

Safety Aspects of New Technologies and Fuels (Revision 1)

Our Position

IACS is working towards identifying and developing new IACS instruments to address the safety aspects related to new technologies and fuels, while referring to available standards, guidelines and common best practice in other industries.

IACS will strive to achieve technical solutions that aim to promote inherently safer designs and comply, as appropriate, with the Goals and Functional Requirements stated in the IGF Code and/or other applicable standards.

BACKGROUND

With the development and use of new technologies to use low-flashpoint and zero or low-carbon fuels, the maritime industry is increasingly seeking practical, technical and operational standards to address the safety aspects of these new technologies and fuels. IMO has already developed extensive requirements around the use of low flashpoint fuels and gases, notably for methane (LNG) and methyl/ethyl alcohol fuels, and is embarking on the development of further instruments to address safety aspects of emerging technologies and alternative fuels, in support of IMO's decarbonization agenda.

Summary of key issues

IACS has identified the following as potential technologies and fuels that would benefit from the development of further IMO and IACS instruments:

Fuels:

- LPG
- Liquefied Anhydrous Ammonia
- Methanol
- Ethanol
- Compressed Hydrogen
- Liquefied Hydrogen
- Blends with hydrogen
- Ethane
- Liquid Biofuels (HVO, FAME)
- Bio-Gas (e.g. Methane)
- Di Methyl Ether (DME)

New Technologies (for maritime sector):

- Fuel Cell Power Systems
- Fuel Reforming systems
- Alternative fuel/multifuel in ICE
- Wind Assisted Propulsion
- Carbon Capture and On-Board Storage
- Hydrides including metal-organic frameworks
- High Pressure Gas Composite Cylinders
- Batteries (Lithium Based, e.g. Lithium-Iron Phosphate, Lithium-Iron-Manganese Phosphate)
- Solar
- Nuclear

Reviewing the properties of the above fuels and technologies, IACS has identified the following aspects which may bring additional risks or increase the risks associated with conventional fuels and technologies which will need to be considered whilst evaluating their overall safety.

Identified fuel properties include low fuel flash points, wide flammability ranges, gaseous state at ambient conditions, storage conditions (e.g. highly pressurized, cryogenic temperatures), compatibility issues, corrosiveness, different densities compared to that of air (lower or higher), toxicity, low ignition energy, low auto ignition temperatures, and fast burning velocities.

With regard to the technology, important aspects to consider include the high temperatures and pressures that machinery/equipment would be exposed to, the associated wear on machinery/equipment, any contamination, the potential loss of control, as well as the general scarcity of certain technologies.

Examples of Identified hazards associated with the handling and use of alternative fuels and technologies include:

- Leaks/ruptures/material permeability, resulting in accumulation or the spread of vapours, leading to potential corrosion, fires/explosions, or poisoning/asphyxiation.
- Leaks/ruptures/material permeability resulting in radiation leak and radiation poisoning in case of nuclear fuels.
- Stratification of fuel, boiling off, over pressurization, oxygen enrichment, resulting in fuel instability.
- Ice formation, material embrittlement, cryogenic/cold burns.

Electrical energy storage problems due to fast charging, or exposure to heat, (resulting in heat energy release, thermal runaway, toxic gases generation), or due to aging and resulting in performance deterioration.

IACS Position

General

IACS notes that the majority of the above mentioned fuels are low-flashpoint or gaseous fuels and have some of the same inherent risks associated with the use of methane (gaseous and liquefied – LNG) as fuel.

Considering that many of the risks have already been addressed in the IGF Code by the goals and functional requirements, together with the detailed prescriptive requirements for methane, IACS is of the view that the IGF code should be used as the basis for future requirements for other low-flashpoint fuels or gases. Noting also that the IGF Code already includes the ‘Alternative Design’ process for approving other low flashpoint fuels and gases to SOLAS II-1/55, the development of additional fuel specific requirements, using the approach already taken for methyl/ethyl alcohol fuels with IMO’s interim guidelines MSC.1/Circ.1621, enables similar requirements for the other fuels to be developed with dedicated requirements addressing the special risks brought by some of those fuels, e.g. toxic impact, oxygen enrichment, low ignition energy, etc. The fuel specific requirements can also reconsider the IGF requirement that are not suitable for the specific fuels or technology, taking into account the IGC Code, Industry standards, guidelines and common practice as well as identified existing gaps or lacks of the existing standards or guidelines.

Similarly, there are technologies whose risks are not addressed by present Rules and/or Regulations.

The use of Ammonia as fuel on different ship types

The CCC Sub-Committee is developing non-mandatory Guidelines for Ammonia-fuelled ships whose publication is expected by late 2024.

