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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**

**Interim training framework for seafarers in decarbonization – Knowledge,
Understanding and Proficiencies (KUPs) to be considered towards training for
working on alternatively fuelled ships**

Submitted by ICS and ITF

SUMMARY

Executive summary: This document provides information about the fuel-specific workshops conducted under the aegis of the Maritime Just Transition Task Force (MJTTF) project on development of interim guidance on training for seafarers on ships using alternative fuels. The outcome of those workshops is the development of Knowledge, Understanding and Proficiencies (KUPs) that were identified and have been detailed in the annex to this document. These KUPs would need to be considered towards training for working on future alternatively fuelled ships.

*Strategic direction, 3
if applicable:*

Output: 3.8

Action to be taken: Paragraph 20

Related documents: MSC 107/20; MEPC 80/17; CCC 9/WP.3 and CCC 10/WP.6

Introduction

1 Implementation of alternatives to fossil fuels is key to decarbonizing shipping. The report of the Correspondence Group on Development of a Safety Regulatory Framework to Support the Reduction of GHG Emissions from Ships Using New Technologies and Alternative Fuels (MSC 108/5), provided a list of fuels and technologies to support the reduction of GHG emissions from ships. The list also included the fuels and technologies for which the CCC Sub-Committee had recently developed interim guidelines (methyl/ethyl alcohol, liquefied petroleum gas (LPG) and ammonia fuels) and also the fuels it is in the process of developing guidelines for (hydrogen fuel and low-flashpoint oil fuels).

Background

2 MSC 107 (31 May to 9 June 2023) agreed to include in its biennial agenda for 2024-2025 a continuous output on "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels", assigning the Committee as the coordinating organ, in association with the CCC, HTW, III, SSE and SDC Sub-Committees as and when requested by the Committee and invited MEPC to consider being an associated organ (MSC 107/20, paragraph 17.6).

3 MEPC 80 (3 to 7 July 2023) adopted resolution MEPC.377(80) on the *2023 IMO Strategy on reduction of GHG emissions from ships* (2023 IMO GHG Strategy) outlining the Organization's commitment to reducing GHG emissions from international shipping and, as a matter of urgency, aiming to phase them out as soon as possible, while promoting, in the context of this Strategy, a just and equitable transition (MEPC 80/17, paragraph 7.54).

4 HTW 10 (5 to 9 February 2024) agreed that the existing output of the Maritime Safety Committee on "Development of a safety regulatory framework to support the reduction of GHG emissions from ships using new technologies and alternative fuels" could be utilized to develop training provisions for seafarers on ships using alternative fuels, taking into account the ongoing work by MSC, the CCC Sub-Committee and any other relevant bodies and invited the Committee to include this output in the provisional agenda for HTW 11 (HTW 10/10, paragraph 6.32.2).

5 MSC 108 (15 to 24 May 2024) endorsed the agreement by the HTW Sub-Committee to proceed with the development of training provisions for seafarers on ships using alternative fuels (MSC 108/20, paragraph 5.4) while also noting that seafarers "are aware of the challenges, risks and complexities that these new and emerging technologies and fuels present in normal and emergency situations" (MSC 108/20, paragraph 5.29).

Status of safety guidelines in relation to ammonia, methanol and hydrogen

6 MSC 102 (4 to 11 November 2020) approved the *Interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel* (MSC.1/Circ.1621) (MSC 102/24, paragraph 15.2).

7 CCC 10 (16 to 20 September 2024), as per the "Updated work plan for the development of new alternative fuels under the IGF Code" (CCC 10/16, paragraph 3.28 and annex 2), agreed to:

- .1 finalize the revision of MSC.1/Circ.1621 with a view to developing mandatory instruments in 2027;
- .2 invite MSC 109 to approve the draft interim guidelines for the safety of ships using ammonia as fuel, with a view to further consideration of revisions to the interim guidelines in the future; and
- .3 further develop/finalize interim guidelines for the safety of ships using hydrogen as fuel at CCC 11, with a view to approval by MSC 111 (2026).

Discussion

8 Seafarers are at the core of the shipping industry. Research commissioned by the Maritime Just Transition Task Force (MJTTF) revealed that by the mid-2030s, approximately 800,000 seafarers may require additional training to handle the fuels and

technologies of ships of the future.¹ Without seafarers' active engagement and significant contribution, shipping would not successfully transition to zero emissions. The current progress of new types of energy ships and related decarbonized technologies has demonstrated that thousands of seafarers need special training in decarbonization knowledge and skills by 2030.

