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DEVELOPMENT OF A SAFETY REGULATORY FRAMEWORK TO SUPPORT THE REDUCTION OF GHG EMISSIONS FROM SHIPS USING NEW TECHNOLOGIES AND ALTERNATIVE FUELS

Report of the Correspondence Group

Submitted by China

SUMMARY

Executive summary:	This document provides the report of the Correspondence Group on the Development of Training Provisions for Seafarers on Ships Using Alternative Fuels and New Technologies.
Strategic direction, if applicable:	3
Output:	3.8
Action to be taken:	Paragraph 36
Related documents:	HTW 11/7, HTW 11/7/1, HTW 11/7/2, HTW 11/7/3; HTW/7/6; HTW 11/INF.7, HTW 11/7/9, HTW 11/INF.16, HTW 11/11 and MSC 110/INF.14

Background

1 The Sub-Committee, at its eleventh session, agreed to develop generic interim guidelines on training for seafarers on ships using alternative fuels and new technologies in parallel with several individual sets of fuel/technology specific interim guidelines (HTW 11/11, paragraph 7.8.3). To progress the work intersessionally, the Sub-Committee agreed to establish the Correspondence Group on the Development of Training Provisions for Seafarers on Ships Using Alternative Fuels and New Technologies (the Group), under the coordination of China (Ms. Sisi Pan).

List of participants

2 Representatives from the following Member States participated in the Group:

AUSTRALIA
BELGIUM
CANADA
CHINA
CYPRUS
DENMARK
ESTONIA
FINLAND
FRANCE
GERMANY
JAPAN
LIBERIA
LUXEMBOURG
MALAYSIA
MARSHALL ISLANDS
NETHERLANDS (KINGDOM OF THE)
NORWAY
PHILIPPINES
POLAND
REPUBLIC OF KOREA
RUSSIAN FEDERATION
SINGAPORE
SOUTH AFRICA
SWEDEN
UNITED ARAB EMIRATES
UNITED KINGDOM
UNITED STATES

the following Associate Member of IMO:

HONG KONG, CHINA

an observer from the following intergovernmental organization:

EUROPEAN COMMISSION (EC)

and observers from the following non-governmental organizations:

INTERNATIONAL CHAMBER OF SHIPPING (ICS)
INTERTANKO
CRUISE LINES INTERNATIONAL ASSOCIATION (CLIA)
INTERCARGO
THE ROYAL INSTITUTION OF NAVAL ARCHITECTS (RINA)
INTERFERRY
INTERNATIONAL ASSOCIATION OF MARITIME UNIVERSITIES (IAMU)
INTERNATIONAL TRANSPORT WORKERS' FEDERATION (ITF)
GLOBAL MARITIME EDUCATION AND TRAINING ASSOCIATION (GlobalMET)
THE SOCIETY FOR GAS AS A MARINE FUEL (SGMF)
ZERO EMISSIONS SHIP TECHNOLOGY ASSOCIATION (ZESTAS)
METHANOL INSTITUTE (MI)

and by the following IMO training institute:

WORLD MARITIME UNIVERSITY (WMU)

Terms of reference

3 The Sub-Committee established the Correspondence Group and instructed it to:

.1 further develop draft interim guidelines on training for seafarers on ships using alternative fuels and new technologies as individual sets of interim guidelines, addressing:

.1 the use of methyl/ethyl alcohol as fuel, taking into account annex 2 to document HTW 11/WP.5, MSC.1/Circ.1621 on Interim guidelines

for the safety of ships using methyl/ethyl alcohol as fuel, and relevant parts of documents HTW 11/7, HTW 11/7/1 and HTW 11/7/2;

.2 the use of ammonia as fuel, taking into account MSC.1/Circ.1687 on Interim guidelines for the safety of ships using ammonia as fuel, and relevant parts of documents HTW 11/7, HTW 11/7/1, HTW 11/7/2, HTW/7/6 and INF.7, and HTW 11/7/9;

.3 hydrogen fuel cell-powered ships, taking into account MSC.1/Circ.1647 on Interim guidelines for the safety of ships using fuel cell power installations, and relevant parts of document HTW 11/7/1;

.4 the use of LPG as fuel, taking into account MSC.1/Circ.1666 on Interim guidelines for the safety of ships using LPG as fuel, and relevant parts of document HTW 11/7/1;

.5 the use of hydrogen as fuel, taking into account relevant parts of documents HTW 11/7/2, HTW 11/7/6, HTW 11/INF.7 and HTW 11/INF.16; and

.6 battery-powered ships, taking into account document HTW 11/7/3; and

.2 submit a written report to HTW 12.

4 The Group noted that MSC 110, forwarded document MSC 110/INF.14 (EC), to the Group for consideration (MSC 110/21, paragraph 13.13). This document included the results of a study on the identification of specific competences for seafarers on ships using alternative fuels and energy systems that was commissioned by the European Maritime Safety Agency (EMSA).

General comments

5 The Group conducted five rounds of discussions under the terms of reference (ToR), which were conducted simultaneously via email and the IMO SPACE platform.

6 To enhance work efficiency and leverage the respective strengths of various countries and international organizations in training seafarers on ships utilizing different alternative fuels and new technologies, the preparation of foundational documents for five specific interim guidelines (ToR 1.2 to 1.6) was assigned to volunteer participants. These materials are expected to serve as inputs for further discussion and development at a future stage.

7 Following exhaustive deliberations on the draft interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel, the Group achieved broad consensus, and the agreed draft interim guidelines is set out in annex 1. Consensus has not been reached on certain sections of the draft interim guidelines on training for seafarers on ships using ammonia as fuel (annex 2). The Group has marked unresolved issues in the draft, as shown in annex1 and 2,[*] to serve as a basis for further discussion during HTW 12.

8 Due to time constraints, the foundational documents for the draft interim guidelines on training for seafarers on ships using other alternative fuels/ new technologies, which were prepared by the assigned participants, have not been discussed by the Group (annexes 3 to 6).

[*] Unresolved issues in annexes are marked with square brackets [ ].

Common issues raised during the discussion

The relationship between the draft generic interim guidelines and fuel/technology-specific interim guidelines

9 Regarding the relations between the draft generic interim guidelines and the fuel/technology-specific interim guidelines, one participant expressed that， the generic guidelines will serve as a solid foundation for all the alternative fuels and new technologies and the fuel/technology-specific guidelines will serve as a supplement. Otherwise, numerous divergent training and certification standards would emerge, leading to excessive training burdens for seafarers. Therefore, they suggested adding a new paragraph proposing that the interim generic guidelines be a prerequisite. This would allow the fuel/technology-specific guidelines to focus on the specific fuel or technology and if the generic guidelines are not a prerequisite, they will be pointless in the future.

10 The Group noted that the relations between the generic training guidelines and fuel/technology-specific training guidelines had been thoroughly discussed and agreed by the working group during HTW 11, namely that the generic training guidelines shall serve as the foundation for developing the fuel/technology-specific interim guidelines (HTW 11/WP.5, paragraph 18). The preliminary framework and key elements of the interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel developed by the working group (HTW 11/WP.5, annex 2) were fully aligned with the generic training guidelines, clearly demonstrating adherence to the principle of being based on the generic guidelines.

11 After consideration, the Group agreed not to add the new paragraph in the specific guidelines that designates the generic guidelines as prerequisites.

To avoid duplication with the training requirements of the IGF Code

12 Several participants pointed out that the development of interim training guidelines should avoid duplicating existing IGF training requirements (section A-V/3 of the STCW Code) for alternative fuels subject to the IGF Code.

13 One participant expressed that the development of interim training guidelines should ensure that training requirements are appropriate to each specific fuel and technology, and should not automatically assume prior completion of IGF Code training (section A-V/3 of the STCW Code), which was developed primarily for cryogenic fuels such as LNG.

14 The Group noted that, in accordance with the decision of HTW 11 and the ToR of the Group, each specific fuel and new technology will have its own interim guidelines, including knowledge, understanding and proficiency (KUP) tables. Consequently, to avoid duplication in seafarer training, those competencies assessed as differing from the existing IGF Code requirements will be clearly identified in the KUP table by the Group, aiming to enable respective Administrations to determine training content based on their actual circumstances.

Scope of application of the Guidelines

15 During the discussions, one participant expressed the view that, in addition to onboard personnel, the interim guidelines should also cover other personnel involved in the bunkering process. It was suggested that the term "seafarers on ships" in the scope of application be revised to "personnel handling and maintaining". Additionally, the 500-gross-tonnage restriction in the guidelines is unnecessary, as these interim guidelines were never intended to be defined by ship size or type, and imposing such limitations at this stage was premature. Consequently, the deletion of the relevant paragraph (2.2) was proposed.

16 The Group concurred that extending the scope to include shoreside fuel operation personnel is inappropriate, as the interim training guidelines specifically address standards for seafarer training. Moreover, since the generic interim guidelines, which explicitly stipulate the 500 gross tonnage restriction, were already adopted by MSC 110 (MSC 110/21, paragraph 13.12), the fuel-specific guidelines should maintain alignment with it.

The third and fourth column of the KUP table

17 Several participants noted that the current discussions within the Group had only focused on column 1 ("Competence") and column 2 ("Understanding, Knowledge and Proficiency (KUP)") of the minimum competence table. They therefore suggested enhancing the content of column 3 ("Methods for Demonstrating Competence") and column 4 ("Criteria for Evaluating Competence").

18 During the discussions, the prevailing view suggested that the interim guidelines should adhere to the structure of STCW.1/Circ.7, focusing primarily on the development of columns 1 and 2. It was suggested that the formulation of columns 3 and 4 be deferred until the future conversion into mandatory training standards, to be addressed during a comprehensive review aligned with the STCW Convention and Code. This approach would foster greater harmonization at a broader level while currently affording sufficient flexibility to individual Administrations.

19 The Group agreed to discontinue further discussion on adding column 3 and column 4 to the minimum competence table in the guidelines, and recommended that this matter be deferred for consideration during the future development of mandatory training standards.

The familiarization training

20 One participant proposed incorporating familiarization training into the draft interim guidelines on training for seafarers on ships using ammonia as fuel and suggested restructuring the current two-tier framework (basic and advanced training) into a three-tier framework comprising familiarization, basic, and advanced training. The following comments were expressed:

.1 given the specific risks associated with ammonia fuel and the importance of ensuring all personnel on board are aware of these hazards, it is necessary to provide familiarization training for seafarers working with new fuels such as ammonia;

.2 in accordance with the requirements of regulation I/14.5 of the STCW Convention, familiarization training onboard is the company's responsibility and is typically arranged by the company. Since existing familiarization with ship characteristics already covers knowledge related to fuel toxicity, there is no need to revise the current model where the shipowner/company is responsible for the onboard familiarization training of all crew members. However, the training content may be appropriately expanded to address the specific risks of ammonia;

.3 the familiarization training required under regulation I/14.5 of the STCW Convention, for which the company is responsible, pertains only to ship characteristics and does not encompass fuel properties (such as toxicity). Therefore, it is necessary to incorporate familiarization training into the interim guidelines on training for seafarers on ships using ammonia as fuels, establishing more detailed and uniform training standards to ensure safety, with certificates to be issued by the Administration;

.4 the existing two-tier training framework in the guidelines should be maintained. A possible solution could be given to expand the required safety familiarization in chapter VI - A-VI/1 with another point .8 – "Fuel Safety" or similar. Another solution could be to issue STCW guidance on what this ammonia familiarization should contain; and

.5 "familiarization training" and "familiarization" are different. While all onboard personnel must become familiar with ship equipment characteristics and fuel properties, this does not mean that the Administration shall issue any certificates. It is therefore recommended to maintain the existing two-tier training framework.

21 During the discussions, the majority opinion held that onboard familiarization training should be organized and implemented by the company, and therefore should not be incorporated as part of the current interim guidelines.

22 The Group agreed to comply with the decision of HTW 11 and the ToR by maintaining the current two-tier framework (basic and advanced training) and excluding familiarization training from the interim guidelines. It was recommended that the matter of developing familiarization training guidelines be further considered at HTW 12, and interested Member States and international organizations may submit relevant proposals to the session.

Draft fuel/technology-specific interim guidelines

Draft interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel (ToR 1.1)

23 As instructed, the Group further developed the interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel by using annex 2 of document HTW 11/WP.5 as the basis, and taking into account other relevant documents mentioned in ToR 1.1. Although the main text of the interim guidelines had been substantially agreed upon at HTW 11, the Group, to ensure the full completion of ToR 1.1, still invited refined comments on the text during the first round of discussion.

24 Discussion of the main text of the interim guidelines:

.1 the Group accepted the proposal to replace "fuels and/or systems" with "fuels and fuel systems".

.2 discussion of paragraph 1.6:

.1 several participants pointed out that training for IGF, basic or advanced, is not supposed to be a prerequisite for alternative fuels and technology, specifically, IGF training should not be prerequisite for methyl/ethyl alcohols. Therefore, it is recommended that references to STCW Convention and Code Regulation V/3 be removed from the interim guidelines.

.2 the Group noted that the *Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel* (MSC.1/Circ.1621) specify that training must comply with Regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code (applicable to ships subject to the IGF Code), taking into account the specific hazards of the methyl/ethyl alcohol used as fuel. The generic interim guidelines further clarify that the training requirements of mandatory instruments, including the IGF Code, IGC Code, and the STCW Convention and Code, should take precedence over those

in the interim training guidelines (HTW 11/ WP.5, paragraph 1.3 of the annex).

.3 accordingly, the Group agreed to retain the references to regulation V/3 of the STCW Convention and Code.

.3 the relationship between basic training and advanced training:

.1 several participants expressed the view that advanced training should take into account the content covered in basic training. The following text was therefore suggested to be added to paragraph 2.4 of the guidelines: taking into account the knowledge, understanding and proficiencies to meet the standard of competence specified in 3.1, as appropriate;

.2 one participant suggested decoupling the basic and advanced training requirements to alleviate the training burden on seafarers who already hold the Advanced IGF Certificate of Proficiency (COP). While Administrations retain the authority to decide whether basic training should be mandatory before advanced training, this participant recommended adding the following text to paragraph 3.3.1: in addition to the competences outlined in paragraph 3.1.1;

.3 the revision proposed for paragraph 3.3.1 gained majority support. However, some participants expressed concern that the amended wording might overlap with the modifications made to paragraph 2.4; and

.4 based on the comprehensive input, the Group endorsed the revisions to both paragraph 2.4 and 3.3.1.

.4 adjustments to the detailed items of the basic training and advanced training:

.1 one participant proposed eliminating content redundant between advanced and basic training, and realigning the titles of training items of paragraph 3.1.1 and 3.3.1 accordingly;

.2 several participants proposed augmenting the basic training (paragraph 3.1.1) by adding the item "use appropriate equipment and PPE in response to emergencies". For the advanced training (paragraph 3.3.1), they suggested incorporating the following items: have knowledge of environmental impacts of a methanol spill and of gas plume dynamics to ensure precise evaluation of the correlated risks, be familiar with construction and design of fuel systems and related components and equipment, operate the emergency ventilation and, ensure clear and smooth communications throughout all handling operations;

.3 one participant proposed that paragraph 3.3.1.3 and 3.3.1.4 could be merged to show interconnection; and

.4 considering the different levels required for the same items in advanced versus basic training, and to maintain alignment with the generic interim guidelines, the Group did not adopt the proposal to adjust the titles of the basic and advanced training items. It was also

agreed that the newly proposed items could be considered later when specifying the training requirements in the KUP tables.

25 The Group commenced a comprehensive discussion on the KUP Tables for seafarers on ships using methyl/ethyl alcohol as fuel from the second round of discussion. Timely adjustments were made to the table regarding issues where consensus was achieved. For matters with divergent views, in-depth discussions continued during the third and fourth rounds of discussion, with the specific details as follows:

.1 the proposal to delete all competencies in the advanced training of the KUP table that duplicate content in the basic training was not adopted, as rationalized in paragraph 24.4.

.2 a review was conducted on the existing competence 4 of basic training and the existing competence 9 of advanced training, with corresponding adjustments subsequently made to the specific components of these competencies.

.3 the proposal to replace all instances of "ships having methyl/ethyl alcohol as fuel" with "ships using methyl/ethyl alcohol as fuel" throughout the KUP tables was adopted to ensure consistency with the guideline title.

.4 regarding the proposal to add knowledge of "the dynamics of gas plume and modelling techniques" to the advanced training requirement, one participant expressed the view that this subject matter would be overly complex for seafarers and recommended against its inclusion in the knowledge requirements. However, several Group participants contended that this knowledge was important on the advanced level. They were of the opinion that seafarers who handle this fuel need to have basic knowledge about modelling techniques and risk analysis including sampling techniques and interpreting the analysis report. The Group ultimately retained this item in the KUP table, designating it for training at the awareness level.

.5 one participant pointed out that, the Sub-committee on Carriage of Cargoes and Containers (CCC) will conduct further consideration of MSC.1/Circ.1621 in accordance with the instructions of MSC 110 to differentiate methanol and ethanol, and recommended revising the concurrent references to "methyl/ethyl alcohol" in the KUP table to "methyl alcohol and ethyl alcohol."

.1 several participants indicated that subsequent actions should be guided by the outcomes of CCC 11. However, due to time constraints, the matter was not addressed at CCC 11. Continuing to await a conclusion from the CCC Sub-Committee could potentially impact the timeline for finalizing the interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel;

.2 several participants maintained that the terminology used in the KUP table should remain consistent with the guideline titles. Therefore, it is unnecessary to separate methanol and ethanol; and

.3 based on the foregoing discussion, the Group did not adopt the proposal to change the terminology from "methyl/ethyl alcohol" to "methyl alcohol and ethyl alcohol", but will continue to pay attention to the progress of the relevant IMO mechanisms.

