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REVIEW OF THE IGC CODE

Interim guidelines for the use of anhydrous ammonia cargo as fuel

Submitted by Australia, Belgium, Cyprus, Denmark, Liberia, United Arab Emirates, EUROMOT and ICS

SUMMARY

Executive summary:	This document includes draft interim guidelines for use of ammonia cargo as fuel and proposes to finalize these interim guidelines within the scope of the CCC work plan for review of the IGC Code.
Strategic direction, if applicable:	1
Output:	1.17
Action to be taken:	Paragraph 20
Related documents:	MSC 95/22; MSC.392(95); CCC 9/4, CCC 9/4/9, CCC 9/14, CCC 9/WP.4; MSC 108/14/1, MSC 108/WP.1 and CCC 10/3

Background

1 The Maritime Safety Committee, at its 103rd session, agreed on a new output for the post 2020-2021 biennium to review the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) with the goal of finalizing this review in two sessions (document MSC 103/21, paragraphs 18.1 to 18.3). The review would include all provisions of the IGC Code, including paragraph 16.9.2, as requested in document MSC 102/21/14 (Norway).

2 The Sub-Committee on Carriage of Cargoes and Containers (CCC), at its ninth session (CCC 9), considered the proposals in related documents CCC 9/4 (Marshall Islands) and CCC 9/4/9 (Belgium et al.). As part of its review of the IGC Code, the Working Group prepared a draft amendment to paragraph 16.9.2 of the Code, as set out in annex 2 to document CCC 9/WP.4.

3 CCC 9 set out to finalize all draft amendments to the IGC Code at CCC 10, with a view to approval at MSC 109 and subsequent adoption at MSC 110, in line with the output formulated by the Maritime Safety Committee (CCC 9/WP.4, paragraph 4.12, and CCC 9/14, paragraph 4.24).

4 In its consideration of the amendment, the Sub-Committee noted that "there was an urgent need to facilitate the industry's transition to low and zero-carbon fuels, including ammonia, and the amendments to the IGC Code would allow and support this much-needed transition" (CCC 9/14, paragraph 4.10.2).

5 At CCC 9, the Sub-Committee also noted the need to develop guidelines for the use of cargoes identified as toxic products and which are required to be carried in type 2G/2PG ships (CCC 9/14, paragraph 4.25).

6 Based on the proposal in the annex of document MSC 108/14/1 (Belgium et al.), the Committee approved draft amendments to the IGC Code, with a view to adoption at MSC 109, and entry into force on 1 July 2026, together with an MSC circular on the early implementation of the draft amendments to be issued at MSC 109. As an alternative to an MSC circular, MSC 109 could consider including an invitation for early implementation in the resolution containing the aforementioned amendments.

7 In accordance with article VIII(b)(i) of the SOLAS Convention, the text of the aforementioned proposed amendments was put forward by Circular Letter No.4879 for consideration and with a view to adoption by the Maritime Safety Committee at its 109th session.

Discussion

8 At MSC 95, the Committee considered the issue of exemption of gas carriers from the application of the IGF Code (MSC 95/22, paragraphs 3.10 to 3.17). The issue was considered due to the issues raised by IACS in applying two Codes simultaneously to a gas carrier where fundamental differences between the Codes exist, for example, on vessel tank location and emergency shutdown (ESD) protected spaces. IACS also requested clarification on application of the IGF Code to gas carriers where a gas carrier may be using dedicated low-flashpoint fuels that are not derived from the vapour or boil-off from their cargo.

9 After considering the issues, the Committee agreed, as given by the policy decision (MSC 95/22, paragraph 3.17), that the IGF Code shall not apply to ships subject to the IGC Code, even in the case of the IGC Code ships using low-flashpoint fuels that are not cargo. This policy decision was captured in the amendments to SOLAS chapter II-1 adopted by resolution MSC.392(95), and the addition of the new part G to SOLAS.

10 The MSC.392(95) amendments to SOLAS II-1 detail this gas carrier exemption under regulation 56 as follows:

> This part shall not apply to gas carriers, as defined in regulation VII/11.2:
>
> .1 using their cargoes as fuel and complying with the requirements of the IGC Code, as defined in regulation VII/11.1; or
>
> .2 using other low-flashpoint gaseous fuels provided that the fuel storage and distribution systems' design and arrangements for such gaseous fuels comply with the requirements of the IGC Code for gas as a cargo.