On the other hand, the IGC Code, applicable to ships carrying liquified gases, prohibits the use of toxic cargo as fuel, and therefore prevents the use of Ammonia as fuel onboard Ammonia Carriers. The CCC9 considered proposal to remove this restriction but according to the IMO’s plan, amendments to the IGC Code should be agreed upon by CCC 10 in September 2024, for approval by MSC 109 in December 2024, and adoption by MSC 110 in mid-2025. With that schedule, the amendments could enter into force in early 2027 (under the IMO’s expedited entry into force for urgent amendments), however, given the four-year cycle of amendments of SOLAS and related Codes, a later date is also possible. A dedicated set of guidelines is recalled in the draft amendment, and their availability is expected by the end of 2025, i.e. well in advance of the entry into force of the draft amendment. This situation could lead to a discrepancy between ships subject to the IGC Code, and namely ammonia carriers, whose crews are familiar with toxic cargoes, which may face delays in adopting Ammonia as fuel, compared to other non-IGC vessels.

IMO and Member States need to address this issue, possibly through a Circular encouraging early adoption of the amendments. However, lifting this restriction raises legal questions about the authority of an IMO circular to waive signatory parties’ (and their RO’s) obligations and requires clarity on Port State Control’s enforcement role.

Other options exist to permit the use of ammonia while the IMO works its way through the necessary amendments to the relevant instruments. Arguments could be presented at the IMO to enable earlier adoption of the required amendments to the IGC Code, for example using the urgent amendment arguments. Alternatively interested parties could work with different port states to create routes on which ammonia using ships to operate between them on a general basis rather than on a ship-by-ship basis.

Summary of Work already carried out by IACS on this Issue to Date

IACS participates in the Correspondence Group on the Development of Technical Provisions for the Safety of Ships using Gaseous and Low-flashpoint Fuels and will continue to monitor and support IMO in the development of technical requirements addressing the use of new technologies and fuels.

IACS has developed many Unified Interpretations to the IGF Code, and these are available on the IACS website as 'GF' UIs:

<https://iacs.org.uk/resolutions/unified-interpretations/ui-gf>

IACS continues to develop its machinery requirements for gas and alternative fuels, e.g. Unified Requirement M78 'Safety of Internal Combustion Engines Supplied with Low Pressure Gas'. IACS machinery URs are available on the IACS website:

<https://iacs.org.uk/resolutions/unified-requirements/ur-m>

IACS has also supported the application of the IGF Code and the use of LNG as fuel through IACS Recommendation No.142 'LNG Bunkering Guidelines', Recommendation No. 146 'Risk Assessment as Required by the IGF Code' and Recommendation No.148 'Survey of Liquefied Gas Fuel Containment Systems'.

IACS has submitted a Paper to IMO (A 32/12/2) that discusses an approach to address the multidimensional challenge posed by the pace of development of technology, decarbonization ambition and the necessary detailed requirements and regulations to deliver a safe zero-CO₂-emitting ship. Further, as a follow-up, IACS offered preliminary views on the risks associated with the options currently researched and trialled to deliver a safe zero-CO₂-emitting ship (MSC 105/2/2).

IACS has established Safe Decarbonisation Panel to deal with all technical items related to environmental issues and safety issues for the development and application/use of alternative energy sources and technologies onboard ships, including the optimization of the onboard energy requirements in a holistic sense.

IACS has submitted a Paper to IMO (CCC 8/2/1) with examples of different technologies, and associated risks, highlighting the need of developments in different regulatory areas to highlight that the challenge of achieving safe decarbonisation implies a scope wider than presently addressed by the CCC sub-committee.

IACS initiated a discussion and co-sponsored the submission of a Paper (MSC 107/17/21) with a Proposal for a new output to facilitate a regulatory framework to support the safe delivery of IMO's strategy on reduction of GHG emissions from ships.

IACS has submitted a Paper to IMO (MSC 107/17/24) proposing timelines and format of the road map for the safe decarbonization regulatory assessment to deliver the regulatory framework.

IACS has convened four Project Teams (PTs) of experts, respectively on Ammonia, Hydrogen, Carbon Capture and Electrical energy storage systems, for them to develop IACS requirements addressing safety aspects of those technologies, as a complement to IMO Regulations.

IACS has carried out gap analyses in respect of application of the International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code) to the use of Ammonia and Hydrogen as fuels, and submitted two information papers to IMO (CCC 9/INF.16 And CCC9/INF.17) with results of the gap analyses.

IACS has submitted a paper to IMO (CCC 9/3/4) concerning the experience gained with the Interim guidelines for safety of ships using fuel cell power installations (MSC.1/Circ.1647)

IACS has submitted two papers to IMO (CCC9/3/14 and CCC9/3/15) with comments on the Report of the Correspondence Group on Alternative Fuels and Related Technologies as contained in document CCC 9/3, and respectively related to the draft interim guidelines being developed for ammonia and hydrogen as fuels.

Please note if you're reading this paper in hard copy the most recent version is available at iacs.org.uk/about-us/position-papers

For more information, contact IACS Permanent Secretariat on +44 (0)20 7976 0660, permsec@iacs.org.uk. This position paper was first published in March 2019.

International Association of Classification Societies Permanent Secretariat, 4 Matthew Parker Street, Westminster, London SW1H 9NP, UK

E: permsec@iacs.org.uk T: +44 (0)20 7976 0660 www.iacs.org.uk