IMO: Unpacking interim guidelines for ammonia fuel use

WEBINAR

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AMMONIA ENERGY ASSOCIATION

Thursday, January 9
4PM CET (10 AM EST)

Ammonia Energy Association

AMMONIA ENERGY ASSOCIATION

Who we are

The **Ammonia Energy Association** (AEA) is a global industry association that promotes the responsible use of ammonia in a sustainable energy economy.

Members: 270+ global and cross-sectoral

Our mission

Supply: decarbonize ammonia production

Demand: adopt ammonia in energy markets

Our strategy

Strategic Pillars: knowledge stewardship, program development, collaboration, advocacy

House rules

AMMONIA ENERGY ASSOCIATION

- Please post your questions for the speakers in the Q&A section. Your questions will be answered by text by the speakers or will be discussed live.

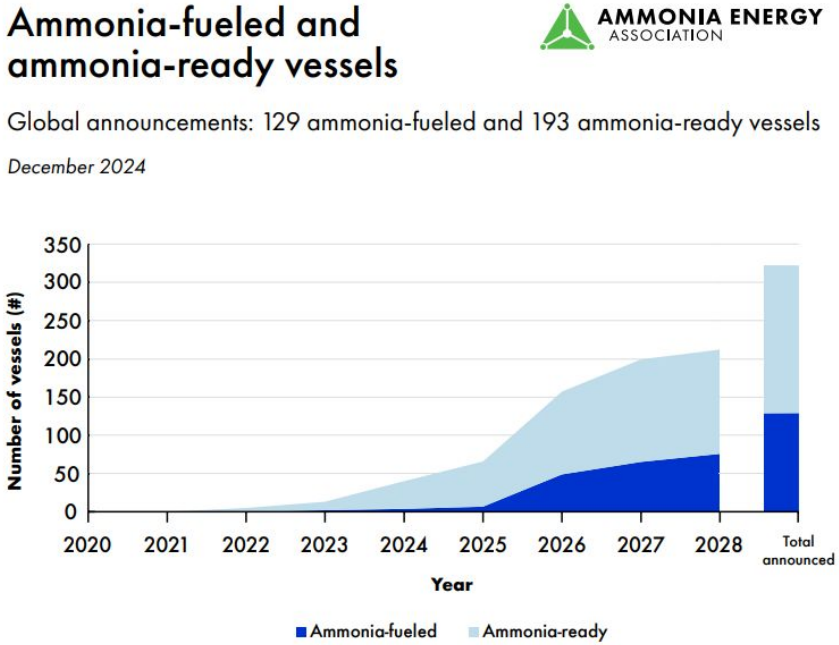
- The recording of this webinar will be shared with all registrants after the webinar, and will be available at ammoniaenergy.org.

- An article summarizing this webinar will be posted on ammoniaenergy.org in the coming days.

Significant Orderbook for Ammonia-fueled and Ammonia-ready Vessels

As of December 2024, the AEA tracks 322 Ammonia-fueled and Ammonia-ready Vessels.

- Out of these, 4 vessels currently operational using ammonia, which are Supply vessels & Tug boats, entering the water in 2023 and 2024.
- The first Ammonia-ready vessel entered the waters in early 2022. 26 Ammonia-ready Vessels are operational, including Ammonia carriers, Bulk carriers, Oil carriers, Container vessels, and Supply vessels.

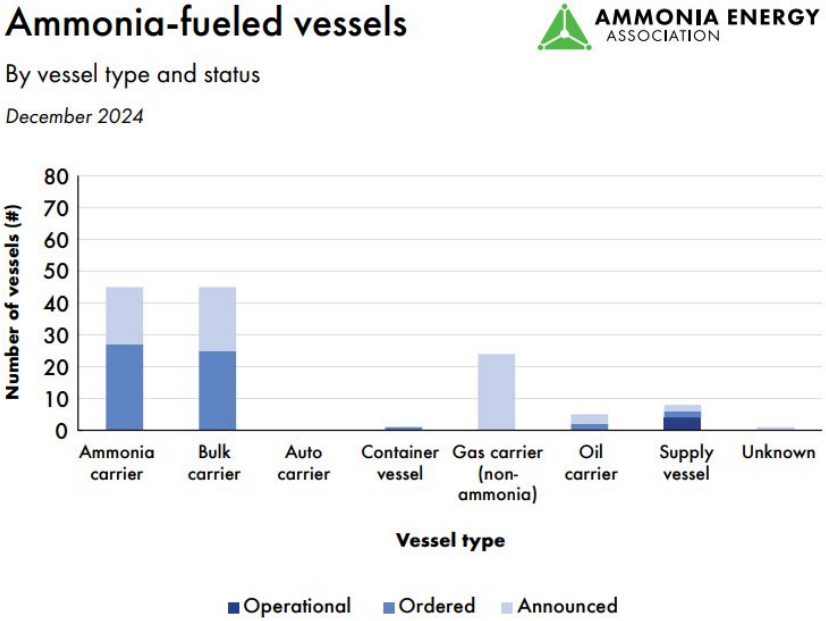


Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Ammonia-fueled Vessels: Ammonia carriers & Bulk carriers

As of December 2024, the AEA tracks 129 Ammonia-fueled Vessels.

