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

Experience gained with the Interim guidelines for the safety of ships using fuel cell power installations (MSC.1/Circ.1647)

Submitted by IACS

SUMMARY

Executive summary:	This document summarizes the experience gained in the use of the MSC.1/Circ.1647 on *Interim guidelines for the safety of ships using fuel cell power installations* and provides suggestions for improvement.
Strategic direction, if applicable:	2
Output:	2.3
Action to be taken:	23
Related documents:	None

Introduction

1 The Maritime Safety Committee (MSC), at its 105th session, approved the *Interim guidelines for the safety of ships using fuel cell power installations* (MSC.1/Circ.1647) (hereafter referred to in this document as "Interim guidelines". Paragraph 3 of the circular note invites "to recount experience gained through the use of these Interim Guidelines to the Organization, for the Committee to keep them under review."

2 IACS has gathered feedback on the application of these Interim guidelines as summarized within the following paragraphs.

Discussion

Functional requirements

3 Section 1.3.1 of the Interim guidelines provides the need to ensure that the safety, reliability and dependability of fuel cell power system should be equivalent to that achieved with new and comparable conventional oil-fuelled machinery installations. In this respect, it is proposed that the demonstration of the dependability of systems should be well established and documented.

4 In regard to the above, it is also recommended that where the power for propulsion is supplied from the fuel cell power system or to any essential services, no fewer than two fuel cell power systems should be provided onboard.

Clarification of terminology

5 It would be useful to introduce definitions for certain other terms with regard to "Fuel cell power installation" in section 1.4 of the Interim guidelines. These are elaborated as below:

.1 *Differential cell pressure* is the difference in pressure across the electrolyte as measured from one electrode to the other;

.2 *Fuel* is the fuel which is used by the fuel cell either directly or following onboard reforming;

.3 *Fuel cell module* is an assembly of one or more fuel cell stacks, their electrical connections and associated equipment and devices which are enclosed within a single casing. IEC 60050-485 International Electrotechnical Vocabulary (IEV) – Part 485: Fuel cell technologies, defines fuel cell module to be an assembly incorporating one or more fuel cell stacks and other main and, if applicable, additional components, which is intended to be integrated into a power system;

.4 *Oxidant* is air, oxygen gas or oxygen rich compounds used to oxidize fuel within the fuel cell stack;

.5 *Power conditioning system* is the system which regulates and conditions the electrical output of the fuel cell modules to meet the requirements of the onboard electrical distribution system or electrical consumers supplied by the fuel cell power system. The power conditioning system is an auxiliary system which forms part of the fuel cell power installation;

.6 *Service profile* is the operational envelope of the fuel cell power system indicating all the intended operational points including any short-term high-power operation;

.7 *Thermal management system* is a system to provide cooling and/or heating to the fuel cell power system, humidity management and condensate removal. The thermal management system is an auxiliary system which forms part of the fuel cell power installation;

.8 *Ventilation system* is a system to provide air to spaces or to enclosures. The ventilation system is an auxiliary system which forms part of the fuel cell power installation.

6 The following existing definitions in section 1.4 of the Interim guidelines can be further elaborated as shown below[*]:

.1 "*Fuel cell* is a source of electrical power in which the chemical energy of a fuel cell fuel is converted directly into electrical and thermal energy by electrochemical oxidation. IEC 62282-2-100 Fuel cell technologies -

[*] Tracked changes are indicated using "strikeout" for deleted text and "grey shading" to highlight all modifications and new insertions, including deleted text.

Part 2- 100: Fuel cell modules – Safety, defines fuel cell to be an electrochemical device that converts the chemical energy of a fuel and an oxidant to electrical energy (DC power), heat and reaction products."; and

.2 "*Fuel cell stack* means the assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen-rich gas and air-reactants to DC power, heat and other reaction products. IEC 62282-2-100 Fuel cell technologies - Part 2-100: Fuel cell modules - Safety, defines fuel cell stack to be an assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen rich gas and air reactants to DC power, heat and other reaction products."

Alternative design

7 Section 1.5 of the Interim guidelines elucidates the requirements to be complied for an alternative design. IACS is of the view that this section would benefit from further elaborating the requirements for an alternative design.