.6 regarding the deletion or retention of paragraph 5.2 of basic training, no consensus has been reached.

26 In summary, the Group has substantially completed the development of the interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel, and reminded all assigned participants to consider the consensus achieved during the methyl/ethyl alcohol discussions when developing interim guidelines for other alternative fuels/ new technologies.

Draft interim guidelines on training for seafarers on ships using ammonia as fuel (ToR 1.2)

27 The foundational provisions for the interim guidelines on training for seafarers on ships using ammonia as fuel were jointly prepared by the representatives of EC, China, Japan, Malaysia, and Singapore in accordance with the instruction of ToR 1.2 and with reference to the discussions on the interim training guidelines for methyl/ethyl alcohol. The Group commenced its deliberations on the draft interim training guidelines of ammonia starting from the third round of discussion.

28 Discussion of the main body of the draft interim guidelines:

.1 discussion of paragraph 1.3:

.1 considering that paragraph 1.3 of the generic training guidelines explicitly references mandatory instruments such as the IGF Code, IGC Code, STCW Convention and Code, some participants argued that corresponding sections of the fuel-specific guidelines should likewise enumerate these mandatory instruments to maintain consistency;

.2 it was noted that many participants consider that Part D, paragraph 19.2, of the IGF Code and paragraph 18.7 of the IGC Code on the training of seafarers refer to the STCW Convention. For this reason, it could be concluded that only the STCW Convention is relevant to mention;

.3 a Group participant stated that this provision merely indicates that in case any specific provisions of the interim guidelines differ from the requirements of mandatory instruments, the provisions of those mandatory instruments should take precedence. It should not mean that seafarers working on ammonia fueled ships must first be qualified for LNG ships; and

.4 considering the need to maintain consistency with the generalized expression in the draft interim guidelines for methyl/ethyl alcohol (HTW 11/WP.5, Annex 2), the Group agreed not to include specific mandatory instruments at this paragraph.

.2 discussion of paragraph 1.6:

.1 several participants pointed out that paragraph 19.2.2 of MSC.1/Circ.1687 does not explicitly reference regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code. Therefore, the reference in paragraph 1.6 should be aligned with the text of the Circular;

.2 many participants considered that ammonia fuel should fall under the scope of IGF Code, with training to be conducted after seafarers have completed the training for ships subject to the IGF Code (required by regulation V/3 of the STCW Convention). Consequently,

the wording in paragraph 1.6 should maintain consistency with that used for methyl/ethyl alcohol;

.3 several participants expressed the view that while IGF Code training should serve as the foundation for ammonia fuel training, the interim training guidelines of ammonia fuel should focus specifically on the properties of ammonia. They emphasized the need to avoid duplication with the training requirements already covered under the IGF Code during the guideline development process;

.4 during the discussions, a Group participant raised concerns that while the IGF model courses currently address only LNG-fueled ships, there is a notable absence of model courses specifically designed for ammonia-fueled vessels; and

.5 the Group considered that the revision and development of relevant model courses would be more appropriately addressed during the phase of transitioning to mandatory training standards and therefore does not fall within the current agenda. Regarding the revision of paragraph 1.6, as consensus could not be reached, the Group recommended referring this matter to HTW 12 for further consideration.

.3 several participants proposed deleting the term "gaseous fuel" from the quoted paragraph 19.2.2 of MSC.1/Circ.1687 in paragraph 1.6, arguing that this term is not defined in either the IGF Code or the Circular. To maintain strict textual alignment with the original wording of paragraph 19.2.2 in MSC.1/Circ.1687, the Group did not adopt the proposal to remove "gaseous fuel";

.4 discussion of paragraph 1.9:

.1 several participants suggested that, to avoid duplication with IGF Code training, corresponding exemption clauses should be incorporated into the interim guidelines: 1.9 Seafarers serving on ships who are qualified and certified in accordance with Regulation V/3 of the STCW Convention are exempted from the training requirements for ships using ammonia as fuel that overlap with the qualifications they already hold;

.2 several participants expressed concern that the proposed addition of paragraph 1.9 might create inconsistency with the provisions in section 1.6, and therefore advised against incorporating the exemption clauses; and

.3 the Group agreed to delete paragraph 1.9.

.5 regarding the comment in the foundational document made by one participant, "The competences 1), 5), 7), 8), and 9) of 3.3.1 have been covered by 1), 6), 2), 3), 4) & 5) of 3.1.1," several participants held the view that the functional requirements differ between the operational and management levels, particularly in areas such as firefighting. Based on this, they recommended deleting the comment on paragraph 3.3. The Group adopted this suggestion and removed the annotated content;

.6 a Group participant highlighted that the CCC is currently developing the interim guidelines for ships using ammonia cargo as fuel, which may impact

the formulation process of the interim training guidelines. The Group took note of this and reminded participants to monitor the progress of this matter; and

.7 to maintain alignment with the generic interim guidelines adopted by MSC 110 and the preliminarily finalized interim training guidelines for methyl/ethyl alcohol as fuel, the Group did not adopt certain proposed amendments to the main text of the interim training guidelines of ammonia fuel (such as the addition of basic and advanced training items).

29 Following two rounds of discussions, the Group has reached broad consensus on the main text of the interim guidelines on training for seafarers on ships using ammonia as fuel. However, certain aspects of the KUP table remain unresolved. The primary discussion points in the KUP table are as follows:

.1 it was noted that the majority of proposed revisions to the KUP table originated from participants' suggestions based on the MMMCZCS - Ammonia as a Fuel Training and Competency Publications;

.2 after repeated discussions regarding the proposal to add "Use and location of mustering points/safe havens" to competence 3 of basic training, it was ultimately decided to revise the content to "use safe havens" and relocate it under competence 5 of basic training;

.3 in line with the approach adopted for methyl/ethyl alcohol, corresponding adjustments were made to the content of competence 4 of basic training and competence 9 of advanced training;

.4 regarding the proposal to include the knowledge of "dual-fuel engines" into competence 3 of advanced training, discussions concluded with a consensus that since these guidelines specifically focus on ammonia fuel, such an addition is unnecessary;

.5 regarding the paragraph 3.1.1 of basic training, one participant proposed deleting "toxicity levels of ammonia and threshold limit values" in this paragraph. In contrast, another participant was concerned that the revised provision lacks the necessary detail to provide clear guidance for course development. They believed that "toxicity levels of ammonia and threshold limit values" should be explicitly addressed. Furthermore, another participant expressed the view that the wording should be aligned with the KUP table of methyl/ethyl alcohol; and

.6 regarding the deletion or retention of paragraph 5.2 of basic training, no consensus has been reached.

30 Due to time constraints, the discussions on the KUP table for ammonia fuel remain incomplete and will be carried forward for completion at HTW 12.

Other alternative fuels and new technologies (ToR 1.3-1.6)

31 To ensure consistency in the annex formats, the Group has made necessary adjustments to the layout of annexes 3 to 6, which have not yet been discussed. These revisions are editorial in nature and do not involve any content modifications, and are provided for reference in subsequent discussions.

32 The Group noted the views expressed by one participant that draft interim guidelines on training for seafarers serving on ships using wind propulsion systems (whether as a

principal or auxiliary means of propulsion) should also be developed and the Working Group's terms of reference be completed accordingly. In this context, the Group invited the interested Member States and international organizations to submit proposals to HTW 12.

Conducting virtual meeting

33 The Group convened a virtual meeting between the fourth and fifth rounds of discussion, aiming to provide an additional opportunity to facilitate the exchange of information and views.

34 Considering that some members were unable to attend the virtual meeting due to their participation in the MEPC/ES.2 session, the Group noted that, if needed, an additional meeting could be convened.

Re-establishment of the Working Group

35 As the Group was unable to finalize the work on all guidelines, the Group was of the view that the Working Group on the Development of Training Provisions for Seafarers on Ships Using Alternative Fuels and New Technologies should be re-established at HTW 12 under the following terms of reference:

.1 finalize the draft interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel (annex 1) for submission to MSC 111 with a view to approval as an STCW.7 circular;

.2 proceed to clarify the unresolved issues in the draft interim guidelines on training for seafarers on ships using ammonia as fuel (annex 2), and finalize it for submission to MSC 111 with a view to approval as an STCW.7 circular;

.3 further develop draft interim guidelines on training for seafarers on ships using alternative fuels and new technologies as individual sets of interim guidelines, addressing:

.1 hydrogen fuel cell-powered ships, taking into account annex 3 to document HTW 12/7, MSC.1/Circ.1647 on Interim guidelines for the safety of ships using fuel cell power installations, and relevant parts of document HTW 11/7/1;

.2 the use of LPG as fuel, taking into account annex 4 to document HTW 12/7, MSC.1/Circ.1666 on Interim guidelines for the safety of ships using LPG as fuel, and relevant parts of document HTW 11/7/1;

.3 the use of hydrogen as fuel, taking into account annex 5 to document HTW 12/7, relevant parts of documents HTW 11/7/2, HTW 11/7/6, HTW 11/INF.7 and HTW 11/INF.16; and

.4 battery-powered ships, taking into account annex 6 to document HTW 12/7 and document HTW 11/7/3.

Action requested of the Sub-Committee

36 The Sub-Committee is invited to approve the report in general, and in particular to:

.1 note the Group's deliberations on the development of the draft interim guidelines on training for seafarers on ships using methyl/ethyl alcohol as fuel (paragraphs 7, 23 to 26 and annex 1);

.2 note the Group's deliberations and the progress made in drafting the interim guidelines on training for seafarers on ships using ammonia as fuel (paragraphs 7, 27 to 30 and annex 2);

.3 note the Group's deliberations and the progress made in drafting interim training guidelines for other specific fuels/technologies (paragraphs 6, 8, 31, 32 and annexes 3 to 6);

.4 note the invitation to the interested Member States and international organizations to submit proposals to HTW 12 to consider the development of draft interim guidelines on training for seafarers serving on ships using wind propulsion systems;

.5 note the invitation to the interested Member States and international organizations to submit proposals to HTW 12 to consider the matter of developing familiarization training guidelines; and

.6 consider re-establishing the Working Group on the Development of Training Provisions for Seafarers on Ships Using Alternative Fuels and New Technologies under the terms of reference set out in paragraph 35.

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ANNEX 1

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING METHYL/ETHYL ALCOHOL AS FUEL

1 INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using methyl/ethyl alcohol as fuel to support the reduction of greenhouse gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using methyl/ethyl alcohol as fuel.

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers working on ships using methyl/ethyl alcohol, the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers serving on ships using methyl/ethyl alcohol as fuel.

General provisions for training and familiarization

1.5 All seafarers serving on board ships using methyl/ethyl alcohol as fuel should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures and ship characteristics that are relevant to their routine or emergency duties, as specified in regulation I/14.5 of the STCW Convention.

1.6 In accordance with MSC.1/Circ.1621 on *Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel*, paragraph 16.6, the master, officer, ratings and other personnel on ships using methyl/ethyl alcohol as fuel should be trained and qualified in accordance with regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code, taking into account the specific hazards of methyl/ethyl alcohol used as fuel.

1.7 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

1.8 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and systems on board ships using methyl/ethyl alcohol as fuel should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of fuel and systems on board ships using methyl/ethyl alcohol as fuel should be delivered in accordance with the KUPs specified in tables 1 and 2 of this guideline and should meet the standard competence specified therein.

2 TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on board a ship using methyl/ethyl alcohol as fuel, all seafarers should receive appropriate training in accordance with this section.

2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.

2.3 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuels and fuel systems on board ships using methyl/ethyl alcohol as fuel should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and fuel systems on ships using methyl/ethyl alcohol as fuel should receive advanced training in accordance with paragraph 3.3 and 3.4 and should meet the standard of competence specified therein, taking into account the knowledge, understanding and proficiencies to meet the standard of competence specified in 3.1, as appropriate.

2.5 Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of the fuels and fuel systems used and the safety procedures involved.

2.6 It is important to emphasize the need to take account of risk analyses. All risk analyses carried out should be made available to participants during training.

3 STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the use of the fuels and fuel systems on board ships using methyl/ethyl alcohol as fuel should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on the use of methyl/ethyl alcohol and related fuel systems so as to:

.1 contribute to the safe operation of a ship;

.2 take precautions to prevent hazards on a ship;

.3 apply occupational health and safety precautions and measures;

.4 carry out firefighting operations on a ship;

.5 respond to emergencies; and

.6 take precautions to prevent pollution of the environment from ships; and

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Documentary evidence should be issued by the Administration indicating that the holder has completed the basic training.

Standard of competence for advanced training

3.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuels and fuel systems on board ships using methyl/ethyl alcohol as fuel should, before being assigned to shipboard duties:

.1 receive advanced training in addition to the competences outlined in paragraph 3.1.1 as determined by the Administration on the use of methyl/ethyl alcohol and related fuel systems so as to:

.1 be familiar with physical and chemical properties of the fuels and/or characteristics of the systems aboard ships;

.2 operate controls of the fuels and fuel systems related to propulsion plant and engineering systems and services and safety devices on ships;

.3 be able to safely perform and monitor all operations related to the fuels and fuel systems used on board ships;

.4 plan and monitor safe bunkering, stowage and securing of the fuels on board ships;

.5 take precautions to prevent pollution of the environment from ships;

.6 monitor and control compliance with legislative requirements;

.7 take precautions to prevent hazards;

.8 apply occupational health and safety precautions and measures on board ships; and

.9 have knowledge of the prevention, control and firefighting and extinguishing systems on board ships;

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration; and

3.4 Documentary evidence should be issued by the Administration indicating that the holder has completed the advanced training.

4 EMERGENCY EXERCISES

4.1 Emergency exercises related to the fuels and fuel systems on board ships using methyl/ethyl alcohol as fuel should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

Table 1

Specification of minimum standard of competence in basic training for seafarers onboard ships using methyl/ethyl alcohol as fuel (mapped against table A-V/3-1 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code is shown in grey)

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
1 Contribute to the safe operation of a ship ~~subject to the IGF Code~~	1.1 Design and operational characteristics of ships subject to the IGF Code 1.2 Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: .1 fuels addressed by the IGF Code .2 types of fuel systems subject to the IGF Code .3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code .4 general arrangement of fuel storage systems on board ships subject to the IGF Code .5 hazard zones and areas .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships subject to the IGF Code	1.1 Basic knowledge of design and operational characteristics of ships using methyl/ethyl alcohol as fuel under atmospheric storage conditions 1.2 Basic knowledge of fuel systems and fuel storage systems: .1 methyl/ethyl alcohol as fuel on board ships .2 fuel systems of methyl/ethyl alcohol as fuel on board ships .3 atmospheric storage of methyl/ethyl alcohol as fuel on board ships .4 general arrangement of fuel storage systems on board ships using methyl/ethyl alcohol as fuel (including Fuel Preparation Room (FPR) and Tank Connection Space) .5 non-hazardous areas, hazardous area zones, including spaces contiguous with hazardous area zones .6 typical fire safety plan

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
		.7 monitoring, control and safety systems aboard ships using methyl/ethyl alcohol as fuel
	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: .1 piping systems and valves .2 atmospheric, compressed or cryogenic storage .3 relief systems and protection screens .4 basic bunkering operations and bunkering systems .5 protection against cryogenic accidents .6 fuel leak monitoring and detection	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships using ethyl/ethyl alcohol as fuel: .1 fuel handling systems and equipment, piping systems and valves including its safe isolation .2 fuel tank/storage including atmospheric storage level monitoring .3 relief systems, protections screens and tank atmosphere control systems .4 basic bunkering operations and bunkering systems. .5 N/A .6 fuel leak monitoring and detection .7 Fuel system accidents including spill containment system, emergency release arrangements
	1.4 Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including: .1 properties and characteristics .2 pressure and temperature, including vapour pressure/ temperature relationship	1.4 Basic knowledge of the physical and chemical properties of methyl/ethyl alcohol as fuel on board ships, including: .1 properties and characteristics of methyl/ethyl alcohol .2 N/A
	1.5 Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.	

