INTERNATIONAL MARITIME ORGANIZATION

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SUB-COMMITTEE ON HUMAN ELEMENT, TRAINING AND WATCHKEEPING
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Agenda item 7

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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

Information about current training measures in use or under development for crews of hydrogen ships

Submitted by United Kingdom, ITF and ZESTAs

SUMMARY

Executive summary:	This document provides information about current available training for crews of vessels utilizing hydrogen as a fuel, as well as the increasing need for proper and safe crew training.
Strategic direction, if applicable:	3
Output:	3.8
Action to be taken:	Paragraph 29
Related documents:	Resolution A.1173(33); CCC 9/INF.17; MEPC 81/INF.5 and CCC 10/16

Background

1 HTW 10 agreed that the existing output of the 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. HTW 10 therefore invited the Committee to include this output in the provisional agenda for HTW 11 (HTW 10/10, paragraph 6.32.2).

2 MSC 108 endorsed the agreement by HTW 10 to proceed with the development of training provisions for seafarers on ships using alternative fuels (MSC 108/20 5.4).

3 CCC 10 noted a view expressing that a new section on training and personnel protection should be included in the interim guidelines (CCC 10/16, paragraph 3.10).

Introduction

4 As seen in document MEPC 81/INF.5, "Commercial Readiness of Absolute Zero-Emission Technologies", a number of commercial vessels using hydrogen as a fuel were already in service in December 2023, with more currently under development. Hydrogen fuel is stored in gaseous or liquid systems on board. Fuel Cell electric-drives and internal combustion systems are being utilized for primary and secondary drives as well as for the running of services on board.

5 Based on updated data from document MEPC 81/INF.5 projects for vessels utilizing hydrogen as a fuel, additional estimates of crew numbers working on hydrogen-powered vessels between 2017 and 2028 are shown in the chart in annex 1 and its accompanying data. It is estimated that a total of 222 crew members are working on hydrogen-fuelled commercial vessels at the end of 2024, and that this number is estimated to increase to at least 730 crew members by 2028. This number is derived from vessels currently in development, based on publicly available information presented in annex 1. The actual number of vessels operational by 2028 is probably higher due to confidential projects and projects yet to be announced. The vessels in question are of a wide variety of sizes, types, system power and installed hydrogen technologies.

6 ZESTAs is aware that some flag State authorities are working with the training sector to find training solutions to enable crew safety whilst meeting STCW requirements.

7 This document provides information on current available training courses for crews of vessels using hydrogen as a fuel which has recognition from a flag State authority, as well as courses that are in development.

Current training provision

8 As of October 2024, the United Kingdom Maritime Coastguard Agency (MCA) has given voluntary recognition to the University of the Highlands and Islands Maritime Studies Department in the Orkney Islands (UHI Orkney) for a course entitled:

> Certificate of Fuel-Specific Training for Service on Ships Using Compressed Gaseous or Liquid Hydrogen as a fuel. (Parts 1 and 2)

UHI Orkney course timetable and content

9 Part 1 training is two days. Part 2 training is three days. Part 2 trainees are then required to attend bunkering on their own vessel which may be at a later date and notified to UK MCA as part of the certification process.

10 The content has been mapped to training under the International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels (IGF Code) to ensure parity and inclusion of relevant topics. Topics covered are listed below.

Part 1 and part 2 candidates equate with Basic and Advanced IGF.

"Basic" theory day for both part 1 and part 2 candidates

- Hydrogen, what is it and how does it behave?
- Characteristics and hazards. Gaseous and liquid hydrogen.
- Pollution and MARPOL.
- First Aid, dangers of asphyxiation.

- Precautions to prevent hazards.
- Effective safety culture.
- Hazards and hazard controls.
- Personal protective equipment.
- Hydrogen storage, general considerations – liquid and gaseous.
- Caution not to attempt to tighten hydrogen fittings.
- Leaks and venting, general considerations – examined in more detail later in course.