9 MJTTF is an initiative set up in 2021 by the International Chamber of Shipping (ICS), the International Transport Workers' Federation (ITF), and the UN Global Compact (UNGC), in collaboration with the International Labour Organization (ILO) and IMO Secretariats. The Task Force commissioned a Position Paper² to explore how best to support seafarers during the transition to alternative fuels and technologies, such as renewable e-fuels, biofuels and fossil fuels with carbon capture and storage; and to provide an overview of the challenges faced in the training of seafarers throughout this transition. In the report launched by the Task Force at the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 27), the need to expedite interim training for alternative fuels was highlighted.

10 MJTTF embarked on a joint project to develop a Baseline Training Framework for Seafarers in Decarbonization, the purpose of which is to support maritime education and training (MET) institutions and the maritime sector to develop, reform, update and undergo upgrades around GHG reduction, (net) zero air emissions and decarbonization through IMO's energy efficiency requirements and other mitigation options, including alternative fuels and other energy resources.³ In order to achieve the project objectives, the technical consultancy has been provided by Lloyd's Register (LR) and the academic consultancy has been provided by the World Maritime University (WMU).

11 During the project, MJTTF engaged with the industry stakeholders in collaborative workshops facilitated by Lloyd's Register (LR). The plan was that the output of the competency and training risk workshops would inform the later development of key seafarer competencies and eventually serve as the basis for the development of training materials later in the project. The workshops would bring all interested parties together with the aim of providing a more robust solution to the challenge of using cleaner fuels and defining seafarers' future training needs.

Aims, objectives and methodology of the fuel-specific workshops

12 The workshops to investigate the use of ammonia, methanol and hydrogen as fuels were held via a series of virtual meetings with participants that included vessel owners, operators, engine manufacturers, fuel producers, training organizations, industry experts and MJTTF representatives.

13 The aim of the workshops was to ensure that there is a robust basis of understanding upon which credible competence standards and training materials can be developed. To achieve this, it was necessary to identify the current training and competency gaps related to the use of the above-mentioned alternative fuels.

¹ Raymond Antoni Kaspersen, et al DNV. (2022) Insights into Seafarer Training and Skills Needed to Support a Decarbonized Shipping Industry.

² Maritime Just Transition Task Force. (2022) Mapping a Maritime Just Transition for Seafarers; Retrieved from <https://www.ics-shipping.org/wp-content/uploads/2022>

³ TC 73/15 – IMO's technical cooperation response to facilitate the implementation of the revised 2023 IMO GHG Strategy – a Baseline Training Framework for Seafarers in Decarbonization.

14 The objectives of the workshops were:

- .1 to gauge the industry's perception about the scale of change needed to move seafarers with experience related to working on ships using conventional fuel oil to ships where alternative fuels would be used along with conventional fuel oil; and
- .2 to solicit recommendations from the workshop participants with regard to what new or modified competencies or training might be needed for working with alternative fuels.

15 The workshops were based on the assumption that seafarers who will be placed on vessels utilizing alternative fuels will have received the relevant training and certification associated with the conventional fuel(s). This project was aimed at identifying additional seafarer KUPs and skills needed to work with dual-fuel engines using both conventional fuel oil and an alternative fuel.

Results of the fuel-specific workshops and development of KUPs

16 The discussions during the workshops produced 162 actionable points related to new or modified seafarer competencies and training for ammonia as fuel. Similarly, there were 215 actionable points for methanol as fuel and 180 actionable points for hydrogen as fuel.

17 All of the more than 500 actionable points contributed towards the development of the KUPs, specific to ammonia, methanol and hydrogen, which are detailed in the annex to the document. The existing frameworks provided within tables A-V/3-1 (Specification of minimum standard of competence in basic training for ships subject to the IGF Code) and A-V/3-2 (Specification of minimum standard of competence in advanced training for ships subject to the IGF Code) of the STCW Code, reproduced below, have served as the basis for mapping out fuel-specific KUPs.