- Out of these, 4 vessels currently operational using ammonia, which are Supply vessels & Tug boats, entering the water in 2023 and 2024.
- Out of the 57 ordered Ammonia-fueled vessels, almost all vessels are Ammonia carriers (27) and Bulk carriers (25), with the first of these vessels expected to hit the waters in 2026 and 2027.
- Although Oil carriers, Auto carriers, and Container vessels represent a small portion of the Ammonia-fueled vessels to date, these Vessel classes are well represented in the Ammonia-ready vessels.

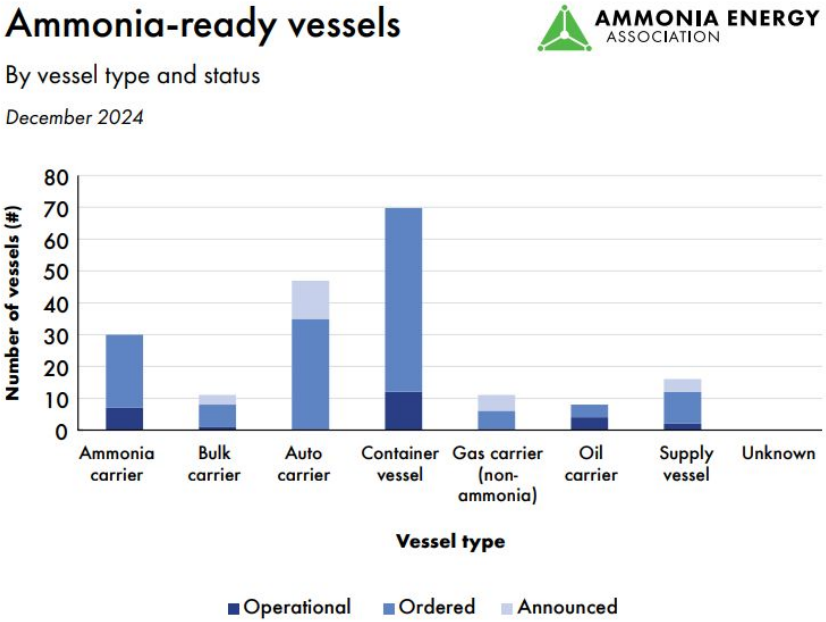


Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Ammonia-ready Vessels: Ammonia carriers, Auto Carriers & Containers

As of December 2024, the AEA tracks 193 Ammonia-ready Vessels.

- Ammonia-ready vessels typically have provisions for ammonia fuel supply systems, ammonia release mitigation systems, and Tank C tanks for ammonia fuel storage. Also, retrofit packages exist for Engines to use ammonia as fuel.
- The first Ammonia-ready vessel entered the waters in early 2022. As of December 2024, 26 Ammonia-ready vessels are operational, including Ammonia carriers (7), Bulk carriers (1), Oil carriers (4), Container vessels (12) & Supply vessels / Tug boats (2).
- Out of the 143 Ordered Ammonia-ready vessels, most are Ammonia carriers (23), Auto carriers (35), and Container vessels (58).



Low-Emission Ammonia Data, Ammonia Energy Association
https://ammoniaenergy.org/lead/

Ammonia-fueled engines are ready

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Engine manufacturers have performed extensive testing of ammonia-fueled two-stroke and four-stroke engines. In fact, first ammonia-fueled engine (a four-stroke engine) was delivered and deployed 2024. Engine manufacturers are ready for scale-up, with 60+ engines ordered. Also, retrofit packages exist for engines to use ammonia as fuel.

A two-stroke engine (the majority of ammonia-fueled engine orders) can operate with up to 95% ammonia as fuel, requiring around 5% pilot fuel such as fuel oil or diesel. In ammonia mode, NO_X emissions are up to 40% lower than in fuel oil mode.

Ammonia-fueled engines are compliant with IMO Tier II NO_X emission limits without a DeNOx system, and are compliant with IMO Tier III NO_X emission limits with a DeNOx system.

Top: WinGD. Middle: MAN ES. Bottom: NYK.

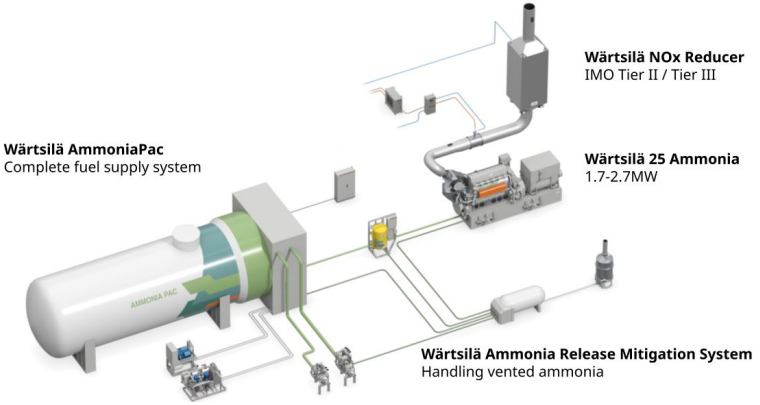
https://ammoniaenergy.org/articles/ammonia-energy-conference-2024-ammonia-for-maritime-propulsion-is-full-speed-ahead/
https://wingd.com/news-media/news//wingd-seals-ammonia-fuelled-x-df-a-engine-orders-for-chinese-gas-carriers
https://www.tradewindsnews.com/technology/man-es-has-around-30-ammonia-engines-on-order-amid-trial-success/2-1-1704861

