RUSSIAN MARITIME REGISTER OF SHIPPING

URGENT RULE CHANGE NOTICE **No. 311-05-2060** dated 10.11.2025

Entry-into-force date:
From the date of publication

Re: amendments to the Rules for the Classification and Construction of Sea-Going Ships, ND No. 2-020101-174-E, version 01.07.2025

Requirements have been introduced for the ships fitted with fuel cell power plant.

Instructions on application:

1. Bring the content of the Urgent Notice with the instructions on the application hereof to the attention of the RS surveyors.

2. Apply the amendments introduced by the Urgent Notice during review and approval of the technical documentation on ships (or equipment installed on board the ships, or products/machinery installed on board the ships) contracted for construction or conversion on or after 10.11.2025, in the absence of a contract, during review and approval of the technical documentation on ships requested for review on or after 10.11.2025.

3. Apply the amendments introduced by the Urgent Notice during review of the technical documentation on ships under construction and in service upon request of the interested parties.

Director General Sergey A. Kulikov

Person in charge: Sergey Panfilov 311 +7(812)312-11-00

AMENDMENTS
TO THE RULES FOR THE CLASSIFIACATION AND CONSTRUCTION OF SEA-GOING SHIPS

REVISION HISTORY

PART I. CLASSIFICATION (01.07.2025)

Item	Applied to	Description	Remarks
Para 2.2.68 (new)	Ships fitted with fuel cell power plant Distinguishing marks in the class notation	New distinguishing mark **FCell** has been introduced for ships fitted with fuel cell power plant generating electrical and thermal power	
Table 2.5, item 1.33 (new)	**FCell** — a distinguishing mark for a ship fitted with fuel cell power plant	Brief description and references to additional RS requirements for distinguishing mark **FCell** have been introduced	
Table 3.2, item 3.2.17.30 (new)	Ships fitted with fuel cell power plant Design documentation	List of design documentation for assignment of distinguishing mark **FCell** has been introduced	

PART XI. ELECTRICAL EQUIPMENT (01.07.2025)

Item	Applied to	Description	Remarks
Para 3.1.1	Electrical equipment Main electrical power source Fuel cells (FC)	Requirement has been introduced for FC allowing their use as the main source of electrical power	
Para 26.3.1	Electrical equipment FC Modes of FC operation	Requirement has been introduced for using FC as the main source of electrical power	

Item	Applied to	Description	Remarks
Para 26.3.3 (new)	Electrical equipment FC FC location on board the ship	Requirement has been introduced for quantity and location of FC when used as the main source of electrical power	
Para 26.6.3 (deleted)	Electrical equipment FC FC safety	Para has been deleted due to transfer of the requirements into Section 36 of Part XVII	
Para 26.10.3 (deleted)	Electrical equipment FC FC location on board the ship	Para has been deleted due to transfer of the requirements into Section 36 of Part XVII	

PART XVII. DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION SPECIFYING STRUCTURAL AND OPERATIONAL PARTICULARS OF SHIPS (01.07.2025)

Item	Applied to	Description	Remarks
Section 36	All ships Fuel cell power plants Fuel cell spaces Ventilation and inerting systems Fire protection Electrical equipment Control, alarm and safety systems	Requirements have been introduced for ships fitted with fuel cell power plant generating electrical and thermal power	MSC.1/Circ.1647

PART I. CLASSIFICATION

2 CLASS OF A SHIP

2.2 CLASS NOTATION OF A SHIP. MANDATORY AND OPTIONAL DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION ASSIGNED BY RUSSIAN MARITIME REGISTER OF SHIPPING

New para 2.2.68 is introduced reading as follows:

"**2.2.68 Distinguishing mark for ships fitted with fuel cell power plant.**

For ships fitted with fuel cell power plant generating electrical and thermal power and complying with the requirements of Section 36 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships", the distinguishing mark **FCell** (Fuel Cell) is added to the character of classification, after which the abbreviated name of the primary fuel used (as specified in Section 36 of Part XVII) is indicated in brackets, for example **(hydrogen)**.".

2.5 SUMMARY INFORMATION ON DISTINGUISHING MARKS IN THE CLASS NOTATION OF A SHIP

Table 2.5. New para 1.33 is introduced reading as follows:

"**1.33 FCell — Distinguishing mark for ships fitted with fuel cell power plant**

Distinguishing mark	Brief description	References to additional RS requirements for the distinguishing mark
FCell (<primary fuel>)	Assigned to ships fitted with fuel cell power plant. The abbreviated name of the primary fuel used is indicated in brackets after the distinguishing mark	**RS Rules/C;** Part I "Classification", 2.2.68; Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships", Section 36

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3 TECHNICAL DOCUMENTATION

3.2 DESIGN DOCUMENTATION

New para 3.2.17.30 is introduced reading as follows:

"3.2.17.30 FCell.