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
		1.5 Knowledge and understanding of safety requirements and safety management on board ships using methyl/ethyl alcohol as fuel
2 Take precautions to prevent hazards on a ship ~~subject to the IGF Code~~	2.1 Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel batch differences	2.1 Basic knowledge of the hazards associated with operations on ships using methyl/ethyl alcohol as fuel**,** including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards (accelerated stress corrosion cracking when in contact with water) .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards .9 N/A .10 N/A .11 N/A

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
		.12 fuel batch differences .13 leakage
	2.2 Basic knowledge of hazard controls: .1 emptying, inerting, drying and monitoring techniques .2 anti-static measures .3 ventilation .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing .9 protection against cryogenic damages (LNG)	2.2 Basic knowledge of hazard controls: .1 emptying, inerting, gas freeing and monitoring techniques .2 anti-static measures .3 ventilation protocols .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 flammable and toxic vapour testing .9 N/A
	2.3 Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)	2.3 Understanding of fuel characteristics on ships using methyl/ethyl alcohol as fuel as found on a Safety Data Sheet (SDS)
3 Apply occupational	3.1 Awareness of function of gas-measuring instruments and similar equipment:	3.1 Proper use gas-measuring instruments and similar equipment

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
health and safety precautions and measures	.1 gas testing	.1 gas detection (flammable and toxic levels of methyl/ethyl alcohol)
	3.2 Proper use of specialized safety equipment and protective devices, including:	3.2 Proper use of specialized safety equipment and protective devices, including:
	.1 breathing apparatus	.1 breathing apparatus
	.2 protective clothing	.2 protective clothing
	.3 resuscitators	.3 resuscitators
	.4 rescue and escape equipment	.4 rescue and escape equipment
	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including:	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships using methyl/ethyl alcohol as fuel, including:
	.1 precautions to be taken before entering hazardous spaces and zones	.1 precautions to be taken before entering enclosed spaces, hazardous area zones, including spaces adjacent to hazardous area zones
	.2 precautions to be taken before and during repair and maintenance work	.2 precautions to be taken before and during repair and maintenance work
	.3 safety measures for hot and cold work	.2 bis material compatibilities with methyl/ethyl alcohol fuel systems
	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	.3 safety measures for hot and cold work

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
		.4 measures for decontaminating personal protective equipment, tools or equipment 3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)
4 Carry out fire-fighting operations on a ship ~~subject to the IGF Code~~	4.1 Fire organization and action to be taken on ships subject to the IGF Code 4.2 Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code 4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code 4.4 Fire-fighting system operations	4.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of methyl/ethyl alcohol fuels including portable heat-detection devices. 4.2 N/A 4.3 N/A 4.4 N/A
5 Respond to emergencies	5.1 Basic knowledge of emergency procedures, including emergency shutdown	5.1 Basic knowledge of emergency procedures including emergency shutdown protocols, but not limited to: .1 loss of containment .2 spill during bunkering .3 fire/explosion .4 over-pressurization/ overfilling .5 collision

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Methyl/ethyl alcohol**
		.6 personnel injury ~~[5.2 Basic knowledge of communication methods on using methyl/ethyl alcohol as fuel.]~~
6 Take precautions to prevent pollution of the environment from the release of fuels found on ships ~~subject to the IGF Code~~	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage of fuels from ships using methyl/ethyl alcohol as fuel, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage response procedures .3 awareness of appropriate personal protection when responding to a spill/leakage of methyl/ethyl alcohol .4 the shipboard fuel pollution emergency plan

Table 2

Specification of minimum standard of competence in advanced training for seafarers on board ships using methyl/ethyl alcohol as fuel (mapped against table A-V/3-2 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code is shown in grey)

Competence	Existing IGF Code training	Methyl/ethyl alcohols
1 Familiarity with physical and chemical properties of fuels aboard ships ~~subject to the IGF Code~~	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code .2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 boil-off and weathering of cryogenic fuels .5 compression and expansion of gases .6 critical pressure and temperature of gases	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of methyl/ethyl alcohol used as fuel: .1 the chemical structure of methyl/ethyl alcohol .2 the properties and characteristics of methyl/ethyl alcohol including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 N/A .5 N/A .6 N/A

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.7 flashpoint, upper and lower flammable limits, auto-ignition temperature	.7 flashpoint, upper and lower flammable limits, auto-ignition temperature
	.8 saturated vapour pressure/ reference temperature	.8 N/A
	.9 dewpoint and bubble point	.9 N/A
	.10 hydrate formation	.10 N/A
	.11 combustion properties: heating values	.11 combustion properties: heating values
	.12 methane number/ knocking	.12 knocking
	.13 pollutant characteristics of fuels addressed by the IGF Code	.13 pollutant characteristics of methyl/ethyl alcohol
	.3 the properties of single liquids	.3 the properties of single liquids
	.4 the nature and properties of solutions	.4 the nature and properties of solutions (flammability and corrosivity of water-methyl/ethyl mixtures)
	.5 thermodynamic units	.5 thermodynamic units
	.6 basic thermodynamic laws and diagrams	.6 basic thermodynamic laws and diagrams
	.7 properties of materials	.7 N/A
	.8 effect of low temperature, including brittle fracture, for liquid cryogenic fuels	.8 N/A
		1.2 Understanding the information contained in a Safety Data Sheet (SDS) about methyl/ethyl alcohol

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	1.2 Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code	
2 Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on ships ~~subject to the IGF Code~~	2.1 Operating principles of marine power plants 2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms	2.1 Operating principles of marine power plants 2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms
3 Ability to safely perform and monitor all operations related to the fuels used on board ships ~~subject to the IGF Code~~	3.1 Design and characteristics of ships subject to the IGF Code 3.2 Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships:	3.1 Knowledge of design and characteristics of ships using methyl/ethyl alcohol as fuel 3.2 Knowledge of ship design, systems, and equipment found on ships using methanol as fuel, including: .1 fuel systems for different propulsion systems .2 general arrangement and construction, including the schematic and piping diagram of the fuel system as well as layout of storage tanks .3 fuel storage systems on board ships using methyl/ethyl alcohol as fuel, including materials of construction and insulation

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices .4 flame screens .5 temperature monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD)	.4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines (double-walled piping) and valves .3 expansion devices .4 flame screens and arrestors .5 temperature monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 N/A .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 alarm and fuel Emergency Shut Down system (ESD) 3.2 bis Knowledge of planned maintenance systems .1 the coating or material requirements or compatibility specifically for methyl/ethyl alcohol equipment including tanks

Competence	Existing IGF Code training	Methyl/ethyl alcohols
		.2 the procedures to be taken for invasive maintenance of the methyl/ethyl alcohol system .3 the process for safe isolation of equipment or components and return to service e.g. use of double block and bleed valve system 3.2 ter Knowledge of the regulatory framework to ensure the protection of methyl/ethyl alcohol fuel tanks and piping systems
	3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code .1 low pressure pumps .2 high pressure pumps .3 vapourizers .4 heaters .5 pressure build-up units	3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships using methyl/ethyl alcohol as fuel .1 low pressure pumps .2 high pressure pumps .3 N/A .4 heat exchangers .5 N/A
	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including: .1 inerting	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including: .1 inerting .1 bis gas freeing

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.2 cooling down .3 initial loading .4 pressure control .5 heating of fuel .6 emptying systems	.2 N/A .3 initial loading .4 tank atmosphere pressure control .5 N/A .6 emptying systems
4 Plan and monitor safe bunkering, stowage and securing of the fuel on board ships ~~subject to the IGF Code~~	4.1 General knowledge of ships subject to the IGF Code 4.2 Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code 4.3 Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code 4.5 Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: .1 bunkering procedures	4.1 Knowledge of ships using methyl/ethyl alcohol as fuel 4.2 Ability to use all data available on board related to bunkering, storage and securing of methyl/ethyl alcohol as fuel 4.3 Ability to establish clear and concise communications between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures and preparedness for operation of machinery, fuel and control systems for ships using methanol as fuel 4.5 Proficiency in the operation of bunkering systems on board ships using methyl/ethyl alcohol as fuel including: .1 procedures related to pre-bunkering including tank conditioning and post-bunkering .1 bis knowledge of vapour return/recovery system

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.2 emergency procedures .3 ship-shore/ship-ship interface .4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea	.2 emergency procedures .3 ship-shore/ship-ship interface and use of ship-shore checklist related to methyl/ethyl alcohol. .4 N/A .5 implement and monitoring of the non-hazardous areas associated with the bunkering process 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other methyl/ethyl alcohol related operations concurrent with other onboard operations, both in port and at sea
5 Take precautions to prevent pollution of the environment from the release of fuels	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/ venting	5.1 Knowledge of the effects of pollution on human and environment .1 awareness of the dynamics of gas plume and modelling techniques

Competence	Existing IGF Code training	Methyl/ethyl alcohols
from ships ~~subject to the IGF Code~~		5.2 Knowledge of measures to be taken in the event of spillage/leakage .1 hazard control checklists in mitigating potential risks .2 shipboard fuel pollution emergency plan
6 Monitor and control compliance with legislative requirements	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents
7 Take precautions to prevent hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: .1 flammability .2 explosion .3 toxicity .4 reactivity	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships using methyl/ethyl alcohol as fuel, including: .1 flammability (including water-methyl/ethyl mixtures) .2 explosion .3 toxicity .4 reactivity .5 corrosivity

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.5 corrosivity .6 health hazards .7 inert gas composition .8 electrostatic hazards .9 pressurized gases .10 low temperature 7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships subject to the IGF Code 7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code 7.5 Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code 7.6 Ability to elaborate and develop safety plans and safety instructions for ships subject to the IGF Code	.6 health hazards .7 inert gas composition .8 electrostatic hazards .9 N/A .10 N/A 7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships using methyl/ethyl alcohol as fuel 7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships using methyl/ethyl alcohol as fuel 7.5 Ability to elaborate and develop risks analysis related to risks on board ships using methyl/ethyl alcohol as fuel 7.6 Ability to elaborate and develop safety plans and safety instructions for ships using methyl/ethyl alcohol as fuel 7.7 Knowledge of hot work, enclosed spaces, hazardous area zones, spaces adjacent to hazardous area zones and tank entry including permitting procedures.

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	7.7 Knowledge of hot work, enclosed spaces and tank entry including permitting procedures	
8 Apply occupational health and safety precautions and measures on board a ship ~~subject to the IGF Code~~	8.1 Proper use of safety equipment and protective devices, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and escape equipment	8.1 Proper use of specialized safety equipment and protective devices compatible with methyl/ethyl alcohol exposure, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and personal escape equipment 8.1 bis Knowledge of function, limitation (if any) of gas-measuring instruments and similar equipment: .1 atmosphere testing and gas detection including toxic levels of methyl/ethyl alcohol
	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including: .1 precautions to be taken before, during and after repair and maintenance work on fuel systems addressed in the IGF Code	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships using methyl/ethyl alcohol as fuel, including: .1 precautions to be taken before and during repair and maintenance work .1 bis material compatibilities with methyl/ethyl alcohol systems

Competence	Existing IGF Code training	Methyl/ethyl alcohols
	.2 electrical safety (reference to IEC 600079-17) .3 ship/shore safety checklist 8.3 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code	.2 electrical safety .3 ship/shore safety checklist .3 bis safety measures for hot and cold work 8.3 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)
9 Knowledge of the prevention, control and fire-fighting and extinguishing systems on board ships ~~subject to the IGF Code~~	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	9.1 Fire organization and action to be taken on ships using methyl/ethyl alcohol as fuel 9.2 Special hazards associated with fuel systems and fuel handling on ships using methyl/ethyl alcohol as fuel 9.3 Fire-fighting system operations 9.4 Reporting and notifying relevant authorities and involved parties

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ANNEX 2

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING AMMONIA AS FUEL*

1 INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using ammonia as fuel to support the reduction of greenhouse gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using ammonia as fuel.

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers working on ships using ammonia, the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers serving on ships using ammonia as fuel.

General provisions for training and familiarization

1.5 All seafarers serving on board ships using ammonia as fuel should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures, and ship characteristics that are relevant to their routine or emergency duties, as specified in Regulation I/14.5 of the STCW Convention.

1.6 In accordance with MSC.1/Circ.1687 on *Interim guidelines for the safety of ships using ammonia as fuel*, paragraph 19.2.2, the master, officer, ratings, and other personnel on ships using ammonia as fuel should have received training and be qualified in the use of gaseous fuel in accordance with the [Regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code], taking into account the specific hazards of ammonia used as fuel.

1.7 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

1.8 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and

* The fundamental document was drafted by EC*, China, Japan, Malaysia and Singapore, Party marked with (*) is the focal point.

systems on board ships using ammonia as fuel should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of fuel and systems on board ships using ammonia as fuel should be delivered in accordance with the KUPs specified in tables 1 and 2 of this guideline and should meet the standard competence specified therein.

2 TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on board a ship using ammonia as fuel, all seafarers should receive appropriate training in accordance with this section.

2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.

2.3 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuels and fuel systems on board ships using ammonia as fuel should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and fuel systems on ships using ammonia as fuel should receive advanced training in accordance with paragraph 3.3 and 3.4 and should meet the standard of competence specified therein, taking into account the knowledge, understanding and proficiencies to meet the standard of competence specified in 3.1, as appropriate.

2.5 Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of the fuels and fuel systems used, and the safety procedures involved.

2.6 It is important to emphasize the need to take account of risk analyses. All risk analyses carried out should be made available to participants during training.

3 STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the use of the fuels and fuel systems on board ships using ammonia as fuel should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on the use of ammonia and related fuel systems so as to:

.1 contribute to the safe operation of a ship;

.2 take precautions to prevent hazards on a ship;

.3 apply occupational health and safety precautions and measures;

.4 carry out firefighting operations on a ship;

.5 respond to emergencies; and

.6 take precautions to prevent pollution of the environment from ships; and

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Documentary evidence should be issued by the Administration indicating that the holder has completed the basic training.

Standard of competence for advanced training

3.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuels and fuel systems on board ships using ammonia as fuel should, before being assigned to shipboard duties:

.1 receive advanced training in addition to the competences outlined in paragraph 3.1.1as determined by the Administration on the use of ammonia and related fuel systems so as to:

.1 be familiar with physical and chemical properties of the fuels and/or characteristics of the systems aboard ships;

.2 operate controls of the fuels and fuel systems related to propulsion plant and engineering systems and services and safety devices on ships;

.3 be able to safely perform and monitor all operations related to the fuels and fuel systems used on board ships;

.4 plan and monitor safe bunkering, stowage and securing of the fuels on board ships;

.5 take precautions to prevent pollution of the environment from ships;

.6 monitor and control compliance with legislative requirements;

.7 take precautions to prevent hazards;

.8 apply occupational health and safety precautions and measures on board ships; and

.9 have knowledge of the prevention, control and firefighting and extinguishing systems on board ships;

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration; and

3.4 Documentary evidence should be issued by the Administration indicating that the holder has completed the advanced training.

4 EMERGENCY EXERCISES

4.1 Emergency exercises related to the fuels and fuel systems on board ships using ammonia as fuel should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

Table 1

Specification of minimum standard of competence in basic training for seafarers on board ships using ammonia as fuel
(mapped against table A-V/3-1 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code is shown in grey)

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
1 Contribute to the safe operation of a ship ~~subject to the IGF Code~~	1.1 Design and operational characteristics of ships subject to the IGF Code 1.2 Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: .1 fuels addressed by the IGF Code .2 types of fuel systems subject to the IGF Code .3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code .4 general arrangement of fuel storage systems on board ships subject to the IGF Code .5 hazard zones and areas .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships subject to the IGF Code	1.1 Design and operational characteristics of ships using ammonia as fuel under different storage conditions 1.2 Basic knowledge of fuel systems and fuel storage systems: .1 ammonia as fuel on board ships .2 types of ammonia fuels storage systems .3 atmospheric, low temperature, [compressed] or pressurised storage of ammonia fuels on board ships. .4 general arrangement of fuel systems and fuel storage systems on board ships using ammonia as fuel, including Fuel Preparation Room (FPR) and Tank Connection Space. .5 Provisions for hazardous areas, toxic spaces and toxic areas .6 typical fire safety plan

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
		.7 monitoring, control and safety systems aboard ships using ammonia as fuel.
	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: .1 piping systems and valves .2 atmospheric, compressed or cryogenic storage .3 relief systems and protection screens .4 basic bunkering operations and bunkering systems .5 protection against cryogenic accidents .6 fuel leak monitoring and detection	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships using ammonia as fuel: .1 piping systems and valves .2 atmospheric, pressurised □ [compressed] or low-temperature storage .3 relief systems, protection screens □ and ammonia vapour treatment systems .4 basic bunkering operations and bunkering systems related to ammonia .5 protection against high-pressure □ low-temperature accidents .6 fuel leak monitoring and detection
	1.4 Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including: .1 properties and characteristics .2 pressure and temperature, including vapour pressure/temperature relationship	1.4 Basic knowledge of the physical and chemical properties of ammonia as fuel on board ships, including: .1 properties and characteristics of ammonia .2 pressure and temperature relationship of ammonia in gaseous and liquified phases

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
	1.5 Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.	.3 Understanding the consequences and behaviour of ammonia being discharged into water, air and on deck (in vapour and liquid form) 1.5 Knowledge and understanding of safety requirements and safety management on board ships using ammonia as fuel.
2 Take precautions to prevent hazards on a ship ~~subject to the IGF Code~~	2.1 Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds	2.1 Basic knowledge of the hazards associated with operations on ships using ammonia as fuel, including but not limited to: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards associated with ammonia, including its reaction with water and moisture .5 ignition, implosion, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards and threshold level

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
	.10 extremely low temperatures	.9 liquid pools, vapour leaks and clouds including vapour dispersion
	.11 pressure hazards	.10 low temperatures
	.12 fuel batch differences	.11 pressure hazards
		.12 N/A
		.12 bis external environmental conditions that affect operations
	2.2 Basic knowledge of hazard controls:	2.2 Basic knowledge of hazard controls:
	.1 emptying, inerting, drying and monitoring techniques	.1 emptying, inerting, drying, gas freeing and monitoring techniques
	.2 anti-static measures	.2 anti-static measures
	.3 ventilation	.3 ventilation protocols (considering toxic vapour releases)
	.4 segregation	
	.5 inhibition	.3 bis release protocols (during purging, engine shutdown etc.) including treatment systems}
	.6 measures to prevent ignition, fire and explosion	.4 segregation
	.7 atmospheric control	.5 N/A
	.8 gas testing	.6 measures to prevent ignition, fire, implosion and explosion

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
	.9 protection against cryogenic damages (LNG) 2.3 Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)	.6 atmospheric and temperature control .7 gas testing .8 protection against low temperature damages 2.3 Understanding of fuel characteristics on ships using ammonia as fuel as found on a Safety Data Sheet (SDS)
3 Apply occupational health and safety precautions and measures	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas testing 3.2 Proper use of specialized safety equipment and protective devices, including: .1 breathing apparatus .2 protective clothing .3 resuscitators .4 rescue and escape equipment	3.1 Proper use gas-measuring instruments and similar equipment: **[**.1 gas testing ~~detection (flammable and toxic levels of ammonia, threshold limit value)~~**]** 3.2 Proper use of specialized safety equipment and protective devices compatible with ammonia exposure, including: .1 breathing apparatus .2 protective clothing .3 resuscitators .4 rescue and escape equipment