"Advanced" theory day for part 2 candidates only

- Occupational health and safety measures.
- ATEX – potentially explosive atmospheres. In depth look at procedures, equipment, placarding, considerations, PPE etc.
- Causes of potentially explosive atmospheres.
- General precautions to be taken.
- Specific precautions to be taken.
- Bunkering principles.
- Bunkering: typical arrangements.
- Bunkering checklist. Discussion/role play/ referral to checklist, system arrangement, tank containment space and P & ID diagram to ensure clear orientation and theoretical shared mental model.
- Hose reel and valves.
- Maintenance culture.
- Purging and the use of nitrogen and other gases.
- Isolation valves – P & ID drawing to illustrate different kinds and functions.
- Permit to work.
- Periodic inspection – general principles.
- Fire response theory.

Workshop day for part 1 and part 2 candidates

11 A workshop may be held between part 1 and part 2 theory days. This is a participative workshop day, utilizing vessel plans, procedures and other documents either for a specific vessel or representative examples. Participation is expected and monitored, particularly in the emergency scenarios.

- Operating manual / procedures. Vessel specific or typical examples. Particular attention to:
- Starting and operation.
- Emergency actions.
- System design – P & ID, Tank Pack (TCS), hydrogen fuel rail.
- System service guide and intervals.
- Inspection items.
- Functional tests.
- Leak detection and fault codes.
- Safety Management System.
- Decision support.
- Risk assessment.
- Bunkering checklist refresher.
- Handling of IR camera and/or leak detection equipment.
- Emergency scenarios.

Bunkering

12 Part 2 (Advanced IGF) candidates will have completed at least two simulated bunkering exercises during their training. They may complete their third on their own vessel. This may be at commissioning or a subsequent bunkering. A UHI staff member may attend to witness the bunkering or chief engineer may certify and notify UK MCA.

13 At present there is no international standardization and, in order to trade internationally, vessel crews are having to obtain generic IGF pre-training for fuels other than those in use by their vessel. Fuel-specific UK Near Coastal training is a short-term solution to enable vessel development.

Hydrogen training linked to IGF training

14 In the United Kingdom, the development of hydrogen vessel training is currently approached at two levels; Compliance with IGF for convention sized vessel trading internationally and, secondly, a course for vessels training in United Kingdom near-coastal waters only (not necessarily carrying IGF notation but using hydrogen as a fuel and meeting the functional requirements of the IGF code). The latter, "UK Near Coastal" course is still at a very early stage, awaiting further development so, here, this document will outline the United Kingdom provision linked to IGF training.

15 The UK MCA has been working with UHI Orkney and a course has already been delivered. The structure of the course is proactive and unique as it is mapped against IGF training learning outcomes but is not, in itself, IGF training. The training is specified as follows:

- Crews to attend STCW IGF training, Basic or Advanced, according to their duties. Advanced candidates to complete x2 simulated bunkering exercises (plus a third exercise on board an IGF-certified vessel). This meets the IGF training requirement but it is acknowledged that IGF training is often LNG-based so further, hydrogen, training is required.

- A hydrogen specific course is then provided to crews, part 1 (basic) and / or part 2 (advanced) according to their duties. This meets SMS and Ship familiarization requirements but is also an important addition to the LNG-based IGF training received. Syllabus is expanded later in this document.

- Sea Service, required under IGF training for senior crew, may be obtained by service on, for example, LNG vessels.

- The requirement for three bunkering operations is met by two simulated bunkering operations being carried out during Advanced STCW IGF training and one further operation is undertaken on the hydrogen vessel itself.

Suitability of this training model

16 The training model given above requires crews to undertake two separate training courses in order to meet, firstly, the IGF requirement then secondly, adequate familiarization with the fuel and an appropriate Safety Management System (SMS) to support safe operation of hydrogen as fuel.