	Knowledge, understanding and proficiency			
1	2	3	4	5
Competency	Existing IGF Code training	Ammonia	Methanol	Hydrogen

18 Columns 1 and 2 of the tables in the annex are taken from the existing tables within tables A-V/3-1 and A-V/3-2 of the STCW Code for ships subject to the IGF Code. The key used throughout the tables is as follows:

- n/a indicates that the specific KUP is not applicable;
- [text] indicates that insufficient inputs were received during the workshop discussions;
- {text} indicates that inputs were received during ISWG AF 1 (9 to 13 September 2024); and
- text indicates that a review on this aspect is necessary in future.

Proposals

- 19 ICS and ITF propose that the Sub-Committee:
- .1 note the information provided in the document;
 - .2 note the KUPs detailed in the annex for basic and advanced training in relation to each of the three fuels, i.e. ammonia, methanol and hydrogen;
 - .3 consider the information provided in the annex as a basis for promulgating interim training guidance in the form of STCW.7 circulars for each of the individual fuels and synchronous with the work plan agreed at CCC 10 (CCC 10/16, paragraph 3.28 and annex 2); and
 - .4 consider the information provided in the annex within the discussions of the ongoing comprehensive review of the STCW Convention and Code.

Action requested of the Sub-Committee

- 20 The Sub-Committee is invited to consider the proposal in paragraph 19 and take action, as appropriate.

ANNEX

Table A-V/3-1

Specification of minimum standard of competence in basic training for ships subject to the IGF Code
(mapping with ammonia, methanol and hydrogen fuels)

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	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 1.2 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 1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships subject to the IGF Code: .1 piping systems and valves	1.1 Design and operational characteristics of ships having 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 systems (refrigerated, semi-refrigerated, pressurized) .3 atmospheric or pressurized storage of ammonia as fuel on board ships .4 general arrangement of fuel storage systems on board ships having ammonia as fuel (including Fuel Preparation Room (FPR) {and Tank Connection Space}) .5 hazard zones and areas, including spaces contiguous with hazardous zones, {toxic spaces and toxic areas} .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships having ammonia as fuel (including remote monitoring systems) 1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships having ammonia as fuel under different storage conditions: .1 piping (double-walled) systems and valves including its safe isolation .1bis fuel handling systems and equipment .1 ter fuel tank/storage operations .2 pressurized or low-temperature storage including pressure, temperature {< -30 deg} and level monitoring	1.1 Design and operational characteristics of ships having methanol as fuel under different storage conditions 1.2 Basic knowledge of fuel systems and fuel storage systems: .1 Methanol as fuel on board ships .2 n/a .3 atmospheric storage of methanol as fuel on board ships .4 general arrangement of fuel storage systems on board ships having methanol as fuel (including Fuel Preparation Room (FPR) and Tank Connection Space) .5 hazard zones and areas, including spaces contiguous with hazardous zones .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships having methanol as fuel (including remote monitoring systems) 1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships having methanol as fuel: .1 piping systems and valves including its safe isolation .1bis fuel handling systems and equipment .1ter fuel tank/storage operations .2 atmospheric storage including level monitoring	1.1 Design and operational characteristics of ships having hydrogen as fuel under different storage conditions 1.2 Basic knowledge of fuel systems and fuel storage systems: .1 Hydrogen as fuel on board ships .2 types of hydrogen fuel systems {liquid, ambient compressed, cryogenic compressed} .3 cryogenic or pressurized storage of hydrogen as fuel on board ships .4 general arrangement of fuel storage systems on board ships having hydrogen as fuel (including Fuel Preparation Room (FPR) and Tank Connection Space) .5 hazard zones and areas, including spaces contiguous with hazardous zones .6 typical fire safety plan .7 monitoring, control and safety systems aboard ships having hydrogen as fuel (including remote monitoring systems) 1.3 Basic knowledge of fuels and fuel storage systems' operations on board ships having hydrogen as fuel under different storage conditions: .1 piping systems (double-walled {and vacuum-sealed}) and valves including its safe isolation .1bis fuel handling systems and equipment