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including: .1 precautions to be taken before entering hazardous spaces and zones .2 precautions to be taken before and during repair and maintenance work .3 safety measures for hot and cold work	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships having ammonia as fuel, including: .1 precautions to be taken before entering hazardous area zones, toxic areas, toxic spaces, and spaces adjacent to these areas. .2 precautions to be taken before and during repair and maintenance work .2 bis material compatibilities with ammonia systems .3 safety measures for hot and cold work .4 measures for decontaminating personal protective equipment, tools or equipment.
	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)
4 Carry out fire-fighting operations on a ship ~~subject to the IGF Code~~	4.1 Fire organization and action to be taken on ships subject to the IGF Code 4.2 Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code	4.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of ammonia fuels including portable heat-detection devices. 4.2 N/A 4.3 N/A

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
	4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code 4.4 Fire-fighting system operations	4.4 N/A
5 Respond to emergencies	5.1 Basic knowledge of emergency procedures, including emergency shutdown	5.1 Basic knowledge of contingency plan, emergency procedures and preparedness, including but not limited to: .1 ammonia leaks and escape .1 bis use safe havens .2 search and rescue from ammonia contaminated area .3 personal injury .4 training and safety drills, including understanding the role of the Ammonia Release Mitigation System (ARMS) and double walled pipes as safety measures to tackle toxicity hazards ~~[5.2 Basic knowledge of communication methods when using ammonia as fuel]~~
6 Take precautions to prevent pollution of the environment from the release of	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to:	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/venting of fuels from ships using ammonia as fuel, including the need to: .1 report relevant information to the responsible persons

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Ammonia**
fuels found on ~~ships subject to the IGF Code~~	.1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	.2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/leakage/venting of ammonia

Table 2

Specification of minimum standard of competence in advanced training for seafarers on board ships using ammonia as fuel (mapped against table A-V/3-2 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code is shown in grey)

Competence		
	Existing IGF Code training	**Ammonia**
1 Familiarity with physical and chemical properties of fuels aboard ships ~~subject to the IGF Code~~	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of ammonia used as fuel: .1 the chemical structure of ammonia .2 the properties and characteristics of ammonia including:

Competence	Existing IGF Code training	Ammonia
	.2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 boil-off and weathering of cryogenic fuels .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 flashpoint, upper and lower flammable limits, auto-ignition temperature .8 saturated vapour pressure/ reference temperature .9 dewpoint and bubble point .10 hydrate formation .11 combustion properties: heating values .12 methane number/ knocking .13 pollutant characteristics of fuels addressed by the IGF Code	.1 simple physical laws .2 states of matter of ammonia including phase changes .3 liquid and vapour densities .3 bis liquefaction of gases .4 boil-off of low-temperature fuel (ammonia) .4 bis diffusion and mixing of gases .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 flashpoint of ammonia, upper and lower flammable limits, auto-ignition temperature .8 saturated vapour pressure/ reference temperature .9 N/A .10 hydrate formation .11 combustion properties: heating values .12 N/A

Competence	Existing IGF Code training	Ammonia
	.3 the properties of single liquids .4 the nature and properties of solutions .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials .8 effect of low temperature, including brittle fracture, for liquid cryogenic fuels 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code	.13 pollutant characteristics of ammonia fuels .3 N/A .4 [the nature and properties of solutions] .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials and compatibility with ammonia .7 bis quality of fuel including the effect of impurities .8 effect of low temperature, including ductile or brittle fracture for liquid low temperature fuels 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about ammonia fuels
2 Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on	2.1 Operating principles of marine power plants 2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms	2.1 Operating principles of marine power plants 2.2 Knowledge of Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms

Competence	Existing IGF Code training	Ammonia
ships ~~subject to the IGF Code~~ using ammonia as fuel		
3 Ability to safely perform and monitor all operations related to ~~the fuels used on board ships subject to the IGF Code~~ ammonia fuels used onboard ships	3.1 Design and characteristics of ships subject to the IGF Code 3.2 Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices .4 flame screens	3.1 Knowledge of design and characteristics of ships using ammonia as fuel under different storage conditions 3.2 Knowledge of ship design, systems, and equipment found on ships having ammonia as fuel, including: .1 fuel systems for different propulsion systems .2 general arrangement and construction .3 fuel storage systems on board ships using ammonia as fuel, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines (double-walled piping) and valves .2 bis vapour/boil-off management .3 expansion devices .4 [flame screens]

Competence	Existing IGF Code training	Ammonia
	.5 temperature monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD) 3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code	.5 temperature and pressure monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 [low temperature] fuel tanks temperature and pressure maintenance [system] .6 [fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution] [.6 bis fuel residue and effluent drain system] [.6 ter lubricants and compressors, or other equipment] .7 toxic and flammable gas-detecting systems [.7 bis flame detection systems] [.7 ter Vapour / BOG management and control systems including liquefaction and reliquefaction] .8 alarm and fuel Emergency Shut Down system (ESD) 3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships using ammonia as fuel

Competence	Existing IGF Code training	Ammonia
	.1 low pressure pumps	.1 low pressure pumps
	.2 high pressure pumps	.2 high pressure pumps
	.3 vapourizers	.2 bis compressors
	.4 heaters	.3 vapourizers
	.5 pressure build-up units	.4 heaters
		.4 bis heat exchangers
		[.4 bis Filters
		.4 bis Ventilation system related to spaces where fuel vapours could be present
		.4 bis venting and vapour systems for the ammonia fuel]
		.5 pressure build-up units
	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including:	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including:
	.1 inerting	.1 inerting
	.2 cooling down	.1 bis gas freeing
	.3 initial loading	.2 tank preparation (conditioning/drying)
	.4 pressure control	.3 initial loading

Competence	Existing IGF Code training	Ammonia
	.5 heating of fuel .6 emptying systems	.4 temperature (< -30 deg.) and pressure control .5 heating of fuel .5 bis vapour management .6 emptying systems
4 Plan and monitor safe bunkering, stowage and securing of the fuel on board ships ~~subject to the IGF Code~~	4.1 General knowledge of ships subject to the IGF Code 4.2 Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code 4.3 Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code 4.5 Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: .1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface	4.1 General knowledge of ships using ammonia as fuel 4.2 Ability to use all data available on board related to bunkering, storage and securing of ammonia as fuel 4.3 Ability to establish clear and concise communications between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships using ammonia as fuel 4.5 Proficiency in the operation of bunkering systems on board ships using ammonia as fuel including: .1 procedures related to pre-bunkering including tank conditioning and post-bunkering .2 emergency procedures .3 ship-shore/ship-ship interface and use of ship-shore checklist related to ammonia.

Competence	Existing IGF Code training	Ammonia
	.4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea	.4 [N/A] 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other ammonia related operations concurrent with other onboard operations, both in port and at sea ~~4.8 [Proficiency in interpreting and using readings from instruments and control systems]~~
5 Take precautions to prevent pollution of the environment from the release of fuels from ships ~~subject to the IGF Code~~	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/ venting	5.1 Knowledge of the effects of pollution on human and environment .1 awareness of the dynamics of gas plume and modelling techniques

Competence	Existing IGF Code training	Ammonia
		5.2 Knowledge of measures to be taken in the event of spillage/leakage/venting (including management of ammonia contaminated water) ~~5.3 [Knowledge of measures to be taken in the event of foreseeable release including recovery and treatment systems]~~ 5.4 [Understanding of procedures to prevent pollution of the environment] 5.5 [Knowledge of measures to be taken towards the local or port authority in case of larger emissions of ammonia or the release of a gas plume]
6 Monitor and control compliance with legislative requirements	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the applicable regulatory codes and related documents as appropriate to ship
7 Take precautions to prevent hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including:	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships having ammonia as fuel, including but not limited to:

Competence	Existing IGF Code training	Ammonia
	.1 flammability	.1 flammability
	.2 explosion	.2 explosion [(BLEVE, Boiling Liquid Expanding Vapour Explosion)] and implosion
	.3 toxicity	.3 toxicity hazards and threshold level
	.4 reactivity	.4 reactivity (interactions with water/moisture (hygroscopic))
	.5 corrosivity	.5 corrosivity
	.6 health hazards	.6 health hazards
	.7 inert gas composition	.7 inert gas composition
	.8 electrostatic hazards	.8 [electrostatic hazards]
	.9 pressurized gases	[.8 bis liquid or vapour leaks
	.10 low temperature	.8 bis phase change hazards]
		.9 pressurized gases
		.10 low temperature
	7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships subject to the IGF Code	7.2 Proficiency to calibrate and use monitoring and fuel/gas detection systems, instruments and equipment on board ships using ammonia as fuel

Competence	Existing IGF Code training	Ammonia
	7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code 7.5 Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code 7.6 Ability to elaborate and develop safety plans and safety instructions for ships subject to the IGF Code 7.7 Knowledge of hot work, enclosed spaces and tank entry including permitting procedures	7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships using ammonia as fuel 7.5 Ability to elaborate and develop risks analysis related to risks on board ships using ammonia as fuel 7.6 Ability to elaborate and develop safety plans and safety instructions for ships using ammonia as fuel 7.7 [Knowledge of hot work, toxic spaces, toxic areas, hazardous areas ~~zones~~, enclosed spaces, spaces adjacent to hazardous zones and tank entry including permitting procedures] 7.8 [~~Understanding of how to establish and monitor hazards, safety, security and marine zones / areas and any other monitored locations~~]
8 Apply occupational health and safety precautions and measures on board a ship ~~subject to the IGF Code~~	8.1 Proper use of safety equipment and protective devices, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators	8.1 Proper use of specialized safety equipment and protective devices compatible with ammonia exposure, including: 1. breathing apparatus and evacuating equipment .2 protective clothing and equipment **[such as that** rated for low temperature and personal gas detectors] .3 resuscitators

Competence	Existing IGF Code training	Ammonia
	.4 rescue and escape equipment	.4 rescue and personal escape equipment ~~.5 [understanding of use, location of mustering points / safe havens~~ ~~.6 precautions to be taken before, during and after repair and maintenance work on fuel systems using ammonia as fuel addressed in the IGF Code including~~ ~~.7 precautions to be taken when entering areas with potential high gas (or vapour) concentrations such as hazardous areas, spaces or zones including enclosed spaces~~ ~~.8 precautions for hot and cold work~~ ~~.9 precautions for cold burn and frostbite~~ ~~.10 proper use of personal toxicity and gas monitoring equipment and portable gas meters~~ ~~.11 use of appropriate Personal Protective Equipment (PPE)]~~ 8.1 bis Knowledge of function, limitation (if any) of gas-measuring instruments and similar equipment: .1 atmosphere testing and gas detection including toxic levels of ammonia

Competence	Existing IGF Code training	Ammonia
	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including: .1 precautions to be taken before, during and after repair and maintenance work on fuel systems addressed in the IGF Code .2 electrical safety (reference to IEC 600079-17) .3 ship/shore safety checklist 8.3 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships having ammonia as fuel, including: .1 precautions to be taken before and during repair and maintenance work .1 bis material compatibilities with ammonia systems .2 electrical safety .3 ship/shore safety checklist .3 bis safety measures for hot and cold work ~~.3 ter precautions to be taken before entering enclosed spaces, hazardous zones and areas, including spaces contiguous with hazardous zones, {toxic spaces and toxic areas}~~ .3 qua emergency muster stations/safe havens [.4 understanding of measures for decontaminating personal protective equipment, tools, or equipment after exposure to substances] 8.3 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)

Competence	Existing IGF Code training	Ammonia
9 Knowledge of the prevention, control and fire-fighting and extinguishing systems on board ships ~~subject to the IGF Code~~	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	9.1 Fire organization and action to be taken on ships using ammonia as fuel 9.2 Special hazards associated with fuel systems and fuel handling on ships using ammonia as fuel 9.3 Fire-fighting system operations 9.4 Reporting and notifying relevant authorities and involved parties

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ANNEX 3

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING HYDROGEN AS PRIMARY FUEL IN FUEL CELL POWER INSTALLATIONS*

[*Adapted from title of MSC.1 Circ.1647 on the basis of TOR 1.3 "hydrogen fuel cell powered ships"]

1 INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using hydrogen as primary fuel in fuel cell power installations to support the reduction of greenhouse gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using hydrogen as primary fuel in fuel cell power installations.

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers on ships using hydrogen as primary fuel in fuel cell power installations the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers serving on ships using hydrogen as primary fuel in fuel cell power installations.

General provisions for training and familiarization

1.5 All seafarers serving on ships using hydrogen as primary fuel in fuel cell power installations should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures and ship characteristics that are relevant to their routine or emergency duties, as specified in STCW Regulation I/14.5.

1.6 In accordance with STCW.7/Circ.23 the master, officer, ratings and other personnel on ships using hydrogen as primary fuel in fuel cell power installations should be trained and qualified in accordance with regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code, taking into account the specific hazards of hydrogen used as primary fuel in fuel

* The draft text was prepared by Canada*, United Kingdom and EC. Party marked with (*) is the focal point.

cell power installations. [*MSC.1/Circ.1647 does not contain a reference to training or to levels of training.]

1.7 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

1.8 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and fuel systems on ships using hydrogen as primary fuel in fuel cell power installations should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of fuel and fuel systems on ships using hydrogen as primary fuel in fuel cell power installations should be delivered in accordance with the KUPs specified in Tables 1 and 2 of these guidelines and should meet the standard of competence specified therein.

2 TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on ships using hydrogen as primary fuel in fuel cell power installations, all seafarers should receive appropriate training in accordance with this section.

2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full provisions of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the provisions, bearing in mind the safety of people on ships using hydrogen as primary fuel in fuel cell power installations, the ship and property and the protection of the marine environment.

2.3 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and/or system on ships using hydrogen as primary fuel in fuel cell power installations should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and fuel systems on ships using hydrogen fuel cells should receive advanced training in accordance with paragraphs 3.1 and 3.3 and should meet the standard of competence specified therein.

2.5 Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of liquid and gaseous hydrogen fuels and fuel systems, and the safety procedures involved.

2.6 Basic and advanced training should be given by Instructors and Assessors who have demonstrable industry experience in order to be able to deliver this course, at the discretion of the relevant administrations.

3 STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the use of the fuels and fuel systems on ships using hydrogen as primary fuel in fuel cell power installations should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on the use of the fuels and fuel systems so as to:

.1 contribute to the safe operation of ships using hydrogen as primary fuel in fuel cell power installations; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.2 take precautions to prevent and to control hazards on ships using hydrogen as primary fuel in a fuel cell power installation; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.3 apply occupational health and safety precautions and measures; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies. First aid training should be covered on the elementary &/or medical first aid courses (STCW VI/1 & VI/4) and that their content should include first aid in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face.]

.4 have competence in prevention, detection, and extinguishing of fire on ships ships using hydrogen as primary fuel in a fuel cell power

installation; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies. Practical fire fighting training should be covered in the Fire Prevention & Fire Fighting course (STCW VI/1) and that their content should include practical aspects of fire fighting in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face. Specific fire fighting aspects regarding the individual fuels can be covered in theory on the specific IGF courses (i.e. TOR 1.3, TOR 1.5 etc).]

.5 respond to emergencies; and [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.6 take precautions to prevent pollution of the environment from the release of toxic materials from ships using hydrogen as primary fuel in fuel cell power installations; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Documentary evidence should be issued by the Administration indicating that the holder has completed the basic training.

Standard of competence for advanced training

3.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuels and fuel systems on ships using hydrogen as primary fuel in fuel cell power installations should, before being assigned to shipboard duties:

.1 receive advanced training as determined by the Administration on the use of the fuels and fuel systems so as to:

.1 have familiarity with physical and chemical properties of fuels on ships using hydrogen as primary fuel in fuel cell power installations; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.2 have competence in the management of automation, monitoring, alarm and safety systems in fuel cell power installations; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.3 safely perform and monitor all operations related to the fuels aboard ships using hydrogen as primary fuel in fuel cell power installations; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

~~.4 plan and monitor safe bunkering, stowage and securing of the fuels on board ships;~~ [*Significant overlap with TOR 1.5]

~~.5 Take precautions to prevent pollution of the environment from the release of fuel and toxic materials from ships using hydrogen as primary fuel in fuel cell power installations;~~ [*Significant overlap with TOR 1.5]

.6 monitor and control compliance with legislative requirements; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.7 take precautions to prevent hazards; [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.8 apply occupational health and safety precautions and measures on ships using hydrogen as primary fuel in fuel cell power installations; and [*Significant overlap with TOR 1.5. Emphasis is given to unfamiliar fuel cell technologies.]

.9 manage fire-fighting operations on ships using hydrogen as primary fuel in fuel cell power installations;

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration; and

.3 be issued with documentary evidence by the Administration indicating that the holder has completed the advanced training.

4 EMERGENCY EXERCISES

4.1 Emergency exercises related to the fuels and fuel systems on ships using hydrogen as primary fuel in fuel cell power installations should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

[*The focus group has agreed that:

a) The scope of TOR 1.3 be limited to ships using hydrogen as primary fuel in fuel cell power installations, and

b) Since significant overlap exists with TOR 1.5., the scope has been further limited.

1. The upstream limit of TOR 1.3 excludes fuel bunkering, storage, and handling systems upstream of the fuel supply connection to the fuel cell power system. For clarity, a device for converting hydrocarbons into a gas for fuel cell use, if fitted, is excluded.

2. The downstream limits of TOR 1.3 exclude electrical power distribution systems and consumers downstream of the electrical power outlet connection to the vessel power distribution system.

c) First aid training should be covered on the elementary &/or medical first aid courses (STCW VI/1 & VI/4) and that their content should include first aid in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face.

d) Similarly, practical fire fighting training should be covered in the Fire Prevention & Fire Fighting course (STCW VI/1) and that their content should include practical aspects of fire fighting in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face. Specific fire fighting aspects regarding the individual fuels can be covered in theory on the specific IGF courses (i.e. TOR 1.3, TOR 1.5 etc).

