitoring & active standby

- Visual live feed of vessel during trials to EOC
- Gas detector on standby boat

Gas detectors & ESD

- Multiple ammonia gas detectors, including redundancy, in hazardous areas and near air intake of accommodation space. Auto activation of ESD.

Smart hose system

- Quick Connect Disconnect coupling (QCDC)
- Dry breakaway coupling

QCDC

Dry breakaway coupling

PPE

- HAZMAT & chemical suits, portable detectors

MPA's Efforts -Maritime Energy Training Facility (METF)

Established in 2024, METF serves as a decentralised network of training facilities based in Singapore, anchored by a new dual fuel marine engine simulator for training on the safe handling, bunkering and management of incidents involving the use of new alternative fuels.

Value Chain Partners

- METF comprises of a **strong network of 51 local and international value chain partners** to co-develop training facilities, courses and curriculum.
- These partners include engine manufacturers, international organisations, classification societies, trade associations, unions and institutes of higher learning.

Enhanced Workforce Competency

Provides training for crew and engineers on new energy technologies (e.g., methanol, hydrogen, ammonia, electrification).

Standardised Certification

Maintains real-time records of all crew certifications. Compliance documentation for flag states, and port authorities

METF Courses

- METF currently offers two methanol safe handling courses and has trained around **500 seafarers** trained since its launch
- MPA is working closely with training partners to develop and roll out similar courses for ammonia.

METF Digital Platform

- Launched in Mar 2025, METF digital platform aims to simplify access to training, streamlines certification issuance, and ensures alignment with evolving international standards.
- The portal will facilitate **course discovery, registration**, **payment,** and provide access to **training records for seafarers**.

MPA SINGAPORE

MARITIME SINGAPORE

Thank You