17 Whilst the UK model has been innovative in enabling a number of vessels to progress, it is seen as an interim model.

Current training provision

18 As of October 2024, the UK MCA has given Voluntary Recognition to UHI Orkney for a course entitled:

> Certificate of Fuel-Specific Training for Service on Ships Using Compressed Gaseous or Liquid Hydrogen as a Fuel (Parts 1 and 2)

19 Before undertaking this hydrogen-specific training, crews first undertake STCW IGF training, Basic or Advanced, commensurate with their duties on board. Part 1 and part 2 certificates for the UHI Orkney course are then undertaken by hydrogen vessel crews and Parts 1 and 2 are aligned with either Basic IGF or Advanced IGF. Use of the terms "Basic" and "Advanced" for the UHI Orkney course was avoided to ensure certificates were not confused with STCW IGF certificates. The UHI Orkney certification and reporting pathway is shown in annex 2.

20 Evaluation: Undertaking STCW IGF pre-training clearly meets the legal requirements for serving on a vessel using low flashpoint fuels and is a legal necessity, however most IGF training is delivered by centres specializing in LNG and so crews of hydrogen vessels then need to be re-trained around their specific fuel.

21 Course prerequisites are that Basic (part 1) candidates, hold STCW Basic IGF and STCW Basic Fire-Fighting certificate. Advanced candidates, hold STCW Advanced IGF and STCW Advanced Fire-Fighting certificate. Also, Advanced candidates must have 30 days seatime on an IGF certified vessel. It is understood that the 30 days seatime requirement causes difficulties for industry with alternative methods being looked into. Advanced candidates, whilst undertaking their IGF pre-training, shall complete two simulated bunkering exercises with the third being on their own vessel. This third bunkering is witnessed by the UHI Orkney team or Chief Engineer and notified to MCA.

Evaluation of the Orkney model

22 The UHI Orkney training outlined above is hydrogen-specific and closely mapped with IGF learning outcomes. It is also comprehensive and includes a deep focus on SMS and vessel emergency response. The requirement for crews to first attend STCW IGF courses is largely in order to meet "the letter of the law" so that hydrogen vessel crews have attended STCW training for gaseous fuels or low flashpoint fuels. This should allow vessels to trade internationally under current STCW legislation.

23 However, commercial IGF training typically focuses on LNG which behaves differently to hydrogen. The additional training requirement also places an additional financial and time burden on crews and vessel operators.

24 The IGF requirements of 30 days sea service and two prior simulated bunkering exercises also place a barrier for qualifying crews especially when hydrogen vessels often operate in a different sector to typical LNG vessel operations. Hydrogen vessels currently under development are often inshore, short haul vessels, operating in estuaries or coastal trade. Thus, recruiting crews from the LNG vessel sector is difficult due to differences in pay, skills and experience.

Stand-alone hydrogen training

25 It is the intention of UHI Orkney to develop a stand-alone hydrogen vessel crew course to evaluate the training needs of crews on liquid or gaseous hydrogen vessels. To that end, UHI Orkney is developing a UK Near Coastal course for voluntary recognition by the United Kingdom Government (MCA).

26 The timetable does not differ from the course outlined above except crew do not attend STCW IGF training beforehand. The content is still mapped to IGF Basic and Advanced training to ensure the seafarer receives the necessary material to operate safely. Bunkering training would be on the crew's own vessel although at this stage, simulator options are also being considered.

27 Training within the IGF framework should be fuel specific. There is a risk that crew members who have trained on LNG, then attend training on hydrogen, or some other alternative fuel, could become confused in an emergency, as these fuels behave and react differently.