The focus group acknowledges with gratitude the participation of the European Maritime Safety Agency in the group's work.
The focus group acknowledges that significant portions of the proposed tables are quoted directly or with modifications from the EMSA report *Study on the identification of specific competences for seafarers on ships using alternative fuels and energy systems*, EMSA, Lisbon. A copyright notice must be included in line with the EMSA permission granted to use their material.

Table 1

Specification of minimum standard of competence in basic training for seafarers on ships using Hydrogen as Primary Fuel in Fuel Cell Power Installations

(mapped against table A-V/3-1 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code are shown in **bold and grey highlight.** Deletions from column 1 are additionally shown in ~~**strike out.**~~ **)**

Competence	**Knowledge, Understanding, and Proficiency**		**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Existing IGF Code training	**Ships using hydrogen as primary fuel in fuel cell power installations**		
1 Contribute to the safe operation of ~~a ship subject to the IGF Code~~ ships using hydrogen as primary fuel in fuel cell power installations	1.1 Design and operational characteristics of ships subject to the IGF Code	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **1.1 Knowledge of the design and operational characteristics of ships equipped with marine fuel cell power installations using hydrogen as primary fuel.** **.1 basic knowledge of the general arrangement of marine fuel cell power installations on board ships using hydrogen as primary fuel.** **.2 knowledge of commonly used terms and definitions used to describe fuel cell power installations in marine use, especially those found in the guidelines MSC.1/CIRC. 1647 and classification society rules** **.3 knowledge of the arrangement of devices, piping, and equipment at the levels of**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Communications within the area of responsibility are clear and effective. Operations related to ships using hydrogen as fuel in fuel power installations are carried out in accordance with accepted principles and procedures to ensure safety of operations

		o fuel cell power installations, **o fuel cell power systems,** **o fuel cell spaces,** **o fuel cell modules, and** **o fuel cell stacks** **.4 knowledge of the classification and location of hazardous spaces for the protection of fuel cells, fuel cell enclosures, fuel cell spaces and machinery spaces containing a fuel cell space**		
	1.2 Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: .1 fuels addressed by the IGF Code .2 types of fuel systems subject to the IGF Code .3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code .4 general arrangement of fuel storage systems on board ships subject to the IGF Code .5 hazard zones and areas .6 typical fire safety plan	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **1.2 Proficiency in the basic functioning of fuel cells** **.1 understanding of the basic functioning and differences between fuel cell types, including, but not limited to:** **oSolid Oxide Fuel Cell (SOFC)** **oProton Exchange Membrane Fuel Cell (PEMFC)** **oHigh-Temperature Proton Exchange Membrane Fuel Cell (HT-PEMFC)** **1.3 Proficiency in preventing fuel contamination for fuel cells** **.1 knowledge of the fuel standards for fuel cells** **.2 understanding of how to avoid fuel contamination** **.3 the effects of fuel contamination** **.4 the vulnerability of fuel contamination regarding different fuel cell types** **.5 the possibility for fuel contamination when welding/working on fuel lines, which introduces the possibility of contaminants entering the fuel lines** **.6 the fuel monitoring system and when a system shutdown is triggered**		
2 Take precautions to prevent and to control hazards ~~a ship subject to the IGF Code~~ on ships using hydrogen as primary fuel in fuel cell power installations	2.1 Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition	**[Significant overlap with TOR 1.5]**		

	.7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel batch differences			
	2.2 Basic knowledge of hazard controls: .1 emptying, inerting, drying and monitoring techniques .2 anti-static measures .3 ventilation .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing .9 protection against cryogenic damages (LNG) 2.3 Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **.1 knowledge and understanding of the physical and chemical properties of hydrogen, especially as they relate to risks and hazards of fire and explosion** **.2 understanding of the inherent explosion/fire risk of fuel cells, especially if an internal fuel leak within the FUEL CELLS occurs** **.3 the safety features required of fuel cells as per guidelines MSC.1/CIRC. 1647** **.4 the handling of high temperatures associated with a SOFC** **.5 knowledge of the safety concepts for the protection of fuel cells, fuel cell enclosure, fuel cell spaces and machinery spaces containing a fuel cell space** **.6 knowledge of** o **the specific safety concepts, hazard controls, and safety barriers for various fuel cell types** o **of the role of the explosion-resistant container within the fuel cell** o **of the role of ventilation, inerting, purging, gas freeing and re-inerting as a safety control** o **the barriers in the fuel cell space fuel cell stacks, fuel cell modules, and fuel cells** o **the importance of retaining a double-barrier** **.7 knowledge of** o **purge gases - various types of gases & individual characteristics & differing complications** o **operation of nitrogen generators** o **purge gas composition**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Hazards are promptly identified, and appropriate actions are taken in accordance with established procedures. Hazards to the ship and to personnel are correctly identified from the Safety Data Sheet (SDS), and appropriate actions are taken in accordance with established procedures.
3 Apply occupational health and safety precautions and measures	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas testing 3.2 Proper use of specialized safety equipment and protective devices, including:	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **3.1 knowledge and understanding of the risk and hazards of toxic, explosive, and oxygen deficient atmospheres and spaces in a fuel cell power system.**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Safe working practices and procedures are followed at all times to safeguard personnel and the ship. Safety and protective equipment is correctly used in accordance with established procedures.

	.1 breathing apparatus .2 protective clothing .3 resuscitators .4 rescue and escape equipment 3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including: .1 precautions to be taken before entering hazardous spaces and zones .2 precautions to be taken before and during repair and maintenance work .3 safety measures for hot and cold work 3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	**[First aid training should be covered in the elementary &/or medical first aid courses (STCW VI/1 & VI/4) and that their content should include first aid in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face.]**		
~~**4 Carry out fire-fighting operations on a ship subject to the IGF Code**~~ **4 Competence in prevention, detection, and extinguishing of fire on board ships using hydrogen as primary fuel in fuel cell power installations**	4.1 Fire organization and action to be taken on ships subject to the IGF Code 4.2 Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code 4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code 4.4 Fire-fighting system operations	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **4.1 knowledge and understanding of the systems and equipment for fire prevention, fire detection, firefighting and extinguishing on board ships using hydrogen as primary fuel in a fuel cell power installation** **.1 fire extinguishing media and systems in the fuel cell power system, fuel cell space, and fuel cell modules** **.2 extinguishing fires in fuel cells by terminating fuel supply** **.3 procedures and precautions when fighting fire in the fuel cell power system, fuel cell space, and fuel cell modules** **.4 fire detection and extinguishing arrangement and equipment for different fuel cell types, including but not limited to, SOFC, PEMFC and HT-PEMFC fuel cell power installations** **[Practical fire fighting training should be covered in the Fire Prevention & Fire Fighting course (STCW VI/1) and that their content should include practical aspects of fire fighting in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face. Specific fire fighting aspects regarding the individual fuels can be covered in theory on the specific IGF courses (i.e. TOR 1.3, TOR 1.5 etc).]**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Initial and follow-up actions are appropriate to the emergency and carried out in accordance with established procedures. Actions taken on identifying muster signals are appropriate to the nature of the emergency and comply with established procedures. Protective clothing and equipment are correctly selected and used for the type of firefighting operation. The timing and sequence of actions are appropriate to the circumstances and reflect accepted firefighting practices. The fire is extinguished using correct procedures, techniques and suitable firefighting agents.

5 Respond to emergencies	5.1 Basic knowledge of emergency procedures, including emergency shutdown	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **5.1 Proficiency in emergency procedures, including emergency shutdown** **.1 knowledge of the fuel cell manufacturer's procedures for manual or automatic emergency shutdown systems** **.2 knowledge of the alarm conditions and safety actions of MSC.1/CIRC. 1647 section 5** **.3 Understanding of the fuel cell manufacturer's safety strategy**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	The type and impact of the emergency are promptly identified, and response actions are carried out in accordance with emergency procedures and contingency plans.
6 Take precautions to prevent pollution of the environment from the release of ~~**fuels found on ships subject to the IGF Code**~~ 6 Take precautions to prevent pollution of the environment from the release of toxic materials from ships using hydrogen as primary fuel in fuel cell power installations;	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **6.1 Knowledge and understanding of the potential for the release of toxic materials, smoke, or gases in the event of leakage, fire, and explosion.**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Procedures designed to safeguard the environment are observed at all times

[*The focus group has agreed that:

e) The scope of TOR 1.3 be limited to ships using hydrogen as primary fuel in fuel cell power installations, and

f) Since significant overlap exists with TOR 1.5., the scope has been further limited.

3. The upstream limit of TOR 1.3 excludes fuel bunkering, storage, and handling systems upstream of the fuel supply connection to the fuel cell power system. For clarity, a device for converting hydrocarbons into a gas for fuel cell use, if fitted, is excluded.

4. The downstream limits of TOR 1.3 exclude electrical power distribution systems and consumers downstream of the electrical power outlet connection to the vessel power distribution system.

g) First aid training should be covered on the elementary &/or medical first aid courses (STCW VI/1 & VI/4) and that their content should include first aid in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face.

h) Similarly, practical fire fighting training should be covered in the Fire Prevention & Fire Fighting course (STCW VI/1) and that their content should include practical aspects of fire fighting in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face. Specific fire fighting aspects regarding the individual fuels can be covered in theory on the specific IGF courses (i.e. TOR 1.3, TOR 1.5 etc).

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Table 2

Specification of minimum standard of competence in advanced training for seafarers on ships using Hydrogen as Primary Fuel in Fuel Cell Power Installations

(mapped against table A-V/3-2 of the STCW Code for reference)

(Note: Competences assessed to be different from the existing IGF Code are shown in **bold and grey highlight.** Deletions from column 1 are additionally shown in ~~**strike out.**~~ **)**

Competence	**Knowledge, Understanding, and Proficiency**		**Methods for demonstrating competence**	**Criteria for evaluating competence**
	Existing IGF Code training	**Ships using hydrogen as primary fuel in fuel cell power installations**		
1 Familiarity with physical and chemical properties of fuels ~~**aboard ships subject to the IGF Code**~~ **1. Familiarity with physical and chemical properties of fuels on ships using hydrogen as primary fuel in fuel cell power installations.**	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code .2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **Understanding of the physical and chemical properties and characteristics of hydrogen with respect to its use as fuel in fuel cell power installations**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Effective use is made of information resources for identification of properties and characteristics of hydrogen as a fuel in fuel cell power installations and their impact on safety, environmental protection and ship operation.

	.4 boil-off and weathering of cryogenic fuels .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 flashpoint, upper and lower flammable limits, auto-ignition temperature .8 saturated vapour pressure/ reference temperature .9 dewpoint and bubble point .10 hydrate formation .11 combustion properties: heating values .12 methane number/ knocking .13 pollutant characteristics of fuels addressed by the IGF Code .3 the properties of single liquids .4 the nature and properties of solutions .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials			
~~**2 Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on ships subject to the IGF Code**~~ **2 Competence in the management of automation, monitoring, alarm and safety systems in fuel cell power installations**		**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **2.1 Knowledge and understanding of the automation system design, operation and functioning** **2.2 Knowledge and understanding of the safety system strategy of Emergency Shut Down systems (ESD)** o **Safety functions performed by software** o **Safety functions performed by hardware**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Plant, auxiliary machinery and equipment is operated in accordance with technical specifications and within safe operating limits at all times.

		o **System initiated slow shutdown** o **System initiated hard shutdown**		
		2.3 Proficiency in the operation and functioning of fuel cells at the management level **.1 Knowledge and understanding of the electro-chemical processes used in different fuel cell types, including, but not limited to:** o **Solid Oxide Fuel Cell (SOFC)** o **Proton Exchange Membrane Fuel Cell (PEMFC)** o **High-Temperature Proton Exchange Membrane Fuel Cell (HT-PEMFC)** **.2 knowledge of the properties of hydrogen and quality standards for hydrogen for use as primary fuel in fuel cells.** **.3 Knowledge and understanding of the functioning of a fuel cell, the flow paths of fuel, process air, exhaust gas, exhaust air, coolant.** **.4 Knowledge of the arrangement of devices such as pumps, valves, and coolers within fuel cell stacks and fuel cell modules** **.5 Knowledge and understanding of the purpose and functioning of exhaust gas and exhaust air recirculation.** **.6 Knowledge of the need for fuel and process air conditioning, such as purity, content, and humidity** **.7 Knowledge and understanding of the purpose and need for deionized cooling water, and for cooling water additives such as glycol.**		
3 Ability to safely perform and monitor all operations related to the fuels used on board ships ~~**subject to the IGF Code**~~ **3 Ability to safely perform and monitor all operations related to the fuels on board ships using hydrogen as primary fuel in fuel cell power installations.**	3.1 Design and characteristics of ships subject to the IGF Code 3.2 Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **3.1 Proficiency in the operational limitations inherent to fuel cells** **.1 Understanding of** o **the operational limitations inherent to the different fuel cells**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Plant, auxiliary machinery and equipment are operated in accordance with technical specifications and within established safety limits at all times. Ship operations using hydrogen as fuel in fuel cell power installations are carried out safely, taking into account ship design, systems and equipment. Operations are planned and conducted in accordance with established procedures, with risks effectively

	.3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices .4 flame screens	o **the startup/shutdown time delays for fuel cells, especially an SOFC** o **the consequences of certain actions on the fuel cell service life (e.g. emergency shutdown)** o **the role of battery systems in conjunction with fuel cells** o **the load responsiveness and limits of fuel cells.**		identified, assessed, and managed to ensure safety and prevent pollution of the marine environment.
	.5 temperature monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and pressure maintenance	**3.2 Proficiency in the control and monitoring of the fuel cell** **.1 Knowledge of the type of fuel cell failures that trigger a shutdown of the fuel cell/fuel system** **.2 Understanding of the readings and alarms from the fuel cell and the importance of detecting internal fuel cell failures** **.3 Proficiency in the troubleshooting of the fuel cell**		
	.6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD)	**3.3 Proficiency in safeguarding the operational lifespan of the fuel cell** **.1 Understanding of the different actions to a fuel cell that can reduce its operational lifespan:** o **Improper temperature handling** o **Contaminated fuel, especially sulpher contamination** o **Load instability**		
		3.4 Proficiency in potential maintenance and inspection procedures on fuel cell **.1 Understanding of the limitations set by the manufacturer on conducting work on fuel cells** **.2 Proficiency in** o **the replacement of fuel filters for the fuel cell** ~~o~~ **the authorised maintenance and inspection procedures**		

		3.5 Proficiency in handling of contingencies related to fuel cell-related emergencies **.1 Knowledge of the appropriate emergency procedures when an ESD is triggered** **.2 Understanding of potential hazardous scenarios related to fuel cells** **.3 the risks specific to a SOFC to cracking fuel to hydrogen within the fuel cell** **.4 when crew action is needed** **.5 the consequences to an SOFC when it is cut off from fuel** **.6 proficiency in procedures for limiting fuel leakage inside and outside the fuel cell**		
~~4. Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code~~	4.1 General knowledge of ships subject to the IGF Code 4.2 Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code 4.3 Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code 4.5 Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: .1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface .4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ)	**[Significant overlap with TOR 1.5]**		

	.3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea			
~~**5 Take precautions to prevent pollution of the environment from the release of fuel and toxic materials from ships using hydrogen as primary fuel in fuel cell power installations;**~~		**[Significant overlap with TOR 1.5]**		
6 Monitor and control compliance with legislative requirements	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **6.1 knowledge of applicable flag state and classification society rules and guidelines for ships using hydrogen as primary fuel in fuel cell power installations.** **6.3 understanding of the impact alternative construction approval regimes have on system design and construction of ships using hydrogen as primary fuel in fuel cell power installations.** **6.4 understanding of applicable safe working legislation and industrial best practices**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	The handling of hydrogen as a fuel in fuel cell power installations complies with relevant IMO instruments and established industrial standards and codes of safe working practices.
7 Take precautions to prevent hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: .1 flammability .2 explosion .3 toxicity .4 reactivity	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **7.1 Proficiency in risk awareness inherent in the high temperatures of a SOFC** **.1 Understanding of** o **the importance of sufficient external cooling of a SOFC** o **the fact that an SOFC can be a burn hazard** o **the fact that an SOFC can be an ignition source** o **the effects of potential high temperature exhaust**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Hazards associated with the use of hydrogen as fuel in fuel cell power installations are correctly identified, and appropriate control measures are implemented in accordance with established procedures. Flammable gas detection equipment is correctly used in accordance with manufacturer's instructions, operational manuals, and recognised safety practices.