Technology toolkit is ready

In addition to engines being commercially available, the rest of the technology toolkit is ready for ammonia-fueled vessels, in line with the timeframe for the IMO guidelines:

- **Onboard ammonia fuel storage**: Ammonia fuel will be stored in Type C Tanks on the deck of a vessel. These tanks are also used for LNG, LPG, LEG, Hydrogen, etc.
- **Ammonia bunkering**: Various ship-to-ship bunkering operations have been safely demonstrated in 2024.
- **Ammonia Fuel Supply System (AFSS)**: Safe ammonia supply systems (liquid or gas) supply ammonia to the engine
- **Ammonia Release Mitigation System (ARMS)**: Safe handling and dilution of vented ammonia at acceptable concentrations.
- **Gas detection**: Potential leaks can be measured with gas detection, allowing for immediate action, and ammonia containment.
- **Emission mitigation**: DeNOx systems are commercially available, reducing NO_X emissions down to IMO Tier III levels.

https://ammoniaenergy.org/articles/ammonia-energy-conference-2024-ammonia-for-maritime-propulsion-is-full-speed-ahead/



Top: Fuel Supply System, Ammonia Release Mitigation System, DeNOx (Wärtsilä). Bottom Left: Ship-to-Ship bunkering (GCMD). Bottom Right: DeNOx system (BUTTING).

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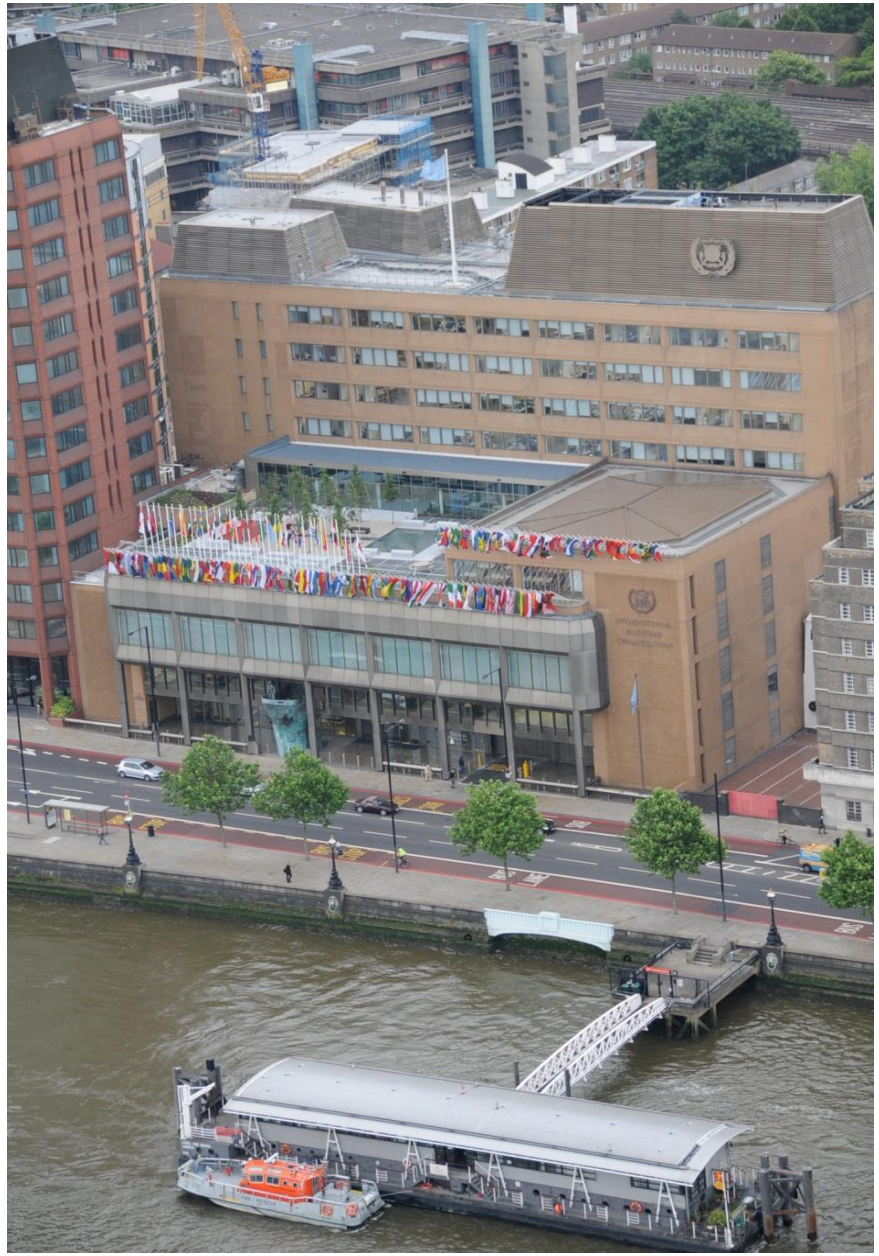
Interim Guidelines for the safety of ships using ammonia as fuel

Some remarks on the process for development of the Interim Guidelines

Antti Nironen
Technical Officer
Maritime Safety Division



International Maritime Organization

- The mission of IMO, as a United Nations specialized agency, is to promote **safe, secure, environmentally sound, efficient and sustainable shipping**.

