

SUB-COMMITTEE ON CARRIAGE OF
CARGOES AND CONTAINERS
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Agenda item 13

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**DEVELOPMENT OF GUIDELINES FOR THE SAFETY OF SHIPS USING
AMMONIA AS FUEL**

**Issues to be considered and possible way forward for the development of guidelines
for the safety of ships using ammonia as fuel**

Submitted by Japan, Singapore, ICS and INTERCARGO

SUMMARY

Executive summary: This document provides information on possible issues to be considered for developing guidelines for the safety of ships using ammonia as fuel and proposes the way forward.

Strategic direction, if applicable: 2 and 3

Output: 2.0

Action to be taken: Paragraph 14

Related documents: CCC 7/3/9, CCC 7/8, CCC 7/15; MSC 104/15/9, MSC 104/15/10, MSC 104/15/30, MSC 104/15/33; MSC 105/20; MEPC 78/INF.7; CCC 8/13 and CCC 8/INF.10

Introduction

1 The Maritime Safety Committee, at its 105th session, agreed to include in the biennial agenda of the CCC Sub-Committee for 2022-2023 and the provisional agenda for CCC 8 an output on "Development of guidelines for the safety of ships using ammonia as fuel", with a target completion year of 2023.

2 With a view to facilitating the discussion on this matter, this document provides information on possible issues to be considered and proposes a possible way forward to develop the guidelines.

Background

3 To achieve the levels of ambition set out in the annex to the *Initial IMO strategy on reduction of GHG emissions from ships* (resolution MEPC.304(72), annex), utilization of alternative fuels is essential, and ammonia is one of the promising alternative fuels, as mentioned in the Full Report of the Fourth IMO GHG Study 2020.

4 Various R&Ds on ships using ammonia as fuel have already been started, including demonstration projects as a part of "Green Innovation Fund Project" in Japan as introduced by document MEPC 78/INF.7, and delivery of such vessels engaging on international voyages are expected in mid-2020s. Thus, ensuring the safety of such ships is a paramount issue and the development of internationally applicable safety requirements will proactively contribute to safety.

5 Considering the necessity and urgency of this matter, the CCC Sub-Committee, at its seventh session, agreed to instruct the Correspondence Group on Amendments to the IGF Code and Development of Guidelines for Low-flashpoint Fuels to collect information on the safety of ships using ammonia as fuel while waiting for the decision of the Maritime Safety Committee on the development of guidelines for the safety of ships using ammonia as fuel. The report of the Group was submitted as documents CCC 8/13 and CCC 8/INF.10.

6 Under such circumstances, to develop guidelines effectively, it is beneficial to set a common starting point as soon as possible.

Discussion

7 Hazard Identification of ships using ammonia as fuel in document MSC 104/15/10 reveals that the hazards with a highest Risk Index are:

- .1 "ammonia leakage" and "ammonia leakage (piping)" in Fuel tank, Recirculation system, Liquified fuel supply system as well as Fuel valve train; and
- .2 "Loss of control" on Valve in Recirculation system and Fuel valve train.

8 Taking into account that the high-risk hazards identified in 7.2 above also lead to "ammonia leakage", the most significant hazard will be "ammonia leakage", which may result in adverse health effects due to toxicity. To ensure the health and safety of seafarers on board, countermeasures against toxicity on board should be carefully addressed.

9 Japan further carried out a preliminary bibliographic survey and an investigation of accident data involving ammonia in document MSC 104/15/30. It concluded that:

- .1 the guidelines should address operational safety measures to protect the crew and other persons in charge of works related to ammonia, in addition to safety measures for systems and equipment such as prevention of leakage, early detection and rapid alerting and safe escape (paragraph 15); and
- .2 the applicability and effectiveness of the functional requirements and the general requirements of the IGF Code should be carefully considered for ammonia-fuelled ships. These requirements mainly contain provisions against fire and explosion, in order to meet the functional requirements for natural gas fuel, as mentioned in the preamble to the Code (paragraph 16).

10 While, as mentioned above, differences between natural gas and ammonia, especially in toxicity and risk for fire and explosion, should be carefully considered, the co-sponsors believe that the content of the IGF Code is a good starting point to consider the draft guidelines of ammonia-fuelled ships under these urgent circumstances, since the IGF Code is the one instrument to be applied for gas-fuelled ships in general and there is nearly a decade of implementation experience.

Proposal

11 Taking into account the discussion in paragraphs 7 to 10, the co-sponsors made an initial review of the Code in terms of whether requirements should be amended for the application of ships using ammonia as fuel. The result of the review is set out in the annex.

12 To develop the guidelines for ammonia-fuelled ships, the co-sponsors propose that the Sub-Committee firstly analyses the requirements which should be amended, added or removed from those of the IGF Code and then identify prioritized issues, such as ventilation capacity, the measures to treat ammonia gas or bilge containing ammonia. In doing so, the annex to this document would be helpful.

13 Due to the toxicity of ammonia, there are many provisions which will need in-depth consideration, and consequently the applicability of the IGF Code as a base document may need to be reassessed. The co-sponsors therefore propose to establish a correspondence group to prepare the draft guidelines for the safety of ships using ammonia as fuel with subsequent finalization at CCC 9.