No.	Description of documentation	Stamp	TD	DD	PAD	Remarks
.1	Drawing of fuel cells arrangement with indication of distance from bottom and side plating to the equipment containing primary and reformed fuel	A	●		●	
.2	Drawing of supports and other structures to ensure fastening and mechanical protection of fuel cells	A	●		●	
.3	Drawings and diagrams of systems and piping for primary and reformed fuel specifying such assemblies as compensators, flange joints, stop and control valves and fittings, drawings of quick-closing arrangements of the fuel system, diagrams of fuel preparation systems	A	●	●	●	Diagrams are submitted during review of the technical design with submission of drawings at the stage of review of the detailed design documentation
.4	Drawings of safety and vacuum valves in fuel system, if any	A		●	●	
.5	Installation drawings of arrangements for measurement of fuel amount and characteristics, and for leakage detection	A		●	●	
.6	Diagrams and calculations of gas-dangerous spaces ventilation	A	●		●	
.7	Electrical diagrams for connection of drives and control systems for fuel preparation plants, ventilation of hazardous spaces and airlocks	A	●	●	●	Diagrams are submitted during review of the technical design with submission of drawings at the stage review of the detailed design documentation
.8	Electrical circuit diagrams for measurement and alarm systems for equipment related to the use of primary and reformed fuel	A		●	●	
.9	Arrangement drawings of electrical equipment related to the use of primary and reformed fuel	A		●	●	
.10	Drawings of cable laying in hazardous and gas-dangerous spaces	A		●	●	
.11	Drawings of earthing for electrical equipment, cables, piping located in gas-dangerous spaces	A		●	●	

No.	Description of documentation	Stamp	TD	DD	PAD	Remarks
.12	Hazardous areas diagram specifying the layout of primary and reformed fuel storage tanks and any openings in them; spaces for fuel storage and preparation and any openings leading into them; doors, hatches and any other openings leading into hazardous spaces and areas; venting pipes and air inlet and outlet locations of ventilation system of hazardous spaces and areas; doors, scuttles, companions, ventilation duct outlets locations and other openings in spaces adjacent to hazardous area	A	●		●	
.13	Analysis of risks related to the use and storage of primary and reformed fuel and possible consequences of its leakages. The analysis shall consider the risks of damage of hull structural members and failure of any equipment after accident related to the use of primary and reformed fuel. The results of risk analysis shall be taken into account in the ship's operational documentation	AG	●		●	
.14	Diagram of pressure water-spraying system (if any), including piping, valves, nozzles and fittings, as well as diagram of dry powder system (if any) and foam fire extinguishing system (if any), their operating manuals and capacity calculation	A	●		●	
.15	Description and functional diagrams of control, monitoring and alarm systems of fuel cell power plant	A	●		●	
.16	Gas detection system diagram	A	●		●	

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PART XI. ELECTRICAL EQUIPMENT

1 GENERAL

1.3 SCOPE OF SURVEYS

New para 1.3.3.1.4 is introduced reading as follows:

"**.4** fuel elements;".

Existing **paras 1.3.3.1.4 — 1.3.3.1.16 and references thereto** are renumbered **1.3.3.1.5 — 1.3.3.1.17** accordingly.

3 MAIN ELECTRICAL POWER SOURCE

3.1 COMPOSITION AND CAPACITY OF MAIN ELECTRICAL POWER SOURCE

Para 3.1.1 is amended as follows:

"**3.1.1** In every ship, a main electric power source shall be provided with a capacity sufficient to supply all the electrical equipment on board under conditions specified in 3.1.5. Such a source shall consist of two independently driven generators at least.

In ships of 500 gross tonnage and below (except for passenger ships), in ships not engaged in international voyages and in ships of restricted area of navigation R3 (except passenger ships engaged in international voyages) with a low-power electrical installation as the main source of electrical power only one generator with an independent prime mover, ~~or~~ accumulator batteries or fuel cells (FC) may be installed.".

26 SPECIAL REQUIREMENTS FOR STATIC SOURCES OF ELECTRICAL POWER

26.2 GENERAL

Para 26.2.2 is amended as follows:

"**26.2.2** In respect of all the parameters not specified in this Section, SPS shall meet the requirements of this Part, ~~and~~ Part XV "Automation" and Section 36 of Part XVII "Distinguishing Marks and Descriptive Notations in the Class Notation Specifying Structural and Operational Particulars of Ships".".

26.3 MODES OF OPERATION

Para 26.3.1 is amended as follows:

"**26.3.1** In accordance with 3.1.1, Li-Ion battery systems (LIBS) and fuel cells (FC) may be used as main power source on board the ships. LIBS may be used as an emergency and emergency transient power source. LIBS, SCS, FC and SA may be used as an auxiliary power source.".

New para 26.3.3 is introduced reading as following:

"**26.3.3** If FC is the main power source, at least two FC or two FC stacks shall be provided arranged in different spaces.".