		.2 Proficiency in limiting the spread of high temperatures from the SOFC upon cooling system failure		
	.5 corrosivity .6 health hazards .7 inert gas composition .8 electrostatic hazards	**7.2 Understanding of hazards due to High voltage and high current draw from large fuel cell stacks** **7.3 Toxic materials used in fuel cells such as ethylene glycol, off-gassing from fuel cell components and toxic emissions from fires.**		
	.9 pressurized gases .10 low temperature	**7.4 Understanding of the safety features required of fuel cells as per guidelines MSC.1 Circ. 1647** **7.5 the inherent explosion/fire risk of fuel cells, especially if an internal fuel leak within the fuel cell occurs, and the risk of explosion or fire in the fuel cell module and cathode fuel cell exhaust.** **7.6 the handling of high temperatures associated with a SOFC**		
		7.6 Proficiency in the proper operation and procedures for onboard safety systems **.1 Understanding of the safety principles for fuel cells:** o **Segregation** o **Prevention of fire hazard by segregation of cathode flow and anode flows** o **Double barrier** o **Ventilation/inert condition** o **Leakage detection** o **ESD** o **the layout of the system regarding redundancy**		
8 Apply occupational health and safety precautions and measures on ~~**board a ship subject to the IGF Code**~~ **8 Apply occupational health and safety precautions and measures on ships using hydrogen as**		**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **8.1 Knowledge and understanding of the hazards to health and safety posed by using hydrogen in marine fuel cell power installations, with particular regard to:** o **fuel cell power systems,**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	Safety and protective equipment is correctly used in accordance with established procedures. Procedures designed to safeguard personnel and the ship are observed at all times Working practices comply with legislative requirements, codes of

primary fuel in fuel cell power installations		o **fuel cell spaces,** o **fuel cell modules, and** o **fuel cell stacks**		practice, permits to work, and environmental standards
~~**9 Knowledge of the prevention, control and fire-fighting and extinguishing systems on board ships subject to the IGF Code**~~ **9 Manage fire-fighting operations on ships using hydrogen as primary fuel in fuel cell power installations**	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	**[Significant overlap with TOR 1.5]** **[Emphasis is given to the unfamiliar fuel cell technology.]** **[Practical fire-fighting training should be covered in the Fire Prevention & Fire Fighting course (STCW VI/1) and that their content should include practical aspects of fire fighting in relation to low flash point fuels to equip seafarers ready for the changes the industry is about to face. Specific fire-fighting aspects regarding the individual fuels can be covered in theory on the specific IGF courses (i.e. TOR 1.3, TOR 1.5 etc).]** **9.1 Knowledge and understanding of** **.1 the flammable and explosive characteristics of hydrogen such as LEL, UEL, flammability limits, autoignition temperature, ignition energy, explosive energy, flame temperature, flame spread characteristics, thermal radiation, flame velocity, relative density in air, dispersion in air.** **.2 fire extinguishing media and systems in the fuel cell power system, fuel cell space, and fuel cell modules** **.3 Prevention of fire hazard by segregation of cathode flow and anode flows** **.4 fire detection and extinguishing arrangement and equipment for SOFC, PEMFC and HT-PEMFC fuel cell power installations** **.5 detection systems equipment and arrangement for hydrogen gas leakage, and for flammable and explosive atmospheres**	Evaluation and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved training ship experience .3 approved simulator training .4 approved training programme	The type and scale of the emergency are promptly identified, and initial actions are carried out in accordance with established emergency procedures for hydrogen fuel systems. Evacuation, emergency shutdown, and isolation procedures are appropriate to the situation and carried out in accordance with established procedures for the use of hydrogen as a fuel in fuel cell power installations.

***

ANNEX 4

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING LPG AS FUEL*

1 INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using liquified petroleum gas (LPG) as fuel to support the reduction of greenhouse gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using LPG as fuel.

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers working on ships using LPG, the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers serving on ships using LPG as fuel.

General provisions for training and familiarization

1.5 All seafarers serving on board ships using LPG as fuel should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures and ship characteristics that are relevant to their routine or emergency duties, as specified in regulation I/14.5 of the STCW Convention.

1.6 In accordance with MSC.1/Circ.1666 on *Interim guidelines for the safety of ships using liquified petroleum gas (LPG) fuels*, paragraph 16, unless expressly provided otherwise, the IGF Code parts B-1, C-1 and D apply to ships using LPG as fuel, which means that the master, officer, ratings and other personnel on ships using LPG as fuel should be trained and qualified in accordance with regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code, taking into account the specific hazards of LPG used as fuel.

1.7 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

1.8 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and systems on board ships using LPG as fuel should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

* The draft text was prepared by Malaysia.

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of fuel and systems on board ships using LPG as fuel should be delivered in accordance with the KUPs specified in [tables 1 and 2] of this guideline and should meet the standard competence specified therein.

2 TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on board a ship using LPG as fuel, all seafarers should receive appropriate training in accordance with this section.

2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.

2.3 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and/or system on board ships using LPG as fuel should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of fuels and/or systems on ships using LPG as fuel should receive advanced training in accordance with paragraph 3.3 and 3.4 should meet the standard of competence specified therein.

2.5 Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of the fuels and/or systems used and the safety procedures involved.

2.6 It is important to emphasize the need to take account of risk analyses. All risk analyses carried out should be made available to participants during training.

3 STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the use of the fuels and/or systems on board ships using LPG as fuel should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on the use of LPG and related fuel systems so as to:

.1 contribute to the safe operation of a ship;

.2 take precautions to prevent hazards on a ship;

.3 apply occupational health and safety precautions and measures;

.4 carry out firefighting operations on a ship;

.5 respond to emergencies; and

.6 take precautions to prevent pollution of the environment from ships; and

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Documentary evidence should be issued by the Administration indicating that the holder has completed the basic training.

Standard of competence for advanced training

3.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuels and/or systems on board ships using LPG as fuel should, before being assigned to shipboard duties:

.1 receive advanced training as determined by the Administration on the use of LPG and related fuel systems so as to:

.1 be familiar with physical and chemical properties of the fuels and/or characteristics of the systems aboard ships;

.2 operate controls of the fuels and/or systems related to propulsion plant and engineering systems and services and safety devices on ships;

.3 be able to safely perform and monitor all operations related to the fuels and/or systems used on board ships;

.4 plan and monitor safe bunkering, stowage and securing of the fuels on board ships;

.5 take precautions to prevent pollution of the environment from ships;

.6 monitor and control compliance with legislative requirements;

.7 take precautions to prevent hazards;

.8 apply occupational health and safety precautions and measures on board ships; and

.9 have knowledge of the prevention, control and firefighting and extinguishing systems on board ships;

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration; and

.3 be issued with documentary evidence by the Administration indicating that the holder has completed the advanced training.

3.4 Documentary evidence should be issued by the Administration indicating that the holder has completed the advanced training.

4 EMERGENCY EXERCISES

4.1 Emergency exercises related to the fuels and/or systems on board ships using LPG as fuel should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

Table 1

*Specification of minimum standard of competence in basic training for seafarers on board ships using **liquified petroleum gas (LPG)** as fuel*

(mapped against table A-V/3-1 of the STCW Code for reference)

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
1 Contribute to the safe operation of a ship subject to the IGF Code	1.1 Design and operational characteristics of ships subject to the IGF Code 1.2 Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems: .1 fuels addressed by the IGF Code .2 types of fuel systems subject to the IGF Code .3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code .4 general arrangement of fuel storage systems on board ships subject to the IGF Code .5 hazard zones and areas .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships subject to the IGF Code	1.1 Design and operational characteristics of ships having **LPG as fuel** under different storage conditions 1.2 Basic knowledge of **LPG** fuel systems and fuel storage systems: **.1 LPG as fuel onboard ships** **.2 LPG fuel systems** .3 refrigerated and/or compressed LPG fuel storage systems .4 general arrangement of fuel storage systems on board ships having **LPG as fuel** .5 hazardous zones and areas .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships **having LPG as fuel**. 1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships **having LPG as fuel**.

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: .1 piping systems and valves .2 atmospheric, compressed or cryogenic storage .3 relief systems and protection screens .4 basic bunkering operations and bunkering systems .5 protection against cryogenic accidents .6 fuel leak monitoring and detection 1.4 Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including: .1 properties and characteristics .2 pressure and temperature, including vapour pressure/ temperature relationship 1.5 Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.	.1 piping systems and valves .2 refrigerated and/or compressed storage (including boil off gas handling systems for gas fuel) .3 relief systems and protection screens .4 basic bunkering operations and bunkering systems .5 protection against fire, cold and toxic/asphyxiation accidents .6 fuel leak monitoring and detection **.7 spill containment systems** **.8 emergency release arrangements** **.9 safety zones associated with the bunkering process** 1.4 Basic knowledge of the **chemical and** physical properties of **LPG as fuel** on board ships .1 properties and characteristics of **LPG** .2 pressure and temperature, including vapor pressure/ temperature relationship 1.5 Knowledge and understanding of safety requirements and safety management on board ships **having LPG as fuel**

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
2 Take precautions to prevent hazards on a ship subject to the IGF Code	2.1 Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel batch differences 2.2 Basic knowledge of hazard controls: .1 emptying, inerting, drying and monitoring techniques	2.1 Basic knowledge of the hazards associated with operations on ships **having LPG as fuel**. .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 toxicity hazards .9 vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel batch differences 2.2 Basic knowledge of hazard controls: .1 emptying, inerting, drying and monitoring techniques

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
	.2 anti-static measures .3 ventilation .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing .9 protection against cryogenic damages (LNG) 2.3 Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)	.2 anti-static measures .3 ventilation protocols .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing .9 protection against refrigeration damages 2.3 Understanding of fuel characteristics on ships having LPG as fuel as found on a Safety Data Sheet (SDS)
3 Apply occupational health and safety precautions and measures	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas testing 3.2 Proper use of specialized safety equipment and protective devices, including: .1 breathing apparatus .2 protective clothing	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas detection and testing (flammable and toxic levels of LPG) 3.2 Proper use of specialized safety equipment and protective devices, including: .1 breathing apparatus .2 protective clothing

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
	.3 resuscitators .4 rescue and escape equipment 3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including: .1 precautions to be taken before entering hazardous spaces and zones .2 precautions to be taken before and during repair and maintenance work .3 safety measures for hot and cold work 3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	.3 resuscitators .4 rescue and escape equipment 3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships **having LPG as fuel**. .1 precautions to be taken before entering hazardous spaces and zones .2 precautions to be taken before and during repair and maintenance work .3 safety measures for hot and cold work 3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS) **and IMDG Code Supplement (MFAG)**
4 Carry out fire-fighting operations on a ship subject to the IGF Code	4.1 Fire organization and action to be taken on ships subject to the IGF Code 4.2 Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code 4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code	4.1 Fire organization and action to be taken on ships **having LPG as fuel** 4.2 Special hazards associated with fuel systems and fuel handling on ships **having LPG as fuel** 4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with **LPG as fuel** 4.4 Fire-fighting system operations

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
	4.4 Fire-fighting system operations	**.1 portable fire-fighting equipment** **.2 fixed dry chemical system operations** **.3 portable extinguishers and fixed dry chemical system operations** **.4 Basic knowledge of spill containment in relation to firefighting operations**
5 Respond to emergencies	5.1 Basic knowledge of emergency procedures, including emergency shutdown	5.1 Basic knowledge of emergency procedures and preparedness, including emergency shutdown **.1 emergency organization** **.2 alarms** **.3 emergency procedures** **.4 emergency shutdown** **.5 collision** **.6 personnel injury** **5.2 Basic knowledge of communication methods and elaboration of process for notifying relevant authorities and involved parties**
6 Take precautions to		

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**LPG**
prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/venting of fuels from ships **having LPG as fue**l .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/leakage of **LPG** **.4 awareness of the Shipboard Marine Pollution Emergency Plan (SMPEP)**

Table 2

Specification of minimum standard of competence in advanced training for seafarers on board ships using Liquified Petroleum Gas (LPG) as fuel

(mapped against table A-V/3-2 of the STCW Code for reference)

Competence	Existing IGF Code training	LPG
1 Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code .2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 boil-off and weathering of cryogenic fuels .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 flashpoint, upper and lower flammable limits, auto-ignition temperature	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of **LPG as fuel**: .1 the chemical structure of **LPG** .2 the properties and characteristics of **LPG** including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 boil-off and weathering of **refrigerated** fuels .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 flashpoint, upper and lower flammable limits, auto-ignition temperature .8 saturated vapour pressure/ reference temperature

Competence	Existing IGF Code training	LPG
	.8 saturated vapour pressure/ reference temperature .9 dewpoint and bubble point .10 hydrate formation .11 combustion properties: heating values .12 methane number/ knocking .13 pollutant characteristics of fuels addressed by the IGF Code .3 the properties of single liquids .4 the nature and properties of solutions .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials .8 effect of low temperature, including brittle fracture, for liquid cryogenic fuels 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code	.9 dewpoint and bubble point .10 hydrate formation .11 combustion properties: heating values **.12 knocking** .13 pollutant characteristics **of LPG** .3 the properties of single liquids .4 the nature and properties of solutions .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of ship structural and fuel tank materials .8 effect of low temperature, including brittle fracture, for liquid refrigerated fuels 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about LPG
2 Operate controls of fuel related to	2.1 Operating principles of marine power plants	2.1 Operating principles of marine power plants

Competence	Existing IGF Code training	LPG
propulsion plant and engineering systems and services and safety devices on ships subject to the IGF Code	2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms	2.2 Ships' auxiliary machinery .1 inert gas generator .2 nitrogen generation and distribution .3 air and inert gas dryers .4 gas heaters .5 vaporizers .6 water curtain .7 control air 2.3 Knowledge of marine engineering terms
3 Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code	3.1 Design and characteristics of ships subject to the IGF Code 3.2 Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation	3.1 Design and characteristics of ships **having LPG as fuel** 3.2 Knowledge of ship design, systems, and equipment found on ships **having LPG as fuel**, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 LPG fuel storage systems on board ships, including materials of construction and insulation

Competence	Existing IGF Code training	LPG
	.4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices .4 flame screens .5 temperature monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD) 3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code .1 low pressure pumps	.4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices .4 temperature monitoring systems .5 fuel tank level-gauging systems .6 tank pressure monitoring and control systems .5 refrigerated fuel tanks temperature and pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 toxic and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD) 3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships **having LPG as fuel** .1 low pressure pumps .2 high pressure pumps

Competence	Existing IGF Code training	LPG
	.2 high pressure pumps .3 vapourizers .4 heaters .5 pressure build-up units 3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including: .1 inerting .2 cooling down .3 initial loading .4 pressure control .5 heating of fuel .6 emptying systems	.3 vapourizers .4 heaters .5 pressure build-up units 3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service .1 inerting .2 cooling down .3 initial loading .4 pressure control .5 heating of fuel .6 emptying systems
4 Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code	4.1 General knowledge of ships subject to the IGF Code 4.2 Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code 4.3 Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker-supply ship	4.1 General knowledge of ships having **LPG as fuel** 4.2 Ability to use all data available on board related to bunkering, storage and securing of **LPG as fuel** 4.3 Ability to establish clear and concise communications between the ship and the terminal, truck or the bunker-supply ship

Competence	Existing IGF Code training	LPG
	4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code 4.5 Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: .1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface .4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations	4.4 Knowledge of safety and emergency procedures snf preparedness for operation of machinery, fuel and control systems for ships having **LPG as fuel** 4.5 Proficiency in the operation of bunkering systems on board ships having LPG as fuel .1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface .4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other **LPG** related operations concurrent with other onboard operations, both in port and at sea

Competence	Existing IGF Code training	LPG
	4.7 Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea	
5 Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/ venting	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/venting
6 Monitor and control compliance with legislative requirements	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2Proficiency in the use of the IGF Code and related documents	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents
7 Take precautions to prevent hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: .1 flammability .2 explosion .3 toxicity .4 reactivity .5 corrosivity	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships **having LPG as fuel** .1 flammability .2 explosion .3 toxicity .4 reactivity .5 corrosivity

Competence	Existing IGF Code training	LPG
	.6 health hazards .7 inert gas composition .8 electrostatic hazards .9 pressurized gases .10 low temperature 7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships subject to the IGF Code 7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code 7.5 Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code 7.6 Ability to elaborate and develop safety plans and safety instructions for ships subject to the IGF Code 7.7 Knowledge of hot work, enclosed spaces and tank entry including permitting procedures	.6 health hazards .7 inert gas composition .8 electrostatic hazards .9 pressurized gases .10 low temperature 7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships **having LPG as fuel** 7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations 7.4 Knowledge and understanding of risks assessment method analysis on board ships **having LPG as fuel** 7.5 Ability to elaborate and develop risks analysis related to risks on board ships **having LPG as fuel** 7.6 Ability to elaborate and develop safety plans and safety instructions for ships **having LPG as fuel** 7.7 Knowledge of hot work, enclosed spaces and tank entry including permitting procedures
8 Apply occupational health	8.1 Proper use of safety equipment and protective devices, including:	8.1 Proper use of safety equipment and protective devices

Competence	Existing IGF Code training	LPG
and safety precautions and measures on board a ship subject to the IGF Code	.1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and escape equipment 8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including: .1 precautions to be taken before, during and after repair and maintenance work on fuel systems addressed in the IGF Code .2 electrical safety (reference to IEC 600079-17) .3 ship/shore safety checklist 8.3 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code	.1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and escape equipment 8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety .1 precautions to be taken before, during and after repair and maintenance work on LPG fuel systems .2 electrical safety (reference to IEC 600079-**20**) .3 ship/shore safety checklist 8.3 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for LPG fuel
9 Knowledge of the prevention, control and fire-fighting and extinguishing systems on board ships subject to the IGF Code	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of LPG fuels

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ANNEX 5*

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING HYDROGEN AS FUEL

1. INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using hydrogen as fuel to support the reduction of greenhouse gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using hydrogen as fuel.

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers working on ships using hydrogen, the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers serving on ships using hydrogen as fuel.

General provisions for training and familiarization

1.5 All seafarers serving on board ships using hydrogen as fuel should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures, and ship characteristics that are relevant to their routine or emergency duties, as specified in Regulation I/14.5 of the STCW Convention.

1.6 The master, officers, ratings and other personnel on ships using hydrogen as fuel should have received training and be qualified in the use of the fuel in accordance with regulation V/3 of the STCW Convention and section A-V/3 of the STCW Code, taking into account the specific hazards of hydrogen.

1.7 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

* The draft text was prepared by Japan*, EC and UK. Party marked with (*) is the focal point.

1.8 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and systems on board ships using hydrogen as fuel should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuel and systems on board ships using hydrogen as fuel should be delivered in accordance with the KUPs specified in tables 1 and 2 of this guideline and should meet the standard competence specified therein.

1.9 Seafarers serving on ships who are qualified and certified in accordance with regulation V/3 of the STCW Convention are exempt from the training requirements for ships using hydrogen as fuel that overlap with the qualifications they already hold.

2. TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on board a ship using hydrogen as fuel, all seafarers should receive appropriate training in accordance with this section.