The need for hydrogen vessel training - Vessels in operation or development

28 Information on estimated crew on hydrogen-fuelled ships is set out in annex 1.

Action requested of the Sub-Committee

29 The Sub-Committee is invited to note the information provided above.

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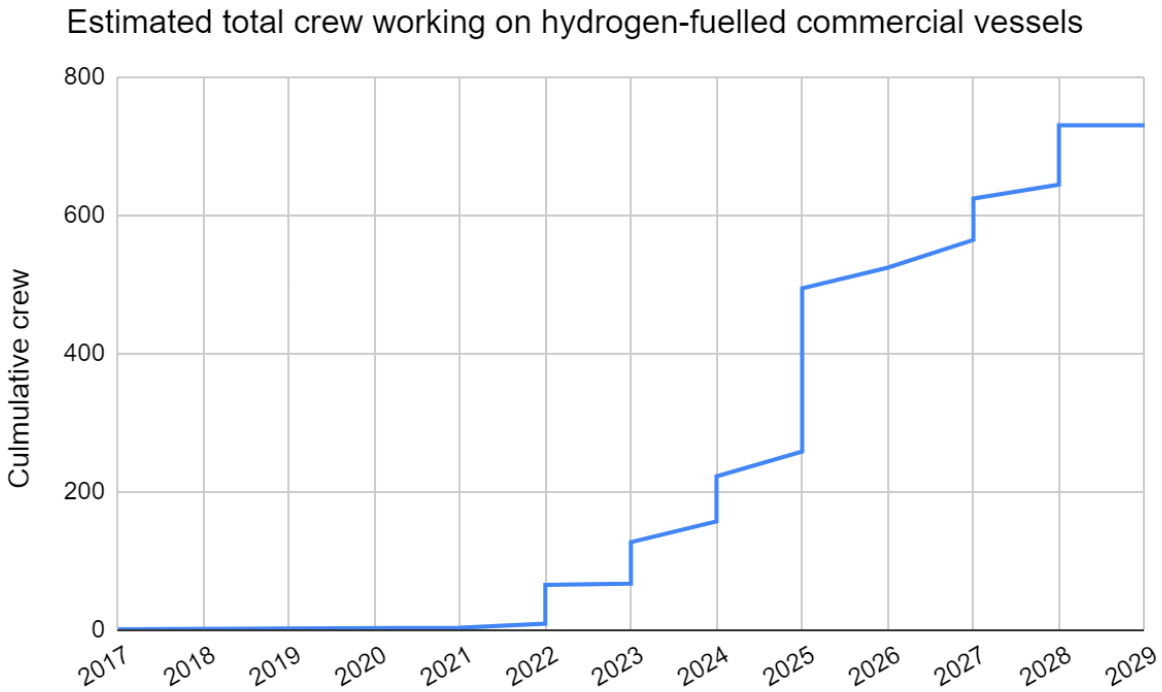
Annex 1

Estimated crew on hydrogen-fuelled ships



See next page for chart data, where:

- Data for vessels utilising hydrogen as a fuel is updated from MEPC 81/INF.5;
- Cells in grey are estimated values;
- Crew estimates only include crew who would otherwise be eligible for IGF training;
- Projects at “funded” stage have at least 2.5 million EUR in public grants per vessel;
- For an expanded version of the data in this annex and all references, please email contact@zestas.org.

