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AMENDMENTS TO THE IGF CODE AND DEVELOPMENT OF GUIDELINES FOR ALTERNATIVE FUELS AND RELATED TECHNOLOGIES

Comments on document CCC 11/3 (Norway) – part 1

Submitted by IACS

SUMMARY

Executive summary:	This document provides the first set of comments by IACS on annex 1 of document CCC 11/3 (Norway) as regards the development of the interim guidelines for the safety of ships using hydrogen fuels.
Strategic direction, if applicable:	2
Output:	2.3
Action to be taken:	Paragraph 23
Related document:	CCC 11/3

Introduction

1 This document is submitted in accordance with the provisions of paragraph 6.12.5 of the *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.5/Rev.6) and comments on annex 1 of document CCC 11/3 (Norway) which contains the draft interim guidelines for safety of ships using hydrogen fuels (hereafter referred to as the "draft interim guidelines"). All references in this document are with regard to the draft interim guidelines unless otherwise mentioned.

Discussion and proposals

Comments on section 2

2 As regards the definition of "hydrogen consumer space" in paragraph 2.2.1, it is considered that "hydrogen consumer space" should be rephrased as "fuel consumer space" and placed in section 2 of the IGF Code, rather than in the current description in the draft interim guidelines only.

3 IACS proposes to clarify the definition of "cold hydrogen vapour" described in paragraph 2.2.3. It should be noted that the boiling point of air is lower than the boiling point of oxygen. Therefore, cold hydrogen vapour should be defined such that it is at a temperature which can cause oxygen to liquefy. This will also be consistent with the definition of the term proposed for section 2.2.4. Therefore, it is proposed to change the definition of cold hydrogen vapour for section 2.2.3 is as follows:*

> ".3 Cold hydrogen vapour means hydrogen vapour at or below -183°C ~~a sufficiently low temperature to cause condensation of air~~."

4 IACS notes the definition of "condensed air" in section 2.2.4. It is understood that the term "condensed air" is intended to refer rather to the phenomenon of oxygen enrichment. The term "condensed air" is only referenced once in the draft interim guidelines, while the term "oxygen enrichment" is used various times, including in the functional requirement in paragraph 3.2.19. Also, there appears to be little to distinguish between the definition of "condensed air" and "liquid air" (section 2.2.5). It is therefore suggested to rename the term "condensed air" to "oxygen enrichment", as follows:

> ".4 ~~Condensed air~~ Oxygen enrichment/oxygen enriched refers to the phenomenon of increase of oxygen concentration above 23.5% by volume in air ~~oxygen-enriched gaseous air~~, caused by the ~~presence of~~ exposure of air to liquid hydrogen and/or cold hydrogen vapour."

5 It is also proposed to improve the definition of "liquid air" in section 2.2.5 as proposed below:

> ".5. Liquid air refers to ~~liquid~~ liquefaction of air, caused by its exposure to ~~the presence of~~ liquid hydrogen and/or cold hydrogen vapour."

6 Regarding the definition of "permeation" in paragraph 2.2.9 of the draft interim guidelines, IACS notes that the *Revised interim recommendations for carriage of liquefied hydrogen in bulk* (resolution MSC.565(108)) defines "permeation" as the "flow of a fluid through another material by diffusion without a defect or opening of the latter". For consistency, IACS suggests using the same definition.

7 The definition of "secondary enclosure" in paragraph 2.2.10 needs to be suitably revised to clearly indicate that this enclosure provides a secondary containment (i.e. additional to the primary containment) for possible leak or release of hydrogen. The following revision is proposed:

> ".10 Secondary enclosure – Enclosure providing a secondary gas and liquid-tight barrier ~~for~~ to contain any leaks/release from the primary containment (e.g. tank, piping and equipment) containing fuel. Includes, but is not limited to, double wall pipes and ducts. The secondary enclosure is not considered as a potential source of release."

8 Alternatively, it is noted that the term "secondary enclosure" is also used in the IGF Code, and therefore, this terminology should be defined in the IGF Code, rather than in these interim guidelines.

9 It is suggested to remove the words "for prevention of permeation of gaseous hydrogen" in parenthesis in paragraph 2.2.13, as not all liners can prevent hydrogen permeation, e.g. composite liners.

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* Here and throughout the document tracked changes are indicated using "grey shading" to highlight new insertions and "strikethrough" to highlight deletion of the text.

