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

Comments on document CCC 9/3 pertaining to the use of hydrogen as fuel

Submitted by IACS

SUMMARY

Executive summary:	This document provides comments on document CCC 9/3 proposing to develop the interim guidelines for ships using hydrogen as fuel.
Strategic direction, if applicable:	2
Output:	2.3
Action to be taken:	Paragraph 36
Related documents:	CCC 8/WP.3; CCC 9/3 and CCC 9/INF.17

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.5) and provides comments on the report of the Correspondence Group on Alternative Fuels and Related Technologies as contained in document CCC 9/3.

2 CCC 8 established a correspondence group to work on the development of interim guidelines for ships using hydrogen as fuel. IACS participated in the correspondence group and appreciates the tremendous contributions from the Coordinator and the participants in the development of the draft interim guidelines for ships using hydrogen as fuel.

Discussion

3 IACS would like to offer technical comments on various aspects of the draft interim guidelines for ships using hydrogen as fuel, as set out in the following paragraphs to facilitate further discussion and development of draft guidelines (all references are to the text of the draft interim guidelines as provided in annex 1 of document CCC 9/3 unless otherwise mentioned).

4 IACS considers that there should be a rationale behind the development of the definition of compressed hydrogen (if using the option with pressure threshold exceeding 20 bars).

5 Definition of "Fuel Containment System" was modified in comparison to the IGF Code. The proposed modifications lead to introduction of new terms such as "associated or adjacent spaces", which will need clarification.

6 Regarding definition of "Fuel Preparation Rooms", the use of the word "room" may limit the definition to only those enclosed spaces on the open deck. Conversely, the term "area" apparently also includes areas on open deck in close proximity of equipment for fuel preparation. This may be discussed and clarified.

7 As regards alignment of definition of "Enclosed Space" with resolution A.1050(27), it may be recalled that such reference would imply entry into unmanned non-ventilated spaces, whereas the IGF Code considers ventilated spaces as well. The use of the IGF Code definition is preferred.

8 The term "inherently safe" is used within certain sections in the text. It is proposed to develop a definition for this.

9 Section 3.2.9, permitting the venting of hydrogen vapours during bunkering operations should be considered.

10 Section 3.2.19, the risks of condensation of oxygen and air may also arise due to inadequate insulation from failure or deterioration of vacuum insulation.

11 Section 4.2.2, the original section 4.2.2 which provides a list of minimum topics to be considered should be retained. Additional topics may be added to this list.

12 Footnote to Section 4.3, there is a possibility of minor leakages from the tank connections and from compressed hydrogen tanks which can be designed and constructed as Type III or Type IV cylinders.

13 Section 5.3.3, evaluation of safe location of tanks, should be based on holistic assessment rather than on direct use of the prescriptive formulae in section 5.3.4 of the IGF Code. The use of full probabilistic approach is supported. Hydrogen fuel tanks which are installed on open deck at relatively higher elevations should also be considered as this has potential to reduce the likelihood of damage from an accident (risk of detonation is to be also considered).

14 Section 5.5.2, low pressure hydrogen piping enclosed within ventilated ducts should also be considered as an acceptable arrangement, subject to satisfactory verification that the ventilation is adequate to ensure that the concentration of hydrogen is always below the lower explosive limit (LEL). If double walled pipes are provided, then the redundancy of the ventilation of the room through which the pipes pass may not be necessary, unless simultaneous multiple failures are expected to occur.

15 Section 5.8.2, pressure buildup in the fuel preparation room may also be possible due to release of compressed hydrogen. Measures other than inerting (e.g. provision of adequate ventilation) for the compressed hydrogen only may also be considered to prevent formation of an explosive atmosphere; if this is acceptable then pressure relief devices may not be required. For liquefied hydrogen, measures should be in place to prevent condensation of air.

16 Section 5.10, consideration should be given to the effect of collection/accumulation of liquid hydrogen in the drip tray. This can be addressed by risk assessment required by section 4.2.2 (for example, liquid hydrogen could vaporize from the drip tray and form a hydrogen gas cloud, condensation of air/oxygen in the vicinity of the exposed liquid hydrogen in the drip tray etc.).

17 Section 5.12, suitable shape of the airlock is desirable so that the possibility of formation of hydrogen gas pockets is eliminated.

18 Sections 5.13 and 6.3.7, the requirements appear to be conflicting. It is preferred to not exclude arrangements for hydrogen storage tanks below deck if appropriate safeguards are provided. For section 5.13, "external hazards" must be clarified.

19 Section 6.3.3.1 and 9.8.5, the dimensioning of the vacuum insulated tanks pressure relief capacity (for liquefied hydrogen) may not require consideration of the loss of vacuum and fire to occur simultaneously; rather these may be considered as two separate scenarios, unless loss of vacuum as a consequence of fire is evaluated as probable.