11 Considering the foregoing, it is noted that the Committee has already agreed that the IGF Code shall not apply to gas carriers.

12 It is noted that the CCC Sub-Committee is developing draft interim guidelines for ships using ammonia as fuel under agenda item 3, "Amendments to the IGF Code and development of guidelines for alternative fuels and related technologies", which are based on the IGF Code structure and layout.

13 Furthermore, MSC 108 approved MSC.1/Circ.1679 on the *Interim guidelines for use of LPG cargo as fuel*. The approval of these gas carrier Guidelines recognizes, and is fully aligned with, the MSC 95 policy decision, and supports the provision of IMO instruments for ships subject to either Codes.

14 The co-sponsors consider that the structure of MSC.1/Circ.1679 can be used as the basis for the development of interim guidelines for the use of anhydrous ammonia as fuel, taking into account the technical requirements of the IGF Code Interim guidelines for ships using ammonia as fuel, as far as applicable, to cover the toxicity aspects.

15 Accordingly, the co-sponsors have developed draft interim guidelines for use of ammonia cargo as fuel, as set out in the annex of this document. The purpose of these interim guidelines is to provide unified specific guidance for ships using ammonia (anhydrous ammonia) cargo as fuel until such provisions are incorporated in the IGC Code.

Work output for the review of the IGC Code

16 The list of outputs for the 2024-2025 biennium, as set out in Assembly resolution A 33/Res.1173, contains an output 1.17 on "Review of the IGC Code". The output was placed on the agenda of the Sub-Committee by the Maritime Safety Committee at its 103rd session, with a target completion year of 2023. The target completion year was extended by one year due to the pandemic (MSC 103/21, paragraph 18.2) and is currently set for 2024. Under this output, the draft interim guidelines for use of LPG cargo as fuel (CCC 9/14, annex 6) were developed.

Proposal

17 In light of the above, the co-sponsors propose, as a matter of urgency, to finalize as soon as possible, or at the latest at CCC 11, the draft interim guidelines for use of ammonia cargo as fuel under agenda item 4, "Review of the IGC Code", and take into account annex 2 of document CCC 10/3 (Germany).

18 The co-sponsors propose to re-establish the Correspondence Group on the "Review of the IGC Code" and to prepare terms of reference for the development of these interim guidelines. An initial draft, as set out in the annex of this document, could be used as a basis for this discussion.

19 The co-sponsors also propose to request the Maritime Safety Committee to extend the target completion year of the existing output 1.17 on "Review of the IGC Code" by at least one year to 2025 and to revise the scope to be "Review of the IGC Code and development of guidelines for the use of ammonia cargo as fuel".

Action requested of the Sub-Committee

20 The Sub-Committee is invited to consider the proposal in paragraphs 18 and 19 and the draft interim guidelines as set out in the annex of this document and take action, as appropriate.

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ANNEX

INTERIM GUIDELINES FOR USE OF AMMONIA CARGO AS FUEL

1 Preamble

1.1 Chapter 16 of the IGC Code provides specific provisions for the use of liquefied natural gas (LNG) cargo as fuel. For other cargo gases, section 16.9 (Alternative fuels and technologies) of the IGC Code requires that the same level of safety as natural gas is ensured.

1.2 [Circular MSC.1/Circ.XXXX] [resolution MSC.XXXX(109)] enables flag States to apply the Guidelines on a voluntary basis until the amendment to section 16.9.2 of the IGC Code enters into force on 1 July 2026.

1.3 For the purpose of section 16.9 of the IGC Code, the safety level of the design for each ship should be demonstrated as specified in SOLAS regulation II-1/55 to provide the same level of safety as natural gas. Gas carriers, sailing under the IGC Code and using dangerous cargoes and, more specifically, anhydrous ammonia as fuel, are subject to these Interim guidelines. These Interim guidelines are aimed to be used as the basis for the IGC Guidelines and will be reviewed in case another toxic cargo will be demonstrated to be used as fuel.

1.4 The purpose of these Interim guidelines, referred to in section 16.9.3 of the IGC Code, is to provide unified specific guidance for ships using ammonia (anhydrous ammonia) cargo as fuel until such provisions are incorporated in the IGC Code, with a view to responding to the industry's urgent need for such guidance.