- The mission of IMO is mainly accomplished by developing **international regulatory instruments**, on the basis of proposals by IMO Member States.

- **Implementation** of IMO instruments is the responsibility of the Contracting Governments concerned.

Maritime safety and marine environment

- Shipping is perhaps the most international of all the world's great industries - and one of the most dangerous. It has always been recognized that the best way of improving safety at sea is by developing international regulations that are followed by all shipping nations. These regulations are mainly developed under the auspices of IMO.

- With regard to protection of the marine environment, the original focus of IMO was the prevention of marine pollution by oil. This has changed over the last few decades to include a wide range of measures to prevent marine pollution, addressing pollution from, e.g. chemicals, other harmful substances, garbage, sewage and air pollution and emissions from ships. In particular, IMO is committed to reducing GHG emissions from international shipping.

MEPC 80/WP.12
Annex 1, page 1

RESOLUTION MEPC.377(80)

Adopted on 7 July 2023

2023 IMO STRATEGY ON REDUCTION OF GHG EMISSIONS FROM SHIPS

THE MARINE ENVIRONMENT PROTECTION COMMITTEE

RECALLING Article 38(e) of the Convention on the International Maritime Organization concerning the functions of the Marine Environment Protection Committee (the Committee) to consider and take appropriate action with respect to any other matters falling within the scope of the Organization which would contribute to the prevention and control of marine pollution from ships,

ACKNOWLEDGING that work to address greenhouse gas (GHG) emissions from ships has been undertaken by the Organization continuously since the adoption of Conference Resolution 8 on *CO_2 emissions from ships* in September 1997, in particular, through the adoption of global mandatory technical and operational energy efficiency measures for ships under MARPOL Annex VI,

ACKNOWLEDGING ALSO the decisions of the Assembly at its thirtieth and thirty-second sessions in December 2017 and December 2021, that approved for the Organization a strategic direction to "Respond to climate change",

RECALLING that the Committee at its seventy-second session (MEPC 72) in April 2018 adopted, by resolution MEPC.304(72), the *Initial IMO Strategy on Reduction of GHG Emissions from Ships* (Initial IMO GHG Strategy),

NOTING that the Initial IMO GHG Strategy foresees that a revised IMO GHG Strategy should be adopted in 2023,

RECALLING the United Nations 2030 Agenda for Sustainable Development,

RECALLING ALSO the Paris Agreement adopted at the UN Climate Change Conference (COP 21), which identifies the long-term goal to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change, as was also reaffirmed in the Glasgow Climate Pact at COP 26 and in the Sharm el-Sheikh Implementation Plan at COP 27,

RECALLING FURTHER IMO Assembly resolution A.998(25) on the need to develop capacity -building for the development and implementation of new and amendments to existing instruments,

RECALLING FURTHER that the Maritime Safety Committee at its 107th session decided to initiate work on the "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels",

HAVING CONSIDERED, at its eightieth session, the draft 2023 IMO Strategy on Reduction of GHG emissions from ships,

adopted

2023 IMO GHG Strategy

VISION

“IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible, while promoting, in the context of this Strategy, a just and equitable transition.”

INTERNATIONAL MARITIME ORGANIZATION

2023 IMO GHG Strategy – levels of ambition

1 **carbon intensity of ships to decline through further improvement of the energy efficiency for new ships** by strengthening the energy efficiency design requirements;

2 **carbon intensity of international shipping to decline** to reduce CO_2 emissions per transport work, as an average across international shipping, by at least 40% by 2030, compared to 2008;

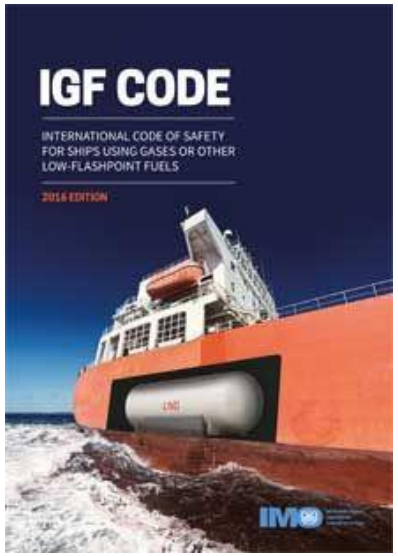
3 **uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources to increase** uptake of zero or near-zero GHG emission technologies, fuels and/or energy sources to represent at least 5%, striving for 10%, of the energy used by international shipping by 2030; and

4 **GHG emissions from international shipping to reach net zero** to peak GHG emissions from international shipping as soon as possible and to reach net-zero GHG emissions by or around, i.e., close to, 2050, taking into account different national circumstances, whilst pursuing efforts towards phasing them out as called for in the Vision consistent with the long-term temperature goal set out in Article 2 of the Paris Agreement.

The IGF Code

- The purpose of the International Code of Safety for Ships Using Gases or Other Low-flashpoint Fuels (IGF Code) is to provide an international standard for ships, other than vessels (gas carriers) covered by the IGC Code, operating with gas or other low-flashpoint fuels. The development of the IGF Code took over 10 years.