Action requested of the Sub-Committee

14 The Sub-Committee is invited to consider the proposals in paragraphs 12 and 13, and in particular to:

- .1 consider the initially reviewed requirements as set out in the annex;
- .2 specify the prioritized issues to be reflected in the guidelines;
- .3 establish a correspondence group to prepare the draft guidelines with a view to finalization at CCC 9; and
- .4 further consider subsequent issues regarding the use of ammonia as fuel and invite other relevant committees or sub-committees, as necessary, and take action as appropriate.

ANNEX

**RESULT OF INITIAL REVIEW OF REQUIREMENTS FOR AMMONIA-FUELLED SHIPS
SUPPOSED TO BE DIFFERENT FROM THOSE OF THE IGF CODE**

Table of content of the IGF Code	Issues to be considered for amendment, addition or removal from the requirements of the IGF Code for ammonia-fuelled ships
PART A	
General	
GOAL AND FUNCTIONAL REQUIREMENTS	
GENERAL REQUIREMENTS	<ul style="list-style-type: none"> · Consideration of toxicity should be included in the risk assessment.
PART A-1	
SHIP DESIGN AND ARRANGEMENT	<ul style="list-style-type: none"> · ESD-protected machinery spaces, location and protection of fuel piping, arrangement of entrances and other openings in enclosed spaces, and bilge systems should be considered for ammonia. · The secondary enclosure of ammonia, such as fuel preparation rooms, ducts for fuel pipes, and secondary barriers of fuel containment systems, should not have direct contact with accommodation spaces, control stations, etc. · Life-saving appliances and escape routes including on-deck may be isolated from the openings of secondary enclosures and the vent of fuel containment systems.
FUEL CONTAINMENT SYSTEM	<ul style="list-style-type: none"> · Materials selection against corrosion should be considered. · Pressure relief system, atmospheric control within the fuel containment system, inert gas production and storage on board and detoxification system should be considered for ammonia. · Provisions for CNG fuel containment is not needed and those for liquified gas should be modified for ammonia.
MATERIAL AND GENERAL PIPE DESIGN	<ul style="list-style-type: none"> · Material selection against corrosion should be considered. · Wall thickness, design pressure and allowable stress should be considered for ammonia.
BUNKERING	<ul style="list-style-type: none"> · Appropriate emergency disconnection of bunkering line, including whether or not to disconnect the line, should be considered.
FUEL SUPPLY TO CONSUMERS	<ul style="list-style-type: none"> · Provisions for gas fuel supply to consumers in ESD-protected machinery spaces should be modified.
POWER GENERATION INCLUDING PROPULSION AND OTHER GAS CONSUMERS	-
FIRE SAFETY	<ul style="list-style-type: none"> · Water spray system might be effective both as gas absorber and as fire extinguisher. · On the other hand, careful consideration should be needed against heat of dissolution to water. It may not be appropriate to use water spray system for cooling.

Table of content of the IGF Code	Issues to be considered for amendment, addition or removal from the requirements of the IGF Code for ammonia-fuelled ships
EXPLOSION PREVENTION	<ul style="list-style-type: none"> · Hazardous area zones for ammonia should be different from those of LNG because of the difficulty of forming combustible mixtures. Furthermore, in certain areas, safety measures against toxicity of ammonia may supersede those against explosivity.
VENTILATION	<ul style="list-style-type: none"> · Material selection against corrosion should be needed. · Ventilation capacity should be considered. · Necessity of treatment of ammonia before release to the air/sea may be considered. · Height restriction from sea level and alert system should be considered for ventilation outlets for releasing ammonia to the air.
ELECTRICAL INSTALLATIONS	<ul style="list-style-type: none"> · Dangerous zone of flammability on open deck may not be required considering the difficulty of forming combustible mixtures.
CONTROL, MONITORING AND SAFETY SYSTEMS	<ul style="list-style-type: none"> · Toxic gas monitoring/detection should be needed for bunkering, fuel tank, gas compressor, gas engine. · The target value of gas detection should be determined based not only on LEL but also the limit of toxicity, such as time weighted average and short-term exposure limit.
PART B-1	
MANUFACTURE, WORKMANSHIP AND TESTING	-
PART C-1	
DRILLS AND EMERGENCY EXERCISES	<ul style="list-style-type: none"> · Periodical drills on engine plant operation, use of PPE and toxic gas monitor/detector should be needed. · Periodical emergency exercises on medical first aid and life-saving measures as well as safe evacuation should be needed.
OPERATION	<ul style="list-style-type: none"> · Use of personnel protective equipment such as gas masks and emergency showers should be considered. · Toxic gas monitor/detection/prevention of leakage should be needed for operations which have a risk of ammonia exposure. · For crew, onboard operations such as engine plant operation, bunkering, maintenance/repair of machinery should be considered. Furthermore, operations done by those other than crew such as dry-dock should be considered. · Safe evacuation from the area where ammonia gas is detected should be needed. · Proper ventilation should be needed when the crews enter and work in enclosed spaces.
PART D-1	
TRAINING	<ul style="list-style-type: none"> · Training should be needed regarding: knowledge about chemical properties and their impacts on human bodies; engine plant operation; medical first aid and life-saving measures; use of PPE and gas detector; and safe evacuation.