1.5 The provisions in the Interim guidelines take into account the goal-based approach (MSC.1/Circ.1394/Rev.2), as they refer to the existing provisions of the IGC Code, which is a goal-based instrument. Therefore, goals and functional requirements were specified forming the basis for the design, construction and operation.

2 Guidance

2.1 Application and definitions

2.1.1 These Interim guidelines, complying with paragraph 16.9.3 of the IGC Code, apply to gas carriers as defined in SOLAS regulation VII/11.2 complying with the requirements of the IGC Code using ammonia as fuel, as a supplement to the existing provisions of chapter 16 of the IGC Code. These present Guidelines refer intentionally only to ammonia as it is the only toxic cargo which is foreseen for fuel at the time of redaction. In the eventuality of the use of another toxic cargo as fuel, which is not covered by any IGC Guidelines, the present Guidelines will be reviewed in accordance with the use of fuels in the sector.

2.1.2 For the purposes of these Interim guidelines and application of chapter 16 of the IGC Code, ammonia fuel consists of anhydrous ammonia as listed in chapter 19 of the IGC Code. It can be in either in liquefied or gaseous state. Ammonia in liquefied state is referred to as ammonia liquid, and ammonia in gaseous state is referred to as ammonia vapour. References to "gas" in the requirements in chapter 16 of the IGC Code are to be taken as referring to ammonia, in liquid or gaseous state.

2.1.3 The ammonia fuel storage and distribution systems' design and arrangements should be in accordance with the general requirements of the IGC Code and the special requirements for ammonia as given in chapter 17.12 of the IGC Code. The requirements of 14.4, 17.2.1 and 17.12, as indicated as required by chapter 19 for carriage of anhydrous ammonia, should also be applicable for the carriage, containment, distribution and use of ammonia as fuel.

2.1.4 A gas fuel consumer is any unit within the ship using cargo ammonia vapour or liquid as a fuel.

2.1.5 An ammonia fuel preparation room means any space containing pumps, compressors and/or vaporizers for ammonia fuel preparation purposes.

2.2 Goal

2.2.1 The goal of these Interim guidelines is to ensure safe and reliable operation of fuel supply systems and consumers for use of ammonia cargo as fuel.

2.3 Functional provisions

2.3.1 Single failure of the ammonia fuel system should not cause leakage of fuel into any spaces outside the cargo area.

2.3.2 Effectiveness of the ventilation and detection for ammonia leakage should be ensured taking into account the characteristics of ammonia.

2.3.3 The ammonia fuel characteristics should be suitable for operation of the fuel consumer.

2.3.4 Fuel supply systems should be designed to prevent fuel from unintended phase changes in processing of fuel supply to consumers considering temperature and pressure at the design parameters.

2.3.5 Vent, purging and bleed lines of fuel supply systems should be designed to prevent any direct release of ammonia to the atmosphere. Any release of fuel ammonia should not present a health hazard.

2.3.6 Fire detection, protection and extinction measures appropriate to the hazards concerned should be provided.

2.4 Supplementary guidance to the provisions of chapter 16

2.4.1 The company should ensure that seafarers on board ships using ammonia fuel should be trained and qualified taking into account the specific hazards of ammonia used as fuel.

2.4.2 In accordance with the principles of paragraph 16.9 of the IGC Code[*], ammonia cargoes may be consumed in machinery spaces of category A. In these spaces, it may be consumed only in boilers, internal combustion engines, gas combustion units, gas turbines and fuel cells.

2.4.3 The ammonia fuel supply systems and ammonia fuel consumers should be designed for operation considering various characteristics of all possible specified compositions of the ammonia. Information about the range of acceptable compositions for ammonia fuel should be provided on board. Additionally, the system should be designed considering the various pressure and temperature characteristics of the ammonia.

[*] Draft amendment to paragraph 16.9.2 was approved at MSC 108.

2.4.4 The fuel supply system should comply with the requirements of paragraphs 16.4.1, 16.4.2, 16.4.3, 16.4.4 and 16.5 of the IGC Code and with the additional requirements indicated in these Guidelines.