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.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.	.2bis vapour/boil-off-gas management systems .3 relief systems and protection screens .4 basic bunkering operations and bunkering systems including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .5 protection against low-temperature exposure accident .6 fuel leak monitoring, detection and knowledge of vapour dispersion 1.4 Basic knowledge of the physical 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 (including during phase change) 1.5 Knowledge and understanding of safety requirements and safety management on board ships having ammonia as fuel	.3 relief systems, protection screens and tank padding systems .4 basic bunkering operations and bunkering systems including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .5 n/a .6 fuel leak monitoring and detection 1.4 Basic knowledge of the physical properties of methanol as fuel on board ships, including: .1 properties and characteristics of methanol .2 n/a 1.5 Knowledge and understanding of safety requirements and safety management on board ships having methanol as fuel	.1 <i>ter</i> fuel tank/storage operations .2 pressurized or cryogenic storage including pressure, temperature and level monitoring .2bis vapour/boil-off-gas management systems .3 pressure or thermal relief systems .4 basic bunkering operations and bunkering systems including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .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 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	2.1 Basic knowledge of the hazards associated with operations on ships having ammonia as fuel: .1 health hazards .2 environmental hazards (NO_x emissions)	2.1 Basic knowledge of the hazards associated with operations on ships having methanol as fuel: .1 health hazards .2 environmental hazards	2.1 Basic knowledge of the hazards associated with operations on ships having hydrogen as fuel: .1 health hazards .2 environmental hazards

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.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 anti-static measures .3 ventilation .4 segregation .5 inhibition .6 measures to prevent ignition, fire and explosion .7 atmospheric control .8 gas testing	.3 reactivity hazards .4 corrosion (including affinity to water/moisture hazards) .5 ignition, implosion, explosion and flammability hazards .6 sources of ignition .7 n/a .8 toxicity hazards {AEGL 1, 2 and 3 (25, 110 and 220 ppm levels)} .9 liquid pools, vapour leaks and clouds including vapour dispersion .10 low temperatures .11 pressure hazards .12 fuel batch differences 12bis external environmental conditions that affect operations 2.2 Basic knowledge of hazard controls: .1 emptying, inerting, drying, gas freeing and monitoring techniques .2 n/a .3 ventilation protocols (considering toxic vapour releases) {.3bis release protocols (during purging, engine shutdown etc.) including treatment systems} .4 [segregation] .5 [inhibition] .6 measures to prevent ignition, fire, implosion and explosion .7 atmospheric control {temperature < -30 deg} .8 flammable and toxic vapour testing .9 protection against low temperature damages	.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 [vapour leaks and clouds] .10 n/a .11 n/a .12 fuel batch differences 2.2 Basic knowledge of hazard controls: .1 emptying, inerting/padding, 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	.3 reactivity hazards .4 stress corrosion hazards (hydrogen embrittlement) .5 ignition, explosion and flammability hazards .6 sources of ignition .7 electrostatic hazards .8 asphyxiation hazards .9 liquid pools, vapour leaks and clouds .10 extremely low temperatures .11 pressure hazards .12 fuel contamination (particle contaminants) 2.2 Basic knowledge of hazard controls: .1 emptying, inerting, gas freeing and monitoring techniques .2 anti-static measures .3 ventilation protocols [considering asphyxiant vapour releases] .4 [segregation] .5 [inhibition] .6 measures to prevent ignition, fire and explosion .7 atmospheric control

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.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 ammonia as fuel as found on a Safety Data Sheet (SDS)	.8 flammable and toxic vapour testing .9 n/a 2.3 Understanding of fuel characteristics on ships having methanol as fuel as found on a Safety Data Sheet (SDS)	.8 flammable vapour testing .9 protection against cryogenic damage 2.3 Understanding of fuel characteristics on ships having 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: .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 3.3 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	3.1 Awareness of function and proper use of gas-measuring instruments and similar equipment: .1 gas detection (flammable and toxic levels of ammonia) 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 personal 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 ammonia as fuel, including: .1 precautions to be taken before entering enclosed spaces, hazardous zones and areas, including spaces contiguous with hazardous zones, {toxic spaces and toxic areas} .1bis understanding of location of emergency muster stations/safe havens .2 precautions to be taken before and during repair and maintenance work .2bis understanding of material compatibilities with ammonia systems .3 safety measures for hot and cold work .3bis knowledge of measures towards decontaminating personal protective equipment, tools or equipment	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas detection (flammable and toxic levels of methanol) 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 3.3 Basic knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships having methanol as fuel, including: .1 precautions to be taken before entering enclosed spaces, hazardous zones and areas, including spaces contiguous with hazardous zones .1bis understanding of location of emergency muster stations/safe havens .2 precautions to be taken before and during repair and maintenance work .2bis understanding of material compatibilities with methanol systems .3 safety measures for hot and cold work .3bis knowledge of measures towards decontaminating personal protective equipment, tools or equipment	3.1 Awareness of function of gas-measuring instruments and similar equipment: .1 gas detection (flammable and asphyxiant levels of hydrogen) 3.2 Proper use of specialized safety equipment and protective devices resistant to hydrogen embrittlement, including: .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 having hydrogen as fuel, including: .1 precautions to be taken before entering enclosed spaces, hazardous zones and areas, including spaces contiguous with hazardous zones .2 precautions to be taken before and during repair and maintenance work .2bis understanding of material compatibilities with hydrogen systems .3 safety measures for hot and cold work