- The IGF Code contains mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using gas or other low-flashpoint fuels.



- Currently, the IGF Code only contains provisions for using liquefied natural gas (LNG) as fuel.

- Hence, the IGF Code currently does not cover, e.g. low-flashpoint oil fuel, methanol, ethanol, LPG, ammonia or hydrogen.

IMO safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels

- The Maritime Safety Committee (MSC) has initiated (MSC 108, in 2024) the "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels". This is an ongoing work that will remain as a continuous item in the agenda of the Committee.

- The Sub-Committee on Carriage of Cargoes and Containers (CCC) has already developed and foresees the further development of safety codes and interim guidelines for alternative fuels.

- The Sub-Committee on Human Element, Training and Watchkeeping (HTW) is expected to start work on developing guidance to address training for using various alternative fuels on board ships.

IMO safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels

Safety codes and interim guidelines for new alternative fuels	
LNG (the IGF Code)	2017 entered into force
Methyl/ethyl alcohol	2020 approved Interim Guidelines
Fuel cells	2022 approved Interim Guidelines
LPG	2023 approved Interim Guidelines
Ammonia	2024 approved Interim Guidelines *Note also: use of ammonia cargo as fuel on gas carriers to be allowed as from 1 July 2026*
Hydrogen	2026 expected to be approved
Low-flashpoint oil fuels	2026 estimated finalization

Timeline of preparation of the Interim Guidelines for the safety of ships using ammonia as fuel at IMO

- CCC 8, in September 2022, initiated the development of the Interim Guidelines.
- CCC 9, in September 2023, made further progress in developing the Interim Guidelines.
- CCC 10, in September 2024, finalized the Interim Guidelines.
- MSC 109, at the beginning of December 2024, approved the Interim Guidelines.

Developments in the near future

UPDATED WORK PLAN FOR THE DEVELOPMENT OF NEW ALTERNATIVE FUELS UNDER THE IGF CODE

CCC 12	- Further consider the revision of the **Interim guidelines for safety of ships using methyl/ethyl alcohol as fuel**, with a view to developing mandatory instruments. - Further develop/finalize **interim guidelines for safety of ships using low-flashpoint oil fuels.** - If time permits, further consider the development of **mandatory instruments regarding safety of ships using fuel cells**. - Further consider amendments to the IGF Code regarding LNG. - If time permits, consider the revision of the **Interim guidelines on the safety of ships using ammonia as fuel**.	2026
CCC 13	- Consider the revision of the **Interim guidelines on the safety of ships using ammonia as fuel**. - Finalize the revision of the **Interim guidelines for safety of ships using methyl/ethyl alcohol as fuel**, with a view to developing mandatory instruments. - Consider amendments to MSC.1/Circ.1622 based on documents CCC 10/3/10 and CCC 10/INF.28.	2027

- **Note also: CCC 10 invited interested Member States and international organizations to submit a proposal for a new output to MEPC 83 (April 2025), concerning the need to develop guidelines for managing ammonia effluent.**

Thank you.

International Maritime Organization

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youtube.com/imohq

flickr.com/photos/imo-un

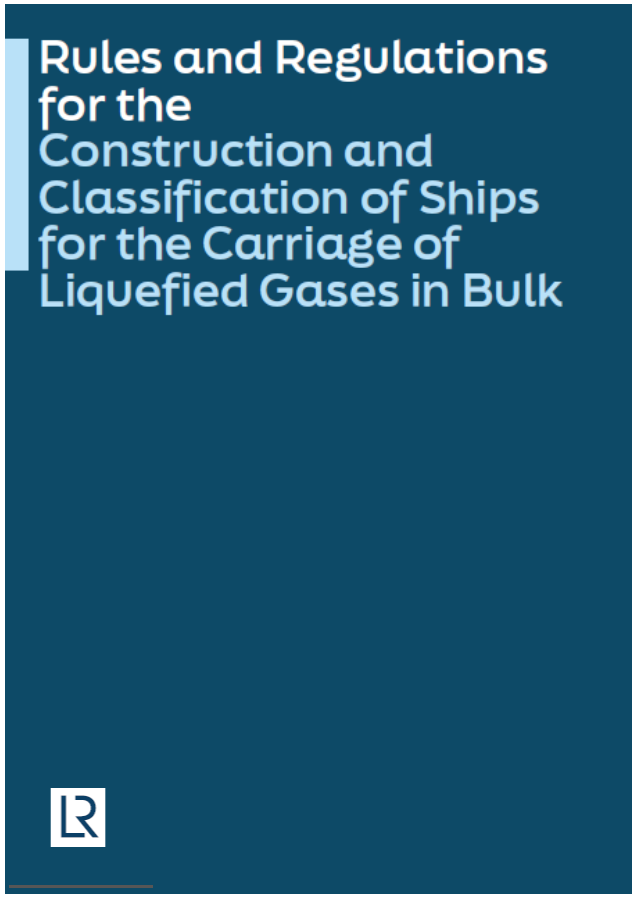
uk.linkedin.com/company/international-maritime-organization

Ammonia as Fuel: safety requirements

Key takeaways and considerations

Liam Blackmore, Lloyd’s Register, Principal Engineer

Ammonia Cargo as Fuel, IGC Code: draft Interim Guidelines



CCC 9 (Sept 2023)

Draft amendment to paragraph 16.9 was prepared

MSC 108 (May 2024)

MSC approves the draft amendment.