Comments on section 4

10 Paragraph 4.3.1 specifies the provisions to be met in case of an explosion due to the fire on deck or in any space containing potential hydrogen leak sources and a "non-inert atmosphere". It is important here to emphasize that the atmosphere should be one with a potential for oxidizing hydrogen rather than non-inert, which is too general. Therefore, it is suggested to amend paragraph 4.3.1 to clearly indicate "oxidizing atmosphere" as opposed to "non-inert atmosphere", as follows:

> "4.3.1 An explosion or fire on open deck or in a space containing hydrogen leak sources and ~~a non-inert atmosphere~~ an oxidizing atmosphere should not: … "

Comments on section 5

11 With regard to paragraph 5.9.3, the specific application of "when relevant" is unclear to IACS. It is considered that a low temperature alarm is only relevant for liquefied hydrogen, and only if the hydrogen piping and systems are not fully enclosed in secondary barriers. To address this, a revision is proposed as follows:

> "5.9.3 The bilge system should have bilge well high-level ~~and low-temperature~~ alarms~~, when relevant~~. Low-temperature alarms should be fitted if liquid hydrogen leakage is possible."

12 To support the drip tray to perform its function, as well as to prevent the hull structure from being exposed to unacceptably low temperatures, it is suggested to also consider active heating arrangements as an option. Therefore, it is suggested to revise paragraph 5.10.5 as follows:

> "5.10.5 Each tray should have a sufficient volume and thermal capacity to ensure that the maximum amount of ~~spill~~ condensate according to the risk assessment can be safely handled. Active heating arrangements should also be considered."

13 Paragraph 5.14.4 should be revised/deleted, as the referenced paragraphs 5.14.3.1 and 5.14.3.2 were deleted.

Comments on section 6

14 Paragraphs 6.3.1 and 6.3.2 should be moved to section 6.4, as the provisions are only relevant for liquified hydrogen tanks.

15 Section 6.4 enumerates the provisions as regards the safe storage of liquefied hydrogen fuel on board the ship. This refers to the IGF Code in general. Paragraph 6.4.2 specifically refers to the application of vacuum insulated type C tanks in accordance with the IGF Code. However, IACS opines that the embrittlement effects of hydrogen on metallic materials need to be considered. This is specifically relevant when considering paragraph 6.4.15.3.1.2 of the IGF Code, which requires the evaluation of the design pressure utilizing the allowable dynamic membrane stress. IACS deems that the allowable dynamic membrane stress should be assessed considering the effect of hydrogen embrittlement. Consequently, it is suggested to revise paragraph 6.4.2 as follows:

> "6.4.2 The provisions for liquefied hydrogen fuel containment in this interim guideline is for vacuum insulated Type C tanks only. The requirements of section 6.4 of the IGF Code Part A-1 related to other tank types should not apply to ships using liquid hydrogen as fuel. The dynamic membrane stress in paragraph 6.4.15.3.1.2 of the IGF Code should be assessed taking into account the exposure of the material of the tank shell to hydrogen and the intended temperature of application."

16 It is suggested that paragraphs 6.4.4.1 and 6.4.4.2 be written in a consistent way: if the intention is that only vacuum insulated tanks are to be used, then there is no need to refer to "insulation", except if this is in relation to vacuum insulation. If the intention is to use both insulation and vacuum, then the provisions in paragraph 6.4.4.2 should also be made applicable for insulated systems.

17 It would appear that paragraphs 6.3.1 and 6.4.6 aim to achieve the same or similar objective, and it is proposed that these be merged.

18 It is suggested to provide a flow restriction device or excess flow device for compressed hydrogen tanks, which would be as close as possible to the tank walls. The text for a new provision is offered as follows:

> "Tanks with compressed hydrogen should be arranged with a flow restriction or excess flow device as near to the tank shell as practicable."

19 It is suggested to amend paragraph 6.6.8.10, because dry disconnect operation is for liquefied hydrogen and not applicable to portable compressed hydrogen containment, and instead a self-sealing operation should be required.

20 With regard to paragraph 6.6.8.12, it is suggested that "(fuel temperature, pressure and filling level)" should be modified as "(fuel temperature and pressure ~~and filling level~~)", because filling level detection is impossible with regard to compressed hydrogen.

21 It is suggested to add the following text in paragraph 6.7:

> "The vent mast should be located away from air intakes, outlets or openings to accommodation spaces, service spaces, and control stations.
>
> The vent system for liquefied hydrogen fuel containment should be designed in such a way that no liquid hydrogen is vented through the vent mast."

22 It is noted that section 6.15 contains provisions in respect of vacuum systems. It is suggested that the terms "vacuum systems" and "vacuum spaces" should be defined in section 3, together with the definition of "cryo-pumping", such as:

> "Cryo-pumping is a vacuum pumping process that removes gas molecules by condensing or adsorbing them onto surfaces cooled to extremely low temperatures."

Action requested of the Sub-Committee

23 The Sub-Committee is invited to consider the proposals in paragraphs 2 to 22 and take action, as appropriate.