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	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)	3.4 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	.3bis knowledge of measures towards 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 Fire organization and action to be taken on ships having ammonia as fuel 4.2 Special hazards associated with fuel systems, storage and handling on ships having ammonia as fuel (liquid pool or vapour ignition) 4.3 Fire-fighting agents and methods used to control and extinguish ammonia-based fires 4.4 Fire-fighting system operations	4.1 Fire organization and action to be taken on ships having methanol as fuel 4.2 Special hazards associated with fuel systems and fuel handling on ships having methanol as fuel 4.3 Fire-fighting agents and methods used to control and extinguish methanol-based fires 4.4 Fire-fighting system operations	4.1 Fire organization and action to be taken on ships having hydrogen as fuel 4.2 Special hazards associated with fuel systems and fuel handling on ships having hydrogen as fuel (compressed hydrogen vapour ignition) 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 protocols	5.1 Basic knowledge of emergency procedures, including emergency shutdown protocols	5.1 Basic knowledge of emergency procedures, including emergency shutdown protocols
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 ammonia 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/venting of ammonia	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage of fuels from ships having methanol 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 methanol	6.1 Basic knowledge of measures to be taken in the event of leakage/spillage/venting of fuels from ships having hydrogen 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 hydrogen

Table A-V/3-2
Specification of minimum standard of competence in advanced training for ships subject to the IGF Code
(Mapping with ammonia, methanol and hydrogen fuels)

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	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 .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	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: .1 simple physical laws .2 states of matter of ammonia including phase changes .3 liquid and vapour densities .3bis liquefaction of gases .4 boil-off of low-temperature fuel (ammonia) .4bis diffusion and mixing of gases .5 compression and expansion of gases .6 critical pressure and temperature of gases .7 high flashpoint of ammonia, 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 [knocking] .13 pollutant characteristics of ammonia	1.1 Basic knowledge and understanding of simple chemistry and physics and the relevant definitions related to safe bunkering and use of methanol used as fuel: .1 the chemical structure of methanol .2 the properties and characteristics of methanol including: .1 simple physical laws .2 n/a .3 liquid and vapour densities .4 n/a .5 n/a .6 n/a .7 flashpoint, upper and lower flammable limits, auto-ignition temperature .8 n/a .9 n/a .10 n/a .11 combustion properties: heating values .12 [knocking] .13 pollutant characteristics of methanol	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: .1 the chemical structure of hydrogen .2 the 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) .4bis capability to freeze surrounding air to form liquid air .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 n/a

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.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	.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 and compatibility with ammonia .7bis quality of fuel including the effect of impurities .8 effect of low temperature, including brittle fracture 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about ammonia	.3 [the properties of single liquids] .4 the nature and properties of solutions (flammability of water-methanol mixtures) .5 thermodynamic units .6 basic thermodynamic laws and diagrams .7 properties of materials and compatibility with methanol .7bis quality of fuel including the effect of impurities .8 n/a 1.2 Understanding the information contained in a Safety Data Sheet (SDS) about methanol	.11 combustion properties: heating values .12 [knocking] .13 pollutant characteristics of hydrogen .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 and compatibility with hydrogen .7bis quality of fuel including the effect of particulate impurities .8 effect of low temperature, including brittle fracture 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	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	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:	3.1 Design and characteristics of ships having ammonia as fuel under different storage conditions 3.2 Knowledge of ship design, systems, and equipment found on ships having ammonia as fuel, including:	3.1 Design and characteristics of ships having methanol as fuel 3.2 Knowledge of ship design, systems, and equipment found on ships having methanol as fuel, including:	3.1 Design and characteristics of ships having hydrogen as fuel 3.2 Knowledge of ship design, systems, and equipment found on ships having hydrogen as fuel, including:

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
board ships subject to the IGF Code	.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 .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 fuel systems for different propulsion systems .2 general arrangement and construction .3 fuel storage systems on board ships having 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 .2bis vapour/boil-off management .3 expansion devices .4 flame screens and arrestors .5 temperature {< -30 deg} and pressure monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 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 ammonia as fuel .1 low pressure pumps .2 high pressure pumps	.1 fuel systems for different propulsion systems .2 general arrangement and construction .3 fuel storage systems on board ships having methanol 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 .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 fuel tanks temperature and atmosphere 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 methanol as fuel .1 low pressure pumps	.1 fuel systems for different propulsion systems .2 general arrangement and construction .3 fuel storage systems on board ships having hydrogen 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, {vacuum-sealed} piping) and valves .2bis vapour/boil-off management (Gas Combustion Unit (GCU)) .3 expansion devices .4 flame screens and arrestors .5 temperature and pressure monitoring systems .6 fuel tank level-gauging systems .7 tank pressure monitoring and control systems .5 cryogenic fuel tanks temperature and atmosphere pressure maintenance .6 fuel system atmosphere control systems (inert gas, nitrogen), including storage, generation and distribution .7 asphyxiant and flammable gas-detecting systems .8 fuel Emergency Shut Down system (ESD)

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.1 low pressure pumps .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	.2bis compressors .3 vapourizers .4 heaters .4bis heat exchangers .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 .1bis gas freeing .2 tank preparation (conditioning/drying) .3 initial loading .4 temperature {< -30 deg} and pressure control .5 heating of fuel .5bis vapour management .6 emptying systems	.2 high pressure pumps .3 n/a .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 .1bis gas freeing .2 n/a .3 initial loading .4 tank atmosphere pressure control .5 n/a .6 emptying systems	3.3 Knowledge of fuel system theory and characteristics, including types of fuel system pumps and their safe operation on board ships having hydrogen as fuel .1 low pressure pumps .2 high pressure pumps .2bis compressors .3 Gas Combustion Unit (GCU) .4 heaters .4bis {heat exchangers} .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 .1bis gas freeing .2 [tank preparation (conditioning/drying)] .3 initial loading .4 tank atmosphere pressure control .5 heating of fuel .5bis 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	4.1 General knowledge of ships having 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	4.1 General knowledge of ships having methanol as fuel 4.2 Ability to use all data available on board related to bunkering, storage and securing of methanol as fuel 4.3 Ability to establish clear and concise communications between the ship and the terminal, truck or the bunker- supply ship	4.1 General knowledge of ships having 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 ship

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	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 4.7 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	4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships having ammonia as fuel 4.5 Proficiency in the operation of bunkering systems on board ships having 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 including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .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 ammonia related operations concurrent with other onboard operations, both in port and at sea	4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships having methanol as fuel 4.5 Proficiency in the operation of bunkering systems on board ships having methanol 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 including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .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 methanol related operations concurrent with other onboard operations, both in port and at sea	4.4 Knowledge of safety and emergency procedures for operation of machinery, fuel and control systems for ships having hydrogen as fuel 4.5 Proficiency in the operation of bunkering systems on board ships having hydrogen 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 including Quick Connect/Disconnect Coupling (QCDC) and Vessel Separation Devices (VSDs) .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 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 {including management of ammonia contaminated water}	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	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/vapour cloud formation

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
		5.3 {Knowledge of measures to be taken in the event of foreseeable release including recovery and treatment systems}		
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]	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 .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	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships having ammonia as fuel, including: .1 flammability .2 explosion and implosion .3 toxicity {AEGL 1, 2 and 3 (25, 110 and 220 ppm levels)} .4 reactivity (interactions with water/moisture (hygroscopic)) .5 corrosivity .6 health hazards .7 inert gas composition .8 n/a .8bis vapour leaks .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 ammonia as fuel	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships having methanol as fuel, including: .1 flammability (including water-methanol mixtures) .2 explosion .3 toxicity .4 reactivity .5 corrosivity .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 having methanol as fuel	7.1 Knowledge and understanding of the hazards and control measures associated with fuel system operations on board ships having hydrogen as fuel, including: .1 flammability .2 explosion .3 asphyxiant .4 reactivity .5 corrosivity (hydrogen embrittlement) .6 health hazards .7 inert gas composition .8 electrostatic hazards .8bis vapour leaks .9 pressurized gases .10 low temperature 7.2 Proficiency to calibrate and use monitoring and fuel detection systems,