CCC 10 (Sept 2024)

Draft Interim Guidelines submitted for discussions were submitted by Belgium

MSC 109 (Dec 2024)

MSC 109 is expected to adopt the amendment and enable flag States to apply the amendment on a voluntary basis.

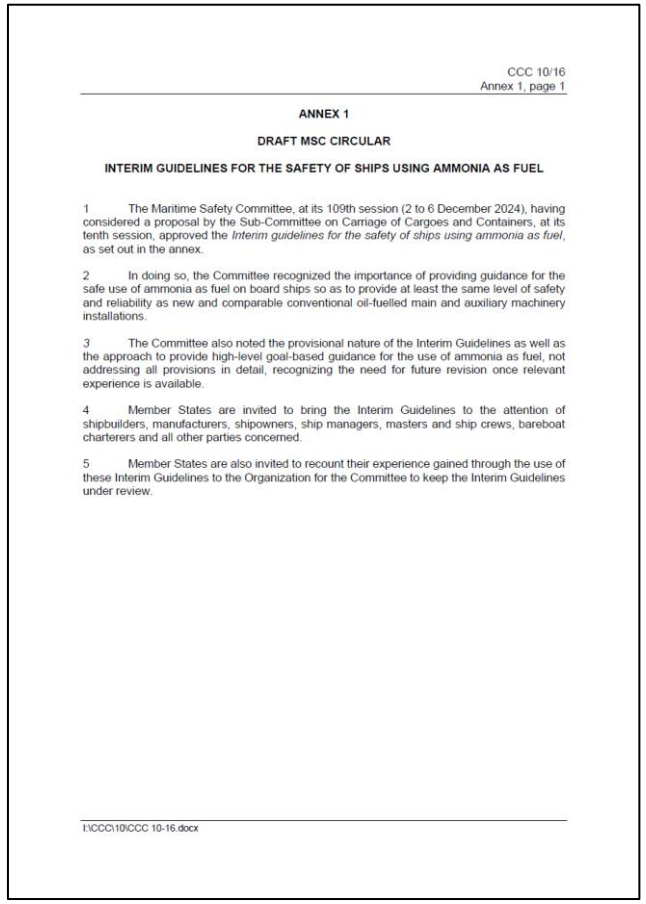
CCC 11 (Sep 2025)

CCC 11 is expected to finalise draft interim guidelines for the use of ammonia cargo as fuel.

Entry-into-force

1 July 2026?

Ammonia as Fuel, IGF Code: Interim Guidelines



CCC 10/16
Annex 1, page 1

ANNEX 1

DRAFT MSC CIRCULAR

INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), having considered a proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its tenth session, approved the *Interim guidelines for the safety of ships using ammonia as fuel*, as set out in the annex.

2 In doing so, the Committee recognized the importance of providing guidance for the safe use of ammonia as fuel on board ships so as to provide at least the same level of safety and reliability as new and comparable conventional oil-fuelled main and auxiliary machinery installations.

3 The Committee also noted the provisional nature of the Interim Guidelines as well as the approach to provide high-level goal-based guidance for the use of ammonia as fuel, not addressing all provisions in detail, recognizing the need for future revision once relevant experience is available.

4 Member States are invited to bring the Interim Guidelines to the attention of shipbuilders, manufacturers, shipowners, ship managers, masters and ship crews, bareboat charterers and all other parties concerned.

5 Member States are also invited to recount their experience gained through the use of these Interim Guidelines to the Organization for the Committee to keep the Interim Guidelines under review.