2.4.5 Ammonia fuel consumers should have a separate exhaust system and exhibit no external visible flame.

2.4.6 Provisions should be made for depressurizing, inerting, purging and venting of the ammonia fuel piping systems, located in the machinery space, to a safe location. All systems connected to the fuel piping should be fitted with double block and bleed valves. In addition, a non-return valve should be installed in the inert gas and other piping systems upstream of the double block and bleed valves. For liquid fuel supply systems, depressurizing and purging the piping should be done without direct release of liquid to the atmosphere.

2.4.7 In accordance with the IGC Code, section 16.4.6, regarding gas fuel supply, the supply and return piping of each gas consumer unit should be provided with fuel isolation by automatic double block and bleed, vented to a safe location in the cargo area, under both normal and emergency operation. The direct release of ammonia from the fuel system directly to the atmosphere during normal operation should be prevented. The automatic valves should be arranged to fail to a safe position on loss of actuating power. In a space containing multiple consumers, the shutdown of one should not affect the gas fuel supply to the others. For liquid ammonia fuel supply systems, the piping should be depressurized and purged without the release of liquid to the atmosphere.

2.4.8 Gas nozzles and the burner control systems should be configured such that gas fuel can only be ignited by an established fuel oil flame.

2.5 Additional provisions

2.5.1 Risk assessment

2.5.1.1 A risk assessment should be conducted for the ammonia fuel system design and arrangements installed outside the cargo area to document that the same level of safety as natural gas is achieved. The risk assessment should also cover the ammonia fuel arrangements installed in the cargo area to document the same level of safety as when utilizing ammonia as cargo. Consideration should be given to the hazards associated with the arrangement, operation and maintenance of the fuel system, considering all reasonably foreseeable failures.

2.5.1.2 The risk assessment should address the consequences of fuel leakage, considering the properties of ammonia, taking into account ammonia toxicity and corrosivity and its accumulation or escape into adjacent areas and spaces. The risk assessment should specifically consider the ammonia fuel system integrity with focus on its ability to prevent and isolate leakages and also evaluate potential toxicity hazards, ignition mechanisms and consequences of ignition. Special consideration should be given, but not limited to, the following specific ammonia-related hazards and topics:

- toxic impact of releases or leakage including, but not limited to, dispersion of emergency toxic releases to atmosphere, access to life-saving appliances and access to escape routes;

- gas detector locations, sample points and suitability for detecting required toxicity levels;

- ventilation arrangements, particularly the relative density and dispersion of any potential ammonia releases, since ammonia readily absorbs moisture and may form vapours that are heavier than air;

- the location of double wall fuel piping ventilation inlets and outlets and the need for mitigation of unintended or emergency toxic releases from the outlets;

- ammonia fuel system leakages and spills and their consequences, particularly the accumulation of ammonia vapours and their spreading throughout the ship's spaces via openings;

- risks associated with any ammonia fuel storage tank locations, such as the open deck;

- coverage of water spray systems;

- risks associated with drip trays, bilge systems or holding tanks for ammonia-contaminated water;

- the location for leak detection in the ammonia fuel system is to be assessed by means of a gas dispersion analysis where gas shall be present outside the cargo area. The gas dispersion analysis shall consider the implications for both toxicity and flammability;

- fuel supply system vent arrangements, including the possibility of two-phase release from any pressure relief system and the requirement for blowdown vessels;

- arrangements for closed fuel return and vent systems, together with associated arrangements for ammonia capture and treatment;

- arrangements for purging and inerting, including proposed alternatives to nitrogen as the inerting media;

- control, monitoring and safety system failure modes and conditions, considering criticality and safety requirements;

- failsafe positions of all remotely operated valves in the ammonia fuel system; and

- risks associated with the chosen exhaust gas abatement technology and piping between the consumers and such equipment.

2.5.1.3 Risks which cannot be eliminated should be mitigated as necessary. Details of risks, and the means by which they are mitigated, should be documented to the satisfaction of the Administration.

2.5.2 Arrangements of spaces containing gas fuel consumers

2.5.2.1 In order to minimize the probability of an ammonia exposure to ship personnel, machinery spaces with ammonia-fuelled machinery should be gas-safe machinery spaces under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.

2.5.2.2 A single failure of fuel systems in the machinery space should not lead to a gas release in the machinery space.

2.5.2.3 Fuel piping should be of double wall design or ducted and the outer boundary should be continuous and gas tight in the space. Non-continuous double barriers should not be used under the circumstances described in paragraph 16.4.6.2 of the IGC Code.