2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.

2.3 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the fuel and fuel systems on board ships using hydrogen as fuel should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuel and fuel systems on ships using hydrogen as fuel should

receive advanced training in accordance with paragraphs 3.3 and 3.4 and should meet the standard of competence specified therein, taking into account the knowledge, understanding and proficiency to meet the standard of competence specified in 3.1, as appropriate.

2.5 Basic and advanced training should be given by qualified personnel experienced in the handling and characteristics of the fuel and fuel systems used, and the safety procedures involved.

2.6 It is important to emphasize the need to take account of risk analyses. All risk analyses carried out should be made available to participants during training.

3. STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the use of the fuel and fuel systems on board ships using hydrogen as fuel should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on the use of hydrogen and related fuel systems so as to:

.1 contribute to the safe operation of a ship;

.2 take precautions to prevent hazards on a ship;

.3 apply occupational health and safety precautions and measures;

.4 carry out firefighting operations on a ship;

.5 respond to emergencies; and

.6 take precautions to prevent pollution of the environment from ships; and

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Documentary evidence should be issued by the Administration indicating that the holder has completed the basic training.

Standard of competence for advanced training

3.3 Masters, engineer officers and all personnel with immediate responsibility for the care and use of the fuel and fuel systems on board ships using hydrogen as fuel should, before being assigned to shipboard duties:

.1 receive advanced training as determined by the Administration on the use of hydrogen and related fuel systems so as to:

.1 be familiar with physical and chemical properties of the fuel and/or characteristics of the systems aboard ships;

.2 operate controls of the fuel and fuel systems related to propulsion plant and engineering systems and services and safety devices on ships;

.3 be able to safely perform and monitor all operations related to the fuel and fuel systems used on board ships.

.4 plan and monitor safe bunkering, stowage and securing of the fuel on board ships;

.5 take precautions to prevent pollution of the environment from ships.

.6 monitor and control compliance with legislative requirements;

.7 take precautions to prevent hazards;

.8 apply occupational health and safety precautions and measures on board ships; and

.9 have knowledge of the prevention, control and firefighting and extinguishing systems on board ships;

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration; and

3.4 Documentary evidence should be issued by the Administration indicating that the holder has completed the advanced training.

4. EMERGENCY EXERCISES

4.1 Emergency exercises related to the fuel and fuel systems on board ships using hydrogen as fuel should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

Table 1

Specification of minimum standard of competence in basic training for seafarers onboard ships using hydrogen as fuel (mapped against table A-V/3-1 of the STCW Code for reference)

*(Note: Competences assessed to be different from the existing IGF Code is shown in **bold / grey**)*

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
1 Contribute to the safe operation of a ship ~~**subject to the IGF Code**~~	1.1 Design and operational characteristics of ships subject to the IGF Code	1.1 Design and operational characteristics of ships **having/using hydrogen** as fuel under different storage conditions
	1.2 Basic knowledge of ships subject to the IGF Code, their fuel systems and fuel storage systems:	1.2 Basic knowledge of fuel systems and fuel storage systems:
	.1 fuels addressed by the IGF Code	.1 **Hydrogen as fuel on board ships**
	.2 types of fuel systems subject to the IGF Code	.2 types of **hydrogen** fuel systems (**cryogenic compressed)**
	.3 atmospheric, cryogenic or compressed storage of fuels on board ships subject to the IGF Code	.3 ~~**atmospheric,**~~ cryogenic or compressed storage of **hydrogen** as fuel on board ships
	.4 general arrangement of fuel storage systems on board ships subject to the IGF Code	.4 general arrangement of fuel storage systems on board ships **having/using hydrogen** as fuel **(including Fuel Preparation Room (FPR) and Tank Connection Space)**
	.5 hazard zones and areas	.5 **hazard zones and areas, including spaces contiguous with hazardous zones**

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
	.6 typical fire safety plan	.6 typical fire safety plan
	.7 monitoring, control and safety systems aboard ships subject to the IGF Code	.7 monitoring, control and safety systems aboard ships **having/using hydrogen as fuel (including remote monitoring systems)**
	1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code:	1.3 Basic knowledge of the fuel and fuel storage systems' operations on board ships **having/using hydrogen** as fuel:
	.1 piping systems and valves	.1 piping systems **(double-walled {and vacuum-sealed, vacuum-insulated})** and valves **including its safe isolation** **.1bis fuel handling systems and equipment** **.1ter fuel tank/storage operations**
	.2 atmospheric, compressed or cryogenic storage	.2 **Compressed or cryogenic storage including pressure, temperature and level monitoring** **.2bis vapour/boil-off-gas management systems**
	.3 relief systems and protection screens	.3 **pressure or thermal** relief systems
	.4 basic bunkering operations and bunkering systems	.4 basic bunkering operations and bunkering systems

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
	.5 protection against cryogenic accidents .6 fuel leak monitoring and detection 1.4 Basic knowledge of the physical properties of fuels on board ships subject to the IGF Code, including: .1 properties and characteristics .2 pressure and temperature, including vapour pressure/ temperature relationship 1.5 Knowledge and understanding of safety requirements and safety management on board ships subject to the IGF Code.	.5 protection against cryogenic accidents .6 fuel leak monitoring, detection **and vapour dispersion** 1.4 Basic knowledge of the physical properties **of hydrogen as fuel** on board ships, including: .1 properties and characteristics **of hydrogen** .2 pressure and temperature relationship of **hydrogen in gaseous and liquified phases (including during phase change)** 1.5 Knowledge and understanding of safety requirements and safety management on board ships **having/using hydrogen as fuel.**
2 Take precautions to prevent hazards on a ship ~~**subject to the IGF Code**~~	2.1 Basic knowledge of the hazards associated with operations on ships subject to the IGF Code, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards	2.1 Basic knowledge of the hazards associated with operations on ships **having/using hydrogen as fuel**, including: .1 health hazards .2 environmental hazards .3 reactivity hazards .4 corrosion hazards **(hydrogen embrittlement)**

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
	.5 ignition, explosion and flammability hazards	.5. ignition, explosion**, detonation** and flammability hazards
	.6 sources of ignition	.6 sources of ignition
	.7 electrostatic hazards	.7 electrostatic hazards
	.8 toxicity hazards	.8 **asphyxiation** hazards
	.9 vapour leaks and clouds	.9 vapour leaks, vapour cloud**, vapour ignition**
	.10 extremely low temperatures	.10 extremely low temperatures
	.11 pressure hazards	.11 pressure hazards
	.12 fuel batch differences	.12 fuel **contamination (particle contaminants)**
		.13 material compatibilities with hydrogen systems
	2.2 Basic knowledge of hazard controls:	2.2 Basic knowledge of hazard controls:
	.1 emptying, inerting, drying and monitoring techniques	.1 emptying, **purging**, inerting, **gas freeing** and monitoring techniques
	.2 anti-static measures	.2 anti-static measures
	.3 ventilation	.3 ventilation **(considering asphyxiant vapour releases)**

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
		.3bis release protocols (during purging, engine shutdown etc.) including treatment systems}
	.4 segregation	.4 segregation
	.5 inhibition	.5 **n/a**
	.6 measures to prevent ignition, fire and explosion	.6 measures to prevent ignition, fire and explosion
	.7 atmospheric control	.7 atmospheric control
	.8 gas testing	.8 **flammable vapour &** gas testing
	.9 protection against cryogenic damages (LNG)	.9 protection against cryogenic damages ~~**(LNG)**~~
	2.3 Understanding of fuel characteristics on ships subject to the IGF Code as found on a Safety Data Sheet (SDS)	2.3 Understanding of fuel characteristics on ships **having/using hydrogen as fuel** as found on a Safety Data Sheet (SDS)
3 Apply occupational health and safety precautions and measures	3.1 Awareness of function of gas-measuring instruments and similar equipment:	3.1 Awareness of function of gas-measuring instruments and similar equipment:
	.1 gas testing	.1 **gas detection (flammable and asphyxiant levels of hydrogen)**
	3.2 Proper use of specialized safety equipment and protective devices, including:	3.2 Proper use of specialized safety equipment and protective devices **compatible with hydrogen exposure,** including:
	.1 breathing apparatus	.1 breathing apparatus

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
	.2 protective clothing	.2 protective clothing
	.3 resuscitators	.3 resuscitators
	.4 rescue and escape equipment	.4 rescue and escape equipment
	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships subject to the IGF Code, including:	3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships **having/using hydrogen as fuel**, including:
	.1 precautions to be taken before entering hazardous spaces and zones	.1 precautions to be taken before entering hazardous **zones and areas**, **including spaces contiguous with hazardous zones**
	.2 precautions to be taken before and during repair and maintenance work	.2 precautions to be taken before and during repair and maintenance work
	.3 safety measures for hot and cold work	.3 safety measures for hot and cold work
	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)
4 Carry out fire-fighting operations on a	4.1 Fire organization and action to be taken on ships subject to the IGF Code	4.1 Fire organization and action to be taken on ships **having/using hydrogen as fuel**

Competence	Knowledge, Understanding and Proficiency	
	Existing IGF Code training	**Hydrogen**
ship ~~**subject to the IGF Code**~~	4.2 Special hazards associated with fuel systems and fuel handling on ships subject to the IGF Code 4.3 Fire-fighting agents and methods used to control and extinguish fires in conjunction with the different fuels found on board ships subject to the IGF Code 4.4 Fire-fighting system operations	4.2 Special hazards associated with fuel systems, and fuel handling on ships **having/using hydrogen as fuel (detonation)** 4.3 Fire-fighting agents and methods used to control and extinguish **hydrogen-based fires** 4.4 Fire-fighting system operations
5 Respond to emergencies	5.1 Basic knowledge of emergency procedures, including emergency shutdown	5.1 Basic knowledge of emergency procedures, including emergency shutdown
6 Take precautions to prevent pollution of the environment from the release of fuels found on ~~ships subject to the IGF Code~~	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/ venting of fuels from ships subject to the IGF Code, including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/ leakage of fuels addressed by the IGF Code	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/venting of fuels from ships **having/using hydrogen as fuel,** including the need to: .1 report relevant information to the responsible persons .2 awareness of shipboard spill/leakage/venting response procedures .3 awareness of appropriate personal protection when responding to a spill/leakage **of hydrogen**

Table 2

Specification of minimum standard of competence in advanced training for seafarers on board ships using hydrogen as fuel (mapped against table A-V/3-2 of the STCW Code for reference)

*(Note: Competences assessed to be different from the existing IGF Code is shown in **bold / grey**)*

Competence	Existing IGF Code training	hydrogen
1 Familiarity with physical and chemical properties of fuels aboard ships ~~**subject to the IGF Code**~~	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of fuels used on board ships subject to the IGF Code, including: .1 the chemical structure of different fuels used on board ships subject to the IGF Code .2 the properties and characteristics of fuels used on board ships subject to the IGF Code, including: .1 simple physical laws .2 states of matter .3 liquid and vapour densities .4 boil-off and weathering of cryogenic fuels	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use **of hydrogen used as fuel:** .1the chemical structure **of hydrogen** .2the properties and characteristics **of hydrogen** including: .1 simple physical laws .2 states of matter **of hydrogen including phase changes** .3 liquid and vapour densities **.3bis liquefaction of gases** .4 boil-off **of low-temperature fuel (hydrogen)**

Competence	Existing IGF Code training	hydrogen
		.4bis capability to freeze surrounding air to form solids
	.5 compression and expansion of gases	.5 compression and expansion of gases
	.6 critical pressure and temperature of gases	.6 critical pressure and temperature of gases
	.7 flashpoint, upper and lower flammable limits, auto-ignition temperature	.7 flashpoint, upper and lower flammable limits, auto-ignition temperature
	.8 saturated vapour pressure/ reference temperature	.8 saturated vapour pressure/ reference temperature
	.9 dewpoint and bubble point	.9 dewpoint [and bubble point]
	.10 hydrate formation	.10 **n/a**
	.11 combustion properties: heating values	.11 combustion properties: heating values
	.12 methane number/ knocking	.12 **[knocking]**
	.13 pollutant characteristics of fuels addressed by the IGF Code	.13 pollutant characteristics **of hydrogen**
	.3 the properties of single liquids	**.3 n/a**
	.4 the nature and properties of solutions	**.4 n/a**

Competence	Existing IGF Code training	hydrogen
	.5 thermodynamic units	.5thermodynamic units
	.6 basic thermodynamic laws and diagrams	.6basic thermodynamic laws and diagrams
	.7 properties of materials	.7properties of materials **and compatibility with hydrogen**
		.**7bis quality of fuel including the effect of particulate impurities**
	.8 effect of low temperature, including brittle fracture, for liquid cryogenic fuels	.8effect of low temperature, including brittle fracture**~~, for liquid cryogenic fuels~~**
	1.2 Understanding the information contained in a Safety Data Sheet (SDS) about fuels addressed by the IGF Code	1.2 Understanding the information contained in a Safety Data Sheet (SDS**) about hydrogen**
2 Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on ships **~~subject to the IGF Code~~**	2.1 Operating principles of marine power plants 2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms	2.1 Operating principles of marine power plants 2.2 Ships' auxiliary machinery 2.3 Knowledge of marine engineering terms

Competence	Existing IGF Code training	hydrogen
3 Ability to safely perform and monitor all operations related to the fuels used on board ships ~~subject to the IGF Code~~	3.1 Design and characteristics of ships subject to the IGF Code 3.2 Knowledge of ship design, systems, and equipment found on ships subject to the IGF Code, including: .1 fuel systems for different propulsion engines .2 general arrangement and construction .3 fuel storage systems on board ships subject to the IGF Code, including materials of construction and insulation .4 fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines .3 expansion devices	3.1 Design and characteristics of ships **having/using hydrogen as fuel** 3.2 Knowledge of ship design, systems, and equipment found on ships **having/using hydrogen as fuel**, including: .1fuel systems for different propulsion **systems** .2general arrangement and construction .3fuel storage systems on board ships **having/using hydrogen as fuel**, including materials of construction and insulation .4fuel-handling equipment and instrumentations on board ships: .1 fuel pumps and pumping arrangements .2 fuel pipelines **(double-walled, {vacuum-sealed, vacuum-insulated } piping) and valves** **.2bis vapour/boil-off management (Gas Combustion Unit (GCU))** .3 expansion devices

Competence	Existing IGF Code training	hydrogen
	.4 flame screens	.4 flame screens
	.5 temperature monitoring systems	.5 temperature **and pressure** monitoring systems
	.6 fuel tank level-gauging systems	.6 fuel tank level-gauging systems
	.7 tank pressure monitoring and control systems	.7 tank pressure monitoring and control systems
	.5 cryogenic fuel tanks temperature and pressure maintenance	.5cryogenic fuel tanks temperature and pressure maintenance
	.6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution	.6fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution
	.7 toxic and flammable gas-detecting systems	.7**asphyxiant** and flammable gas-detecting systems
	.8 fuel Emergency Shut Down system (ESD)	.8fuel Emergency Shut Down system (ESD)
	3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships subject to the IGF Code	3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships **having/using hydrogen as fuel**
	.1 low pressure pumps	.1low pressure pumps
	.2 high pressure pumps	.2high pressure pumps

Competence	Existing IGF Code training	hydrogen
		.2bis compressors
	.3 vapourizers	.3**Gas Combustion Unit (GCU)**
	.4 heaters	.4heaters
		.4bis {heat exchangers} / Vapourisers
	.5 pressure build-up units	.5pressure build-up units
	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including:	3.4 Knowledge of safe procedures and checklists for taking fuel tanks in and out of service, including:
	.1 inerting	**.1 purging**
		.1bis, inerting
		.1ter gas freeing
	.2 cooling down	.2**[tank preparation (conditioning/drying)]**
		2 bis: cooling down
	.3 initial loading	.3initial loading
	.4 pressure control	.4**tank** pressure control
	.5 heating of fuel	.5heating of fuel

Competence	Existing IGF Code training	hydrogen
	.6 emptying systems	**.5bis vapour management** .6emptying systems
4 Plan and monitor safe bunkering, stowage and securing of the fuel on board ships ~~**subject to the IGF Code**~~	4.1 General knowledge of ships subject to the IGF Code 4.2 Ability to use all data available on board related to bunkering, storage and securing of fuels addressed by the IGF Code 4.3 Ability to establish clear and concise communications and between the ship and the terminal, truck or the bunker-supply ship 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel- and control systems for ships subject to the IGF Code 4.5 Proficiency in the operation of bunkering systems on board ships subject to the IGF Code including: .1 bunkering procedures .2 emergency procedures .3 ship-shore/ship-ship interface	4.1 General **arrangement** of ships **having/using hydrogen as fuel** 4.2 Ability to use all data available on board related to bunkering, storage and securing **of hydrogen as fuel** 4.3 Ability to establish clear and concise communications between the ship and the terminal, truck or the bunker supply **vessel** 4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships **having/using hydrogen as fuel** 4.5 Proficiency in the operation of bunkering systems on board ships **having/using hydrogen as fuel** including: .1 bunkering procedures .2emergency procedures .3ship-shore/ship-ship interface **and use of ship-shore checklist**

Competence	Existing IGF Code training	hydrogen
	.4 prevention of rollover 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1 maximum fill quantity .2 On Board Quantity (OBQ) .3 Minimum Remain On Board (ROB) .4 fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other IGF Code fuel related operations concurrent with other onboard operations, both in port and at sea	.4[prevention of rollover] 4.6 Proficiency to perform fuel-system measurements and calculations, including: .1maximum fill quantity .2On Board Quantity (OBQ) .3Minimum Remain On Board (ROB) .4fuel consumption calculations 4.7 Ability to ensure the safe management of bunkering and other **hydrogen** related operations concurrent with other onboard operations, both in port and at sea
5 Take precautions to prevent pollution of the environment from the release of fuels from ships ~~**subject to the IGF Code**~~	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/ venting	5.1 Knowledge of the effects of pollution on human and environment 5.2 Knowledge of measures to be taken in the event of spillage/leakage/ venting **/ vapour cloud formation**
6 Monitor and control compliance with	6.1 Knowledge and understanding of relevant provisions of the International Convention for the Prevention of	6.1 [Knowledge and understanding of relevant provisions of the International Convention for the Prevention of