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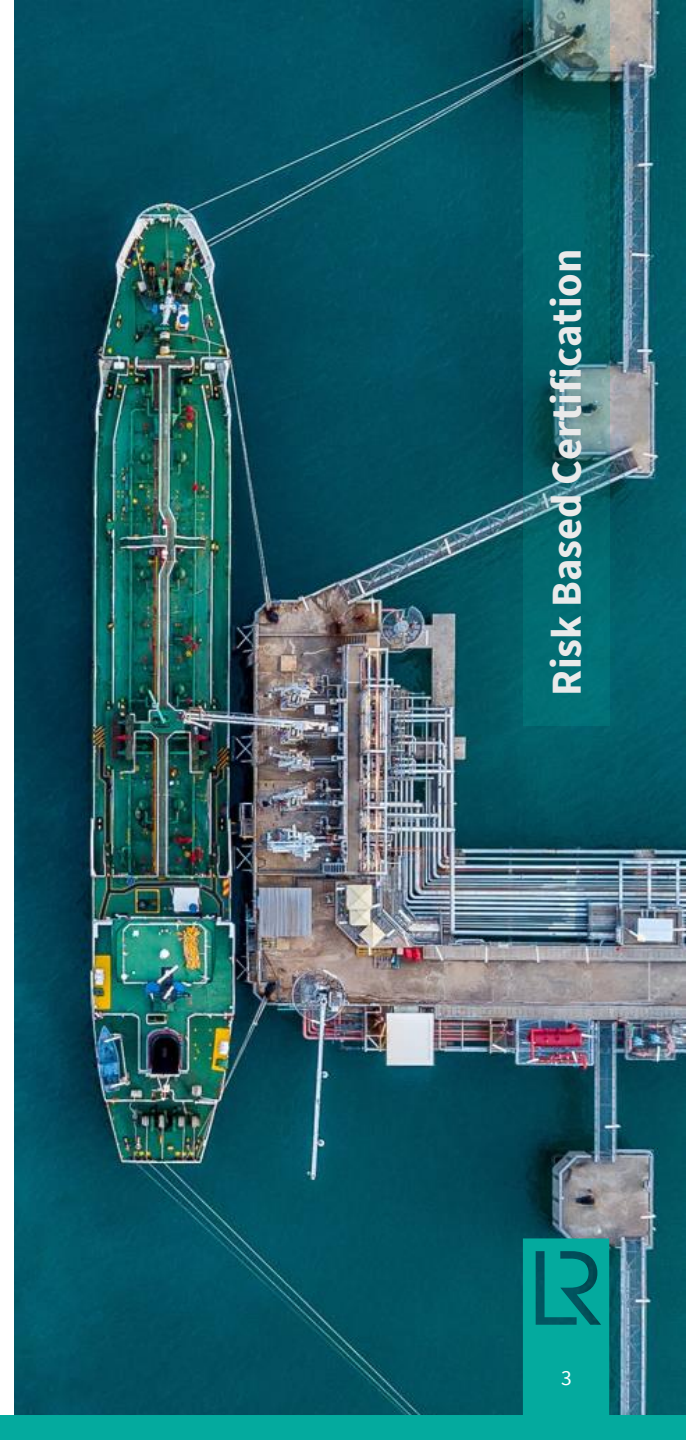
Equivalence

2.3.3 The equivalence of the alternative design should be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration should not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment or type thereof which is prescribed by these Interim Guidelines.

3.2 Functional requirements

3.2.1 The safety, reliability and dependability of the systems should be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.

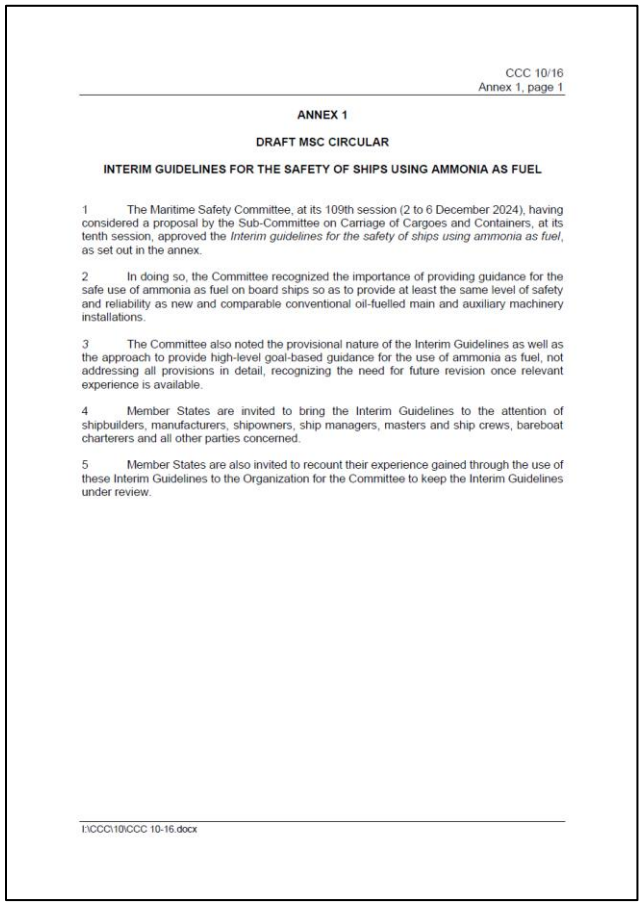
IMO CCC10/16, Annex 1, INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL



Equivalent does not mean the Same…

Generally, equal means things are the same. Whereas equivalent means things are similar.

Ammonia as Fuel, IGF Code: Interim Guidelines.



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Chapter 5	Ship Design and Arrangement
Chapter 6`	Fuel Containment System
Chapter 7	Material and General Pipe Design
Chapter 8	Bunkering
Chapter 9	Fuel Supply System
Chapter 10	Power Generation including Propulsion and other Fuel Consumers
Chapter 11	Fire Safety (Goal and Functional Requirements only)
Chapter 12	Explosion Prevention (Goal and Functional Requirements only)
Chapter 12bis	Prevention of Exposure to Toxicity (new)
Chapter 13	Ventilation (Goal and Functional Requirements only)
Chapter 14	Electrical Installation (Goal and Functional Requirements only)
Chapter 15	Control, Monitoring and Safety Systems
Chapter 16	Manufacture, Workmanship and Testing
Chapter 17	Drills and Emergency Exercises
Chapter 18	Operation (Goal and Functional Requirements only)
Chapter 19	Training (Goal and Functional Requirements only)
Chapter 20	Personal Protection (new)

3.2.8bis Sources of ammonia release should be minimized to reduce the probability of ammonia exposure to humans and the environment.