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	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 having ammonia as fuel 7.5 Ability to elaborate and develop risks analysis related to risks on board ships having ammonia as fuel 7.6 Ability to elaborate and develop safety plans and safety instructions for ships having ammonia as fuel 7.7 Knowledge of hot work, enclosed spaces, hazardous zones, spaces contiguous with hazardous zones and tank entry including permitting procedures, {toxic spaces and toxic areas}	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 methanol as fuel 7.5 Ability to elaborate and develop risks analysis related to risks on board ships having methanol as fuel 7.6 Ability to elaborate and develop safety plans and safety instructions for ships having methanol as fuel 7.7 Knowledge of hot work, enclosed spaces, hazardous zones, spaces contiguous with hazardous zones and tank entry including permitting procedures	instruments and equipment on board ships having hydrogen 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 hydrogen as fuel 7.5 Ability to elaborate and develop risks analysis related to risks on board ships having hydrogen as fuel 7.6 Ability to elaborate and develop safety plans and safety instructions for ships having hydrogen as fuel 7.7 Knowledge of hot work, enclosed spaces, hazardous zones, spaces contiguous with hazardous zones 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 8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety including:	8.X Knowledge of function, calibration and limitation (if any) of gas-measuring instruments and similar equipment: .1 atmosphere testing and gas detection including toxic levels of ammonia 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 .3 resuscitators .4 rescue and personal escape equipment 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:	8.X Knowledge of function, calibration and limitation (if any) of gas-measuring instruments and similar equipment: .1 atmosphere testing and gas detection including toxic levels of methanol 8.1 Proper use of specialized safety equipment and protective devices compatible with methanol exposure, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and personal escape equipment 8.2 Knowledge of safe working practices and procedures in accordance with legislation and industry guidelines and personal shipboard safety relevant to ships having methanol as fuel, including:	8.X Knowledge of function, calibration and limitation (if any) of gas-measuring instruments and similar equipment: .1 atmosphere testing and gas detection of asphyxiant levels of hydrogen 8.1 Proper use of specialized safety equipment and protective devices compatible with hydrogen exposure, including: .1 breathing apparatus and evacuating equipment .2 protective clothing and equipment .3 resuscitators .4 rescue and personal escape equipment 8.2 Knowledge of safe working practices and procedures in accordance with

Competence	Knowledge, understanding and proficiency			
	Existing IGF Code training	Ammonia	Methanol	Hydrogen
	.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 precautions to be taken before and during repair and maintenance work .1bis understanding of material compatibilities with ammonia systems .2 electrical safety [reference to IEC 600079-17:2024] .3 ship/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, {toxic spaces and toxic areas} .3qua understanding of location of emergency muster stations/safe havens 8.3 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	.1 precautions to be taken before and during repair and maintenance work .1bis understanding of material compatibilities with methanol systems .2 electrical safety [reference to IEC 600079-17:2024] .3 ship/shore safety checklist .3bis safety measures for hot and cold work .3ter precautions to be taken before entering hazardous zones and areas, including spaces contiguous with hazardous zones .3qua understanding of location of emergency muster stations/safe havens 8.3 Basic knowledge of first aid with reference to a Safety Data Sheet (SDS)	legislation and industry guidelines and personal shipboard safety relevant to ships having hydrogen as fuel, including: .1 precautions to be taken before and during repair and maintenance work .1bis understanding of material compatibilities with hydrogen systems .2 electrical safety [reference to IEC 600079-17:2024 & ATEX Type 2C equipment or equivalent international standard] .3 ship/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 .3qua understanding of location of emergency muster stations/safe havens 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 ammonia fuels 9.2 Fire organization and action to be taken on ships having ammonia as fuel 9.3 Special hazards associated with fuel systems and fuel handling on ships having ammonia as fuel (liquid pool or vapour ignition) 9.4 Fire-fighting system operations	9.1 Knowledge of the methods and fire-fighting appliances to detect, control and extinguish fires of methanol fuels 9.2 Fire organization and action to be taken on ships having methanol as fuel 9.3 Special hazards associated with fuel systems and fuel handling on ships having methanol as fuel 9.4 Fire-fighting system operations	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 hydrogen as fuel 9.3 Special hazards associated with fuel systems and fuel handling on ships having hydrogen as fuel (liquid pool or vapour ignition) 9.4 Fire-fighting system operations, particularly ventilation systems