2.5.2.4 The air inlet of the annular space should not be in the machinery space. In addition, the air inlet of the annular space should be located in a safe location [for toxicity risk] in the cargo area. Consideration should be given to the risk of liquid carry-over resulting from a liquid leak.

2.5.2.5 As described in the IGC Code, section 3.2, direct access from a space containing ammonia consumers to a fuel supply system space or ammonia fuel preparation room should not be permitted.

2.5.2.6 Provisions and design of ducting and ventilation should be as such that ammonia can be extracted from the space when a leak is detected.

2.5.3 Fuel supply

2.5.3.1 Where fuel supply systems supply liquid ammonia, vent and purging systems should lead to a fuel tank, gas-liquid separator or similar device. Heating arrangements for the gas-liquid separator may be required when ship is operating in cold areas.

2.5.3.2 The release of ammonia from the fuel system directly to atmosphere during normal operation is not allowed. Any operational releases from a fuel treatment system during normal operation are to be considered by the risk assessment. The concentration of any controlled release of ammonia to the atmosphere at the point of release from the treatment system should not present a [significant] health hazard as identified by the risk assessment.

2.5.3.3 Where dedicated ammonia fuel tanks or service tanks are installed, the pressure and temperature of ammonia should be maintained within the tank design range at all times in accordance with chapter 7 of the IGC Code. Venting of fuel vapour for control of the tank pressure is not acceptable except in emergency situations.

2.5.3.4 Fuel supply systems and vent masts should be fitted with an inert gas purging interface and should include a means for preventing condensation of vapour in the system.

2.5.3.5 In application of section 16.4.3.2 of the IGC Code, the ventilation inlets for the double wall piping or ducts should be in a safe location in the cargo area. Ventilation outlets for the double wall piping or ducts should be located in the cargo area.

2.5.3.6 Notwithstanding ammonia's typical storage and distribution temperature above −110°C, a complete stress analysis in accordance with section 5.11.5 of the IGC Code should be undertaken for the fuel supply piping. The thermal stresses in pipework resulting from leakage and rapid expansion of ammonia are also to be evaluated.

2.5.3.7 For double wall fuel piping systems containing high-pressure liquid fuel in the inner pipe, the design pressure of the outer pipe or duct should not be less than the maximum allowable working pressure of the inner pipe.

2.5.3.8 Where the fuel treatment or vent control systems utilize water scrubbing or equivalent treatment systems, these are to be arranged to be independent of any other water treatment or bilge systems and arranged to collect residues or ammonia-contaminated water in holding tanks for further processing or disposal ashore.

2.5.3.9 Where liquid ammonia is heated or cooled, the heating or cooling medium which exchanges heat with ammonia directly is to be utilized in an independent, closed system. Where the auxiliary heat exchange circuits are likely to contain ammonia in abnormal conditions as a result of a component failure, they are to be arranged with means to detect leakage. Alarm is to be given when the presence of ammonia is detected. Auxiliary circuits are to be arranged in a closed system with pressure protection. Vent pipes are to be independent and to be led to the vent mast.

2.5.4 Fuel plant ventilation and liquid/gas detection

2.5.4.1 An ammonia fuel preparation room is a dedicated space located in the cargo area containing machinery intended for cargo as fuel preparation purposes only. The ammonia fuel preparation room should be arranged in accordance with the requirements for cargo machinery spaces (IGC Code, sections 1.2.10 and 3.3). The ammonia fuel preparation room should be independent of the cargo machinery space. Direct access from the ammonia fuel preparation room to other cargo machinery spaces should not be permitted.

2.5.4.2 The ammonia fuel preparation room should, as far as practicable, have an independent access direct from the open deck. Where a separate access from the deck is not practicable, an airlock which complies with section 3.6 of the IGC Code should be provided.

2.5.4.3 The access or other openings to spaces containing fuel sources of release should be so arranged that flammable, asphyxiating and/or toxic gas cannot escape into spaces that are not appropriately zoned.

2.5.4.4 In addition to the requirements of sections 16.3.1 and 16.5.1 of the IGC Code, special consideration should be given to the density, toxicity and lower explosion limit (LEL) of ammonia vapour. Ventilation capacity, including the ventilation inlet and outlet location, should be supported by numerical calculations, such as a computational fluid dynamics (CFD) analysis. The ammonia fuel preparation room should be designed to withstand the maximum pressure build up, or vacuum, during leakages or activation of the safety systems.