Safety: inherently safer design principles have been applied to the Guidelines (Trevor Kletz "*what you don't have, can't leak*")

Environment: CCC 10 (September 2024) has requested MEPC 83 (April 2025) to consider ammonia effluent discharges

5.2.2 fuel containment systems, fuel piping and other fuel sources of release should be so located and arranged that released ammonia is led to a recovery system, treatment system or a safe location in the open air

“recovery system" includes to a tank, “treatment system” includes a burner, and “safe location” is a “toxic area”

6.3.1 The ammonia fuel should be stored in a refrigerated state at atmospheric pressure.

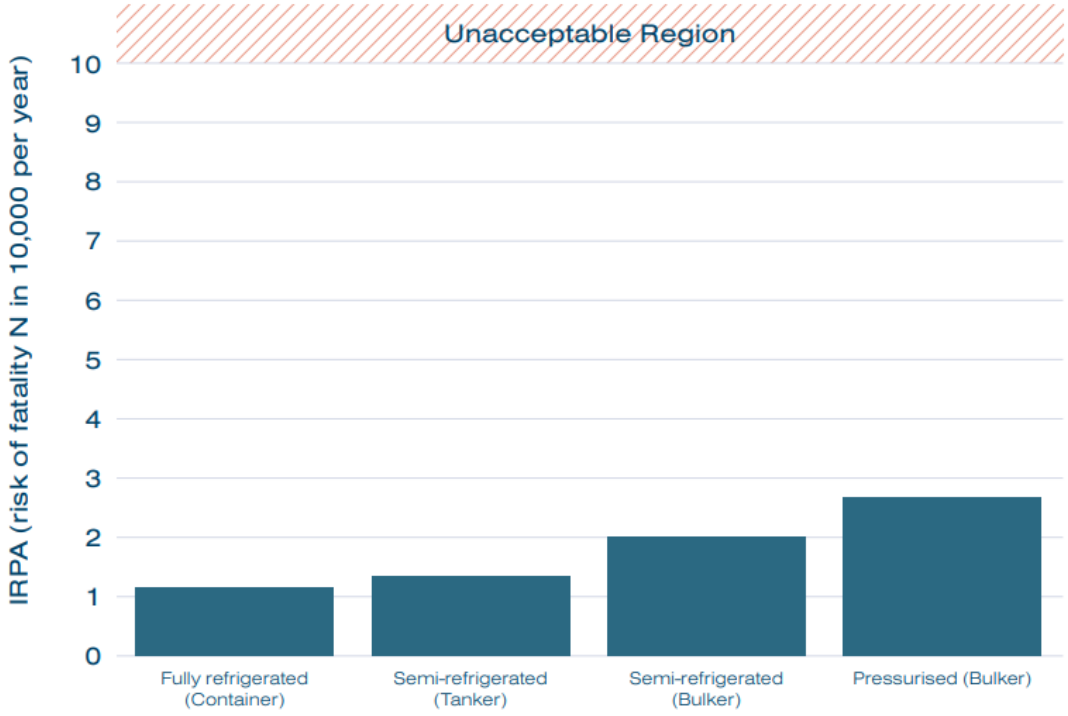
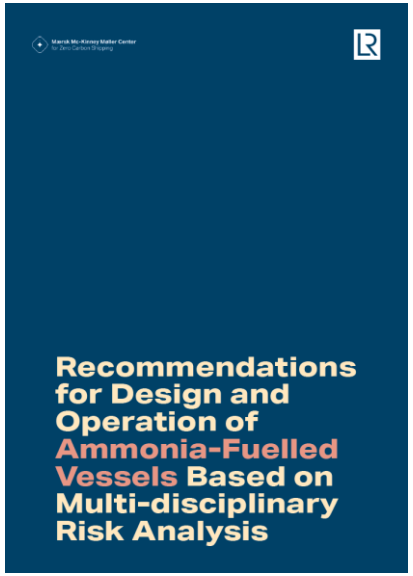


Figure 11: IRPA from ammonia for engineering ratings by type of fuel storage.

Pressure accumulation of the containment system has been deleted i.e. “fuel tanks should be maintained at a temperature of no more than -30C at all times.”



12bis.3.1 Toxic area and space classification is a method of analysing and classifying the areas where ammonia vapour is or may be expected to be present.

Local alarm at 25ppm, global alarm at 110ppm, and shutdown at 220ppm.

TABLE 2-1 Summary of AEGL Values for Ammonia

Classification	10 min	30 min	1 h	4 h	8 h	End Point (Reference)
AEGL-1 (nondisabling)	30 ppm (21 mg/m^3)	30 ppm (21 mg/m^3)	30 ppm (21 mg/m^3)	30 ppm (21 mg/m3)	30 ppm (21 mg/m3)	Mild irritation (MacEwen et al. 1970)
AEGL-2 (disabling)	220 ppm (154 mg/m^3)	220 ppm (154 mg/m^3)	160 ppm (112 mg/m^3)	110 ppm (77 mg/m3	110 ppm (77 mg/m3)	Irritation: eyes and throat; urge to cough (Verberk 1977)
AEGL-3 (lethal)	2,700 ppm (1,888 mg/m^3)	1,600 ppm (1,119 mg/m^3)	1,100 ppm (769 mg/m^3)	550 ppm (385 mg/m3)	390 ppm (273 mg/m3)	Lethality (Kapeghian et al. 1982; MacEwen and Vernot 1972)

Thank you

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