Hydrogen vessel or project name	Stage	Number of vessels	Installed power (MW)	Vessel Type	Length overall (m)	Gross Tonnage (GT)	Number of crew members per rotation	Number of rotation	Total crew per ship	Culmulative crew	Operational	Technology	Crew reference
HydroVille	In service	1	0.44	Passenger shuttle	14		1	1	1	1	2017	Hydrogen-diesel ICE	Information from supplier
HydroBingo	In service	1	0.882	Passenger ferry	19.4		2	1	2	3	2021	Hydrogen-diesel ICE	Information from supplier
Sea Change	In service	1	0.36	Passenger ferry	23	~20	3	2	6	9	2022	Main propulsion FC	
Elektra	In service	1	0.3	Inland push boat		-	5	2	10	19	2022	Auxiliary power FC	CCNR, 2024
Viking Neptune	In service	1	0.1	Cruise	228.2		20	2	40	59	2022	Auxiliary power FC	
HydroTug 1	In service	1	4	Tug	30		3	2	6	65	2022	Hydrogen-diesel ICE	Estimate based on ZEETUG65
Medusa 2	Pilot test	1	0.6	Dredger		-	2	1	2	67	2023	Auxiliary power FC	
Three Gorges H	In service	1	0.5	Passenger ferry	50		4	2	8	75	2023	Main propulsion FC	
Hanaria	Sea trials	1	0.48	Passenger ferry		240	3	2	6	81	2023	Main propulsion FC	
Zulu 06	Sea trials	1	0.4	Inland container		-	2	2	4	85	2023	Main propulsion FC	CCNR, 2024
H2 Barge 1	In service	1	0.825	Inland container	110	-	5	2	10	95	2023	Main propulsion FC	CCNR, 2024
Hydra	In service	1	0.4	RoPax ferry	82.4	2699	6	3	18	113	2023	Main propulsion FC	Information from supplier
Antonie	In service	1	0.3	Inland dry cargo	135	-	5	2	10	123	2023	Main propulsion FC	CCNR, 2024
ZEUS	In service	1	0.14	Research		47800	4	1	4	127	2023	Auxiliary power FC	
Feadship Supe	Sea trials	1	3	Luxury yacht	119	>7000	15	2	30	157	2024	Auxiliary power FC	
Kvitnos - HyEk	Funded	1	2.4	Product tanker		~13500	12	2	24	181	2024	Auxiliary power FC	
H2 Barge 2	In service	1	1.2	Inland container	109.8	-	5	2	10	191	2024	Main propulsion FC	CCNR, 2024
FCV Vanguard	Demonstration	1	0.39	Speedboat	8.2		1	1	1	192	2024	Main propulsion FC	
Skulebas	Under construc	1	0.32	Fishing training			2	2	4	196	2024	Main propulsion FC	
Pilot-E	Under construc	1	0.145	Fish farm workboat		170	2	2	4	200	2024	Main propulsion FC	
Neo Orbis	Under construc	1		Passenger ferry			2	1	2	202	2024	Main propulsion FC	
India hydrogen	Sea trials	1		Passenger ferry	24	1500	2	1	2	204	2024	Main propulsion FC	
FRS HydroCat	In service	1		CTV	23.81		3	2	6	210	2024	Hydrogen-diesel ICE	Information from supplier
HydroCat 48	In service	1		CTV	24.57		3	2	6	216	2024	Hydrogen-diesel ICE	Information from supplier
HydroCat 58	In service	1		CTV	27		3	2	6	222	2024	Hydrogen-diesel ICE	Information from supplier
Torghatten Nor	Under construc	2	6.4	RoPax ferry	97	< 5000	6	3	36	258	2025	Main propulsion FC	
SeaShuttle	Under construc	2	3.2	Container cargo	135	~5000	10	2	40	298	2025	Auxiliary power FC	
Halten Bulk	Funded	2	1	Bulk carrier	88	5500	10	2	40	338	2025	Main propulsion FC	
Rhenus Mannh	Sea trials	2	0.4	Inland container	105	-	5	2	20	358	2025	Auxiliary power FC	CCNR, 2024
Prince Madog (	Under construc	1	0.2	Offshore service/res	35	390	6	1	6	364	2025	Auxiliary power FC	
Hydrogen CSO	Under construc	6		CSOV	87	499	7	3	126	490	2025	Hydrogen-diesel ICE	
HydroCat 60	Under construc	1		CTV	27		2	2	4	494	2025	Hydrogen-diesel ICE	Information from supplier
Maris Fiducia P	Funded	5	0.4	Dry bulk		5000	3	2	30	524	2026	Hydrogen-diesel ICE & FC Auxiliary power	
SAFeCRAFT	Funded	1	2	Bulk carrier	290	88853	20	2	40	564	2027	Main propulsion FC	
RH2IWER	Funded	6	0.6-2	Inland container, bu	135	-	5	2	60	624	2027	Main propulsion FC	CCNR, 2024
Veer Design Nº	Funded	1		Container cargo	100	54300	10	2	20	644	2028	Main propulsion FC	
Viking-Fincantie	Funded	2		Cruise			20	2	80	724	2028	Auxiliary power FC	
ZEAS	Funded	1	1.2	Passenger ferry			3	2	6	730	2028	Main propulsion FC	

Annex 2

UHI Orkney (UK) Hydrogen Vessel Training Certification and Reporting Pathway. (Includes IGF Pre-training for international trade).