8 Thus, it is proposed that this section requires risk assessment specific to fuel cell power installations to be carried out for each installation on board, if the alternative design approach is to be applied. The risk assessment is to evaluate risks related to the safe operation of the ship and as such is to address the safety of the fuel cell power installation itself and, where the fuel cell power installation provides power for propulsion of the ship or other essential services, the dependability of the fuel cell power installation.

Fuel cell modules supplied in metallic enclosures

9 Paragraph 2.1.1.3 of the Interim guidelines stipulates that equipment protected fuel cell spaces should be considered a zone 1 and all electrical equipment should be certified for zone 1. Cases have been observed where fuel cell stacks and the balance of plant components (auxiliary) are manufactured and supplied in form of a fuel cell module within an enclosure. In this regard, it may not be practical to apply the requirements of zone 1 to the overall space which contains the fuel cell module. Understanding can be developed recognizing this aspect and the guidelines may be elaborated in this regard.

10 Paragraph 2.5.1 of the Interim guidelines provides that all pipes containing hydrogen or reformed fuel should not be led through enclosed spaces outside of the fuel cell spaces. It would be useful to clarify the boundaries for the application of such requirement distinguishing between fuel cell module supplied within an enclosure and the fuel cell room which contains these modules.

11 Paragraph 3.2.1 of the Interim guidelines provides that fuel cell spaces separated by a single bulkhead should have adequate strength to withstand the effects of a local gas explosion in either space. Considering the case where fuel modules are already supplied in a metallic enclosure, this provision can be elaborated or clarified.

12 Paragraph 3.3.1 of the Interim guidelines provides that a fire-extinguishing system would be required for fuel cell spaces. However, for fuel cells supplied with a metallic enclosure, this provision may need to be clarified.

Fuel cell spaces and arrangements

13 Paragraph 2.1.1.4 of the Interim guidelines provides the application of requirements in IEC 60079-10:2020 as regards area classification, should the Administration find the prescriptive area classification to be inappropriate for specific cases. For consistency of application, the conditions under which the area classification is found "inappropriate" could be clarified.

14 Paragraph 2.2.10 of the Interim guidelines provides that the fuel cell spaces containing fuel reformers should comply with requirements for the primary fuel. Here, it would be appropriate to refer to the relevant IMO instruments (e.g. the IGC Code or the IGF Code) to further elaborate these provisions.

15 Paragraph 2.3.2.3 of the Interim guidelines describes provisions for ventilation rates considering technical failures leading to leakage of the fuel gas. It is suggested that such technical failures should be identified by risk analysis referred to in section 4.3 of the Interim guidelines.

Fire safety

16 The need to prevent the accumulation of hydrogen vapours after possible leakage is well acknowledged. In this regard, it is proposed that the installation and utilization of catalytic oxidation or controlled combustion units to prevent accumulation of hydrogen vapours should be specially considered to alleviate this concern.

17 The Interim guidelines would also benefit further from introduction of specific provisions pertaining to purging systems for fuel cell system which includes the associated storage tanks, piping and equipment.

18 Paragraph 3.1.2 of the Interim guidelines provides guidance to have fuel cell space protected by A-60 divisions. For conditions which are deemed impracticable, an Administration may consider approval of alternative designs. It would be useful to elaborate the conditions which are deemed "impracticable". Also, it is suggested that this aspect be considered in the risk analysis in section 4.3 of the Interim guidelines, if the prescriptive requirements are not practicable to be applied.

Controls and monitoring

19 It is proposed that means for monitoring exhaust temperature and flammable gas detection should be provided at the fuel cell module level.

20 Paragraph 5.6.5 of the Interim guidelines specifies that a failure leading to a loss of fuel cell coolant should result in an automatic shutdown in a "limited period of time". For consistency of application, it is suggested that this "limited period of time" be clarified, if possible, or addressed within the risk analysis provided by section 4.3 of the Interim guidelines.

Testing of the fuel cell power system

21 It would be useful and appropriate for the Interim guidelines to clarify the requirements for testing of fuel cell power systems. It is proposed that fuel cell power systems should be factory tested in accordance with an approved test programme.

Risk analysis

22 Paragraph 4.3.1 of the Interim guidelines stipulates that risks arising from the use of fuels which affect the integrity of the ship should be addressed. It is proposed that risks to persons and the environment should also be addressed.

Action requested of the Sub-Committee

23 The Sub-Committee is invited to consider the foregoing and take action as appropriate.