2.5.4.5 For spaces within the cargo area containing ammonia fuel conditioning equipment, the requirements of section 12.1.3 of the IGC Code should apply with full capacity redundancy.

2.5.4.6 The ammonia fuel preparation room should be provided with an increased mechanical type of gas evacuation system to limit the consequences of a flammable or/and toxic release by a reasonably foreseeable leakage scenario of ammonia.

[The system is to be designed and constructed in accordance with the following requirements:

.1 the gas evacuation system is to be independent of other shipboard ventilation systems;

.2 the gas evacuation system is to be arranged to automatically start when the concentration of ammonia in the space exceeds 300 ppm;

.3 the combined capacity of the ventilation and gas evacuation fans is to provide a minimum of 45 air changes per hour based on the total empty volume of the space; and

.4 increasing the ventilation capacity may cause under- or overpressure in the fuel preparation room. Safe escape from the fuel preparation room shall be guaranteed.]

2.5.4.7 Ventilation inlets and outlets for fuel supply system spaces should be arranged to prevent exhausted gas from re-entering the space through the inlets. Air inlet openings are to be positioned as low as practicable in the space being ventilated and exhaust openings are to be both the lowest and highest points and at opposite sides to the air inlet openings so that ammonia vapour cannot accumulate in the space.

2.5.4.8 The ventilation outlets from fuel supply system spaces are to discharge to atmosphere at least 6 metres above the deck, as required by the IGC Code sections 8.2.10.3 and 8.2.10.4, and 15 metres from the nearest air inlet or openings to accommodation spaces and enclosed working spaces, as required by the IBC Code, section 15.12.1.3.

2.5.4.9 Fuel supply system space should be designed to minimize the accumulation of gases or the formation of gas pockets. In addition to the requirements of section 13.6.12 of the IGC Code, gas detection heads should be fitted in spaces where ammonia vapour may accumulate particularly where air circulation is reduced or near the bottom of the space. The suitability of their location should be supported by numerical calculations, such as a CFD analysis. In addition, gas detectors are to be located in the ventilation outlets.

2.5.4.10 Following the requirements of section 14.4.3 of the IGC Code, decontamination showers and eyewash stations shall be available in convenient locations:

- near the exits from ammonia fuel preparation rooms; and

- in machinery spaces for ammonia fuelled consumers.

2.5.4.11 The ammonia fuel preparation room should be provided with bilge wells incorporating a high-level alarm. The bilge system should be segregated from other bilge systems and the arrangement should be subject to special consideration within the risk assessment and appropriately zoned.

2.5.5 Combustion equipment

2.5.5.1 A safety concept should be developed for all ammonia fuel gas consumers and approved by the Administration.

2.5.5.2 The ammonia concentration of gas fuel consumers' exhaust gases released to atmosphere should not present a [significant] health hazard at the point of release.

2.5.5.3 In addition to demonstrating that the potential explosion hazards have been considered, the safety concepts for the ammonia fuel consumers should also take account of the toxic injury potential and are to document the arrangements to prevent toxic injury.

2.5.5.4 The fuel line to each consumer should be fitted with means of purging the pipework downstream of the master gas fuel valve. The ammonia content which will be present after purging should be described on the safety concept of the ammonia consumer. Purging should happen automatically when the master gas fuel valve is closed.

2.5.5.5 In case of maintenance of the ammonia consumers or ammonia fuel supply system, the pipework should be arranged with a suitable purging system to ensure that the pipe works and consumers can be purged to a level [that does not present a [significant] health hazard] [below 25 ppm]. Compatibility of the purging medium with ammonia should be demonstrated. Arrangements for fuel depressurization and venting are to be in accordance with paragraphs 2.5.3.2 and 2.3.5 of these Guidelines.

2.5.5.6 Gas turbines should be fitted within a gastight enclosure unless fuel supply piping meets the requirements of section 16.4.3 of the IGC Code and with the additional requirements indicated in these Guidelines. The consequences of gas leakage should be evaluated based on the risk assessment in paragraph 2.5.1.

2.5.5.7 Fuel cell installations should be arranged in accordance with MSC.1/Circ.1647 on *Interim guidelines for the safety of ships using fuel cell power installations* and with the additional requirements indicated in these Guidelines.