Competence	Existing IGF Code training	hydrogen
legislative requirements	Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied 6.2 Proficiency in the use of the IGF Code and related documents	Pollution from Ships (MARPOL), as amended and other relevant IMO instruments, industry guidelines and port regulations as commonly applied] 6.2 **n/a**
7 Take precautions to prevent hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships subject to the IGF Code, including: .1 flammability .2 explosion .3 toxicity .4 reactivity .5 corrosivity .6 health hazards .7 inert gas composition .8 electrostatic hazards	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships **having/using hydrogen as fuel**, including: .1flammability .2explosion**, detonation** .3**asphyxiant** .4reactivity .5corrosivity **(hydrogen embrittlement)** .6health hazards .7inert gas composition .8electrostatic hazards **.8bis vapour leaks**

Competence	Existing IGF Code training	hydrogen
	.9 pressurized gases	.9pressurized gases
	.10 low temperature	.10 low temperature
	7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships subject to the IGF Code	7.2 Proficiency to calibrate and use monitoring and fuel detection systems, instruments and equipment on board ships **having/using hydrogen as fuel**
	7.3 Knowledge and understanding of dangers of non-compliance with relevant rules/regulations	7.3 [Knowledge and understanding of dangers of non-compliance with relevant rules/regulations]
	7.4 Knowledge and understanding of risks assessment method analysis on board ships subject to the IGF Code	7.4 Knowledge and understanding of risks assessment method analysis on board ships **having/using hydrogen as fuel**
	7.5 Ability to elaborate and develop risks analysis related to risks on board ships subject to the IGF Code	7.5 Ability to elaborate and develop risks analysis related to risks on board ships **having/using hydrogen as fuel**
	7.6 Ability to elaborate and develop safety plans and safety instructions for ships subject to the IGF Code	7.6 Ability to elaborate and develop safety plans and safety instructions for ships **having/using hydrogen as fuel**
	7.7 Knowledge of hot work, enclosed spaces and tank entry including permitting procedures	7.7 Knowledge of hot work, enclosed spaces, **hazardous zones, spaces contiguous with hazardous zones and tank entry including permit procedures**

Competence	Existing IGF Code training	hydrogen
8 Apply occupational health and safety precautions and measures on board a ship ~~**subject to the IGF Code**~~		8.X **Knowledge of function, calibration and limitation (if any) of gas-measuring instruments and similar equipment:** **.1 atmosphere testing and gas detection of hydrogen**
	8.1 Proper use of safety equipment and protective devices, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and escape equipment	8.1 Proper use of specialized safety equipment and protective devices **compatible with hydrogen exposure,** including: .1breathing apparatus and **evacuation** equipment .2protective clothing and equipment .3resuscitators .4rescue and personal escape equipment
	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including: .1 precautions to be taken before, during and after repair and maintenance work on fuel systems addressed in the IGF Code	8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships **having/using hydrogen as fuel**, including: .1precautions to be taken before and during repair and maintenance work ~~**on fuel systems addressed in the IGF Code**~~ **.1bis material compatibilities with hydrogen systems**

Competence	Existing IGF Code training	hydrogen
	.2 electrical safety (reference to IEC 600079-17) .3 ship/shore safety checklist 8.3 Basic knowledge of first aid with reference to a Safety Data Sheets (SDS) for fuels addressed by the IGF Code	.2electrical safety [reference to IEC **60079-17:2024 or equivalent standard]** .3ship/shore safety checklist **.3bis safety measures for hot and cold work** **.3ter precautions to be taken before entering enclosed spaces, hazardous zones and areas, including spaces contiguous with hazardous zones** 8.3 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)
9 Knowledge of the prevention, control and fire-fighting and extinguishing systems on board ships ~~**subject to the IGF Code**~~	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of fuels addressed by the IGF Code	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires **of hydrogen fuels** 9.2 **Fire organization and action to be taken on ships having/using hydrogen as fuel** 9.3 **Special hazards associated with fuel systems and fuel handling on ships having/using hydrogen as fuel (vapour cloud, vapour ignition)**

Competence		
	Existing IGF Code training	**hydrogen**
		9.4 **Fire-fighting system operations, particularly ventilation systems**

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ANNEX 6

DRAFT INTERIM GUIDELINES ON TRAINING FOR SEAFARERS ON SHIPS USING BATTERY-POWERED[1]

1 INTRODUCTION

1.1 The purpose of these Interim Guidelines is to provide a reference for the development and approval of training for seafarers on ships using battery-powered to support the reduction of green house gas emissions from international shipping.

Application

1.2 Unless expressly provided otherwise, these Interim Guidelines apply to seafarers on ships using battery-powered[2].

1.3 Where specific provisions of this document differ from the requirements of mandatory instruments applicable to seafarers on ships using battery-powered, the provisions of those mandatory instruments should take precedence.

Goal

1.4 The goal of these Interim Guidelines is to provide an international standard for the development and approval of training of seafarers on ships using battery-powered.

General provisions for training and familiarization

1.5 All seafarers serving on ships using battery-powered should, prior to being assigned shipboard duties, be familiarized with their specific duties and with all ship arrangements, installations, equipment, procedures and ship characteristics that are relevant to their routine or emergency duties, as specified in regulation I/14.5 of the STCW Convention.

1.6 In addition, seafarers should receive appropriate training on the associated risks and emergency procedures, in accordance with their duties and responsibilities.

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1 The draft text was prepared by China*, Singapore and Canada. Party marked with (*) is the focal point.

2 The ships using battery-powered are primarily those that use lithium-ion batteries and energy-type supercapacitors as partial or full power sources, with a total capacity of power battery pack greater than 100 kWh, and equipped with DC integrated power systems.

1.7 On that basis, the following training approach comprising basic and advanced training levels may be applied:

.1 basic training for seafarers responsible for designated safety duties associated with the care, use or in emergency response to the battery and battery power systems on ships using battery-powered should be delivered in accordance with the knowledge, understanding and proficiency (KUPs) specified in table 1 of this guideline and should meet the standard competence specified therein; and

.2 advanced training for the masters, engineer officers and all personnel with immediate responsibility for the care and use of battery and battery power systems on ships using battery-powered should be delivered in accordance with the KUPs specified in tables 2 of this guideline and should meet the standard competence specified therein.

2 TRAINING REQUIREMENTS

General

2.1 Prior to being assigned duties on board a ship using battery-powered, all seafarers should receive appropriate training in accordance with this section.

[2.2 The Administration may, in respect of ships of less than 500 gross tonnage, except for passenger ships, if it considers that a ship's size and the length or character of its voyage are such as to render the application of the full requirements of this section unreasonable or impracticable, exempt the seafarers on such a ship or class of ships from some of the requirements, bearing in mind the safety of people on board, the ship and property and the protection of the marine environment.]

2.3 seafarers responsible for designated safety duties associated with the care, use or in emergency response to the battery and battery power systems on ships using battery-powered should receive basic training or instruction in accordance with paragraphs 3.1 and 3.2 and should meet the standard of competence specified therein.

2.4 Masters, engineer officers and all personnel with immediate responsibility for the care and use of battery and battery power systems on ships using battery-powered should receive advanced training in accordance with paragraph 3.3 and 3.4 and should meet the standard of competence specified therein, taking into account the knowledge, understanding and proficiencies to meet the standard of competence specified in 3.1, as appropriate.

2.5 Basic and advanced training and assessment should be given by personnel appropriately qualified for the type and level of training and assessment involved.

2.6 It is important to emphasize the need to take account of risk analyses. All risk analyses carried out should be made available to participants during training.

3 STANDARDS OF COMPETENCE

Standard of competence for basic training

3.1 Seafarers responsible for designated safety duties associated with the care, use or in emergency response to the battery and battery power systems on ships using battery-powered should, before being assigned to shipboard duties:

.1 receive basic training or instruction as determined by the Administration on ships using battery-powered so as to:

.1 contribute to the safe operation of a ship;

.2 take precautions to prevent hazards on a ship;

.3 apply occupational health and safety precautions and measures;

.4 carry out firefighting operations on a ship;

.5 respond to emergencies;

.6 take precautions to prevent pollution of the environment from ships; and

.7 maintain safe watchkeeping on ships using battery-powered; and

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.2 Administration shall ensure that documentary evidence of the training which has been completed is issued to every person found qualified in accordance with paragraphs 3.1.

Standard of competence for advanced training

3.3 Masters, engineer officers and seafarers all personnel with immediate responsibility for the care and use of battery and battery power systems on ships using battery-powered should, before being assigned to shipboard duties:

.1 receive advanced training in addition to the competences outlined in paragraph 3.1.1 as determined by the Administration on ships using battery-powered so as to:

.1 the composition, functions, working principles, and safety protection requirements of the ship's power distribution system;

.2 be able to safely perform and monitor all operations and safety protections related to battery and power distribution system used on board ships;

.3 be familiar with the composition, functions, and operation of the battery and battery power system;

.4 be able to assess potential risks in battery power systems and take appropriate actions;

.5 be able to safely perform the faults analysis and maintenance of battery and battery systems on board ships; and

.6 prior to the first appointment to ships using battery-powered, receive specific system operation training[3];and

[3] This training should be conducted either onshore or on board ships equipped with the specific systems, and provided by the equipment manufacturers.

.2 be required to provide evidence of having achieved the standard of competence provided to undertake their duties and responsibilities through:

.1 demonstration of competence in accordance with the methods and criteria for evaluating competence determined by the Administration; and

.2 examination or continuous assessment as part of a training programme determined by the Administration.

3.4 Administration shall ensure that documentary evidence of the training which has been completed is issued to every person found qualified in accordance with paragraphs 3.3.

4 EMERGENCY EXERCISES

4.1 Emergency exercises related to the special provisions for firefighting and emergency response for ships using battery-powered should be conducted at regular intervals. The response and safety system for hazard and accident control should be reviewed and tested.

ANNEX

Table 1

Specification of minimum standard of competence in basic training for seafarers on ships using battery-powered

Competence	Knowledge, understanding and proficiency
1 Contribute to the safe operation of a ship	***1.1 Basic knowledge of ships using battery-powered*** .1 Current development status of ships using battery-powered .2 Working principles and structural composition of mainstream marine battery power systems .3 Comparison of characteristics between lithium batteries and supercapacitors .4 Combustion characteristics of lithium batteries and supercapacitors ***1.2 Familiarity with the composition of engine room equipment on ships using battery-powered*** .1 Introduction to the power system of ships using battery-powered .2 Functions of each equipment in the engine room of ships using battery-powered ***1.3 Understand the regulatory requirements for the management of ships using battery-powered*** .1 Relevant requirements of international conventions regarding ships using battery-powered (inspection, ship certificates and documents, etc.) .2 Relevant requirements of domestic regulations for ships using battery-powered (if any)
2 Take precautions to prevent hazards on a ship	**2.1 Understanding battery electrolyte properties based on information in safety data sheets (SDS)** .1 flammability, reactivity, and corrosive nature of electrolytes .2 toxicity, flammability, reactivity, and corrosivity of gases released
3 Apply occupational health and safety precautions and measures	***3.1 Common knowledge of safe electricity use specific to ships using battery-powered*** .1 Safety protective measures against electric shock in battery compartments and charging/discharging areas .2 Electric shock accidents in battery compartments and charging/discharging areas and first aid on site **3.2 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)**

Competence	Knowledge, understanding and proficiency
4 Carry out firefighting operations on a ship	***4.1 Understanding the fire protection design and fire alarm system of ships using battery-powered*** .1 Heat resistance and structural separation of power battery compartments (including fixed battery compartments and box-type batteries) .2 Ventilation and heat dissipation systems .3 Refrigeration and insulation systems for battery compartments .4 Types and principles of fire detection probes .5 Fire detection and alarm systems .6 Fire extinguishing systems .7 Escape routes .8 Identification of fire types .9 Operation of fixed installations and portable and mobile fire-extinguishing equipment .10 Evacuation and organization of rescue operations
5 Respond to emergencies	***5.1 Watchkeeping and Emergency Response on Ships using battery-powered*** Understand the knowledge related to the procedures under various emergencies on ships using battery-powered, including firefighting, security, flooding, and other types of emergencies. Be familiar with the response actions for the following emergency situations: .1 Complete loss of power on board .2 Ingress of water into the engine room or battery compartment .3 Fires in the engine room or battery compartment .4 Steering gear failure .5 Fires and electrical leakage during ship charging .6 Security incidents ***5.2 Emergency response on ships using battery-powered*** .1 Organise drills for power loss, ingress of water into the engine room (or battery compartment), firefighting, steering gear failure, and security, as well as safely and correctly handle the release of harmful gases • Be familiar with the contingency plans related to response to emergencies • In the case of emergencies or abnormal conditions, take correct actions to ensure the safety of the ship and personnel

Competence	Knowledge, understanding and proficiency
6 Take precautions to prevent pollution of the environment from ships	***6.1 Taking measures to prevent pollution caused by marine batteries*** .1 Pollution hazards of marine batteries .2 Sustainable utilization and recycling of marine batteries .3 Management of long-term shutdown of ships using battery-powered
7 Maintain safe watchkeeping on ships using battery-powered	***7.1 Understanding the general requirements for safe watchkeeping on ships using battery-powered*** .1 Watchkeeping and preparations before departure .2 Precautions for watchkeeping during navigation (such as remaining battery power, speed control, etc.) .3 Safety precautions for watchkeeping during charging and discharging

Table 2

Specification of minimum standard of competence in advanced training for seafarers on ships using battery-powered

Competence	Knowledge, understanding and proficiency
1 Master the composition, functions, and operating principles of the power distribution system on ships using battery-powered	***1.1 Structure, functions, and operating principles of DC power distribution systems*** .1 Composition, characteristics, and primary parameters of ship power systems .2 Composition and functions of ship DC power distribution systems .3 Functions and principles of unidirectional/bidirectional DC/DC converters .4 Functions and principles of propulsion inverters .5 Operating principles of DC power distribution systems .6 Propulsion control systems .7 Characteristics of electric propulsion motors .8 Rectifier modules in charging cabinet facilities .9 Cooling systems for DC grid systems .10 Inverter for daily power supply .11 Shore power .12 External charging devices • charging: overcharge prevention, insufficient charging, etc. • charging methods: fast charging, slow charging, hybrid charging, etc. • other future charging methods
2 Be able to safely perform and monitor all operations and safety protections related to battery and power distribution system used on board ships	***2.1 Daily operations of DC power distribution system*** .1 Ship-to-shore power switching operation .2 Manual and automatic start/stop/switching operations .3 Local/remote operation of propulsion system and emergency measures for remote control failures .4 Shore charging operation ***2.2 Knowledge related to protection in DC power distribution systems*** .1 Working principles and range of application of fast acting fuse, DC isolation switches, and DC contactors .2 Working principle of selective protection .3 Emergency batteries .4 Cooling systems for electrical equipment

Competence	Knowledge, understanding and proficiency
	.5 Emergency operating procedures for the system
3 Be familiar with the composition, functions, and operation of the battery power system	***3.1 The composition, functions, and operation of the battery power system, including but not limited to:*** .1 Functions and operating principles of thebattery management system (BMS) .2 Functions and operating principles of energy storage and management system (ESMS) .3 Functions and operating principles of power management system (PMS) .4 Functions and operating characteristics of monitoring and alarm system (MAS) .5 Starting procedures and precautions for battery power systems .6 Learning about battery operation management records
4 Be able to assess potential risks in battery power systems and take appropriate actions	***4.1 Risk management of battery power systems*** .1 Potential safety issues in battery power systems • Design layout and operating principles of battery compartments/battery energy storage systems (BESS) • Design and safety requirements for battery racks • Battery energy storage systems • Risks associated with charging, discharging, and other operations • Ventilation and cooling systems • Gas detection and fire detection systems .2 Emergency response procedures for battery power systems • Understand the specific hazards associated with battery power systems and appropriate measures to mitigate risks • Understand the specific hazards associated with battery charging and discharging, understand the causes, impacts, and dangers of battery thermal runaway, and respond to and prevent battery thermal runaway

Competence	Knowledge, understanding and proficiency
5 Be able to safely perform the faults analysis and maintenance of battery and battery systems on board ships	***5.1 Diagnosis and troubleshooting of common fault alarms in battery power systems*** .1 Maintenance procedures for battery power systems • Understand and comprehend the maintenance and inspection procedures for battery cells, battery packs, and battery modules, considering to be incorporated into all risk assessments • Monitoring (supervision) • Inspection • Risk assessment • Maintenance .2 Common faults and troubleshooting in battery power systems • Before understanding how to perform maintenance and inspections, understand the potential battery and system faults that may arise •understand the possible battery defects before knowing how to carry out maintenance and inspection. •Knowledge of defects management including maintenance, troubleshooting and root cause analysis. •Earthing practice of electrical equipment. •Replacing defective controller and detector •Replenishing cooling water •Detect and replace leaking cooling water tube ***5.2 Operations for protection of DC power distribution systems*** .1 Emergency responses to main switch tripping during navigation and troubleshooting for various tripping scenarios .2 Common fault identification in power grids and potential risk assessment for power systems .3 Emergency operations in emergencies and procedures for external support by agencies or first respondents .4 Maintenance of emergency batteries and battery power systems .5 Regular exercises involving the relevant crew, shore-based personnel and authorities ***5.3 Case study on accidents*** .1 Analysis of typical accident cases involving ships using battery-powered