20 Section 6.4 effects of hydrogen embrittlement and degradation of strength properties (ultimate, fatigue) from continuous exposure to hydrogen should be accounted for in the design of the fuel containment system.

21 Sections 6.5.5 and 6.5.6, flexible hoses should be double walled and insulated to prevent condensation of air constituent components on the hose surfaces. Dry couplings can be used to prevent inadvertent spills during disconnection.

22 Section 6.8, loss or deterioration of vacuum insulation should also be considered.

23 Sections 6.14 and 9.9.4, it is proposed that the oxygen content in the inert gas should not exceed 1%.

24 Section 8.3 and 8.5, requirements in sections 8.3.1.2 to 8.3.1.6 of the IGF Code should be incorporated, especially considering clause 8.3.1.6 (Joule Thomson effect for H_2 is different compared to other gases). Need for gas tight bulkheads to be fitted for semi-enclosed spaces may be discussed (section 8.3.2). It is suggested to use the text of section 8.5 of the IGF Code for section 8.5 of the guidelines. Section 8.5.1 may be clarified as to whether it applies to composite or metallic tanks.

25 With regard to section 9.3.3, IACS proposes that a relaxation from pipe-in-pipe design for gaseous hydrogen piping on open deck should be considered. Section 9.3.5 recommends minimizing the length of the pipe segments. This may lead to an increase in number of pipe connections/joints which may be a source of potential failure and subsequent release.

26 Section 9.4.2, "secondary enclosure" should be defined. Also, the secondary enclosure should be fitted with devices which can detect a leak and accordingly give audible and visual alarms so as to initiate necessary safety actions.

27 With regard to section 9.5.1, it is suggested that means to continually monitor and detect any gas leakage in the secondary enclosure should be provided. For section 9.5.3, it should be clarified as to what is a "low pressure secondary enclosure". For section 9.5.4, it will be pertinent to specify what is the threshold for "high pressure". Regarding section 9.5.5, it is proposed to insert a requirement which states that the filters should be constructed/fabricated from materials appropriate for use in hydrogen service at the design temperature envisaged.

28 Sections 9.6.1, 9.6.2, 9.6.4 and 9.6.6, the "minimum safety functions" should be defined or listed. It is proposed to specify that valves discharging safety functions should be automatic and remotely operable. It is also suggested that control of valves using methods other than pneumatic control should be permitted.

29 Section 9.8.2.6, it is cautioned that section 8.4 of the IGC Code should not be used considering that the sizing is based on liquid temperature distant from the critical point whereas the temperature of liquefied hydrogen is very close to critical point.

30 Section 9.8.6, section 6.7 of the IGF Code provides the pressure relief sizing requirements for liquefied gas fuel tanks (and not compressed gas fuel tanks); reference should be made to international standards such as ISO 21013-3 or other recognised standards such as the API Std 521. It may be clarified whether separate piping systems and vent masts will be required for blowdown and pressure relief.

31 Sections 13.3 to 13.6, the ventilation rate should be prescribed considering various leak scenarios for hydrogen and the objective to stay below 25% LEL. Sections 13.3.1, 13.3.3, 13.3.4, 13.3.9 and 13.3.10 of the IGF Code have not been included; therefore their inclusion may be considered subject to their appropriateness. For section 13.3.8, the "confirmation by measurement" approach should always be used to verify that the space is non-hazardous. Further the term "space having hazard level depending on ventilation system" should be clarified.

32 Section 14, determination of the location and extent of the hazardous area zones based upon the direct approach described in IEC standard 60079-10-1 may be considered. Installation of electrical equipment in spaces containing liquefied hydrogen tanks where there is potential of oxygen enrichment should be given consideration. A new functional requirement is suggested to be added such that a blackout of the power system should not lead to a hazardous situation.

33 Section 15.3.1, analysis for functional safety in accordance with IEC standard 61508 may be considered to determine the safety integrity levels (SIL) of safety instrumented functions.

34 Section 15, suitability of use of acoustic technologies for hydrogen gas leak detection for marine application should be discussed based upon various considerations (e.g. temperature, pressure, size of leak). Requirement to ensure appropriate location of the fixed detectors so that they can be easily serviced, tested and calibrated should be included.

35 IACS observes that the working group at CCC 8 agreed to use the existing structure and provisions of the IGF Code for drafting provisions specific to the use of hydrogen as fuel (paragraph 17 of document CCC 8/WP.3). To further support this, IACS performed a gap analysis of the application of the provisions of the IGF Code in relation to hydrogen as fuel. The outcome of the gap analysis is presented in document CCC 9/INF.17. IACS suggests that this information may also be considered while further developing the draft interim guidelines for hydrogen as fuel.

Action requested of the Sub-Committee

36 The Sub-Committee is invited to consider paragraphs 4 to 35 and take action as appropriate.

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