Para 26.6.3 is deleted. Existing **para 26.6.4 and references thereto** are renumbered **26.6.3**.

Para 26.10.3 is deleted. Existing **para 26.10.4 and references thereto** is renumbered **26.10.3**.

PART XVII. DISTINGUISHING MARKS AND DESCRIPTIVE NOTATIONS IN THE CLASS NOTATION SPECIFYING STRUCTURAL AND OPERATIONAL PARTICULARS OF SHIPS

New Section 36 is introduced reading as follows:

"36 REQUIREMENTS FOR SHIPS FITTED WITH FUEL CELL POWER PLANT

36.1 GENERAL

36.1.1 Scope of application.

36.1.1.1 The requirements of this Section apply to ships fitted with fuel cell power plant generating electrical and thermal power.

36.1.1.2 As the primary fuel used in fuel cells, the following fuel types are reviewed in this Section:

hydrogen;

natural gas;

methanol or ethanol.

36.1.1.3 Ships using natural gas or methanol/ethanol as primary fuel in fuel cell power plants shall also comply with the requirements of Section 9 or Section 23 respectively, if they do not contradict the requirements of this Section.

36.1.1.4 For fuels other than those specified in 36.1.1.2, the level of safety equivalent to the requirements of this Section shall be ensured, which shall be confirmed during the engineering analysis, evaluation and approval of alternative design and arrangement, in accordance with provisions of 9.1.6.

36.1.1.5 In addition to the sea-going ships, the requirements of this Section may be applied to other offshore facilities subject to the RS technical supervision, such as floating oil-and-gas product units, mobile offshore drilling units, fixed offshore platforms. The relevant national requirements applicable for such facilities shall also be considered.

36.1.2 Class notation.

Ships fitted with fuel cell power plant generating electrical and thermal power in accordance with this Section, are assigned the distinguishing mark **FCell** (Fuel Cell) added to the character of classification, after which the abbreviated name of the used primary fuel is indicated in brackets, for example: **(hydrogen)**.

36.1.3 Terms and definitions.

In addition to the below mentioned, the definitions specified in 9.1.3 of this Part are applicable to the requirements of this Section.

Fuel cell stack means an assembly containing two or more fuel cells as well as separators, cooling plates, manifolds, supporting structures, in which electrochemical transformation is carried out, typically, of hydrogen-rich gas and air-reactants to DC power, heat and other reaction products.

Ventilation air is air used to ventilate the fuel cell spaces.

Pre-explosive hydrogen concentration is the concentration of hydrogen within the range of zero to the lower explosive limit (LEL).

LEL means lower explosive limit, which, in the context of this Section, shall be taken as identical to the Lower Flammable Limit (LFL) and which is 4,0% vol. fraction for hydrogen[1].

Exhaust air is exhaust from the cathode side of a fuel cell.

Exhaust gas is exhaust from the reformer or from the anode side of a fuel cell.

Primary fuel is fuel supplied to the fuel cell power system.

Fuel cell space is a space or enclosure containing fuel cell power systems or parts thereof.

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[1] For flammability limits for hydrogen refer to ISO/TR 15916:2015 "Basic considerations for the safety of hydrogen systems".

Reformed fuel is hydrogen or hydrogen-rich gas generated in the fuel reformer.

Process air is air supplied to the reformer and/or to the cathode side of a fuel cell.

Fuel cell — refer to the definition given in 26.1.1 of Part XI "Electrical Equipment".

Fuel reformer is the hookup of all the fuel-reforming equipment for processing gaseous or liquid primary fuel into reformed fuel for use in the fuel cells.

Fuel cell power system is the group of components which may contain fuel or hazardous vapours including fuel cell(s), fuel reformers (if fitted), and associated piping systems.

Fuel cell power plant is the fuel cell power system and other components and systems required to supply electrical power to the ship. The plant may also include auxiliary systems for the fuel cell operation.

36.1.4 Technical documentation.

Technical documentation specified in 3.2.17.30 of Part I "Classification" shall be submitted to the Register for review to confirm compliance with the requirements for ships fitted with fuel cell power plant and to assign the distinguishing mark **FCell** in the class notation.

36.1.5 Risk analysis.

36.1.5.1 A risk assessment shall be conducted to ensure that risks arising from the use of fuel cell power plants and affecting persons on board, the environment, the structural strength or the integrity of the ship are addressed. Consideration shall be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

36.1.5.2 The types of risk shall be analyzed using acceptable and recognized risk analysis techniques, and loss of function, mechanical component damage, auto-ignition of fuels, fire, explosion, toxicity, electric shock, electrical equipment failures, short-term power failure (blackout) shall as a minimum be considered. The analysis shall ensure that risks are eliminated wherever possible.

The consequences of the risk types that cannot be eliminated shall be mitigated to the required level. Details of the risk types with the means of mitigating their consequences shall be documented and submitted to the Register for review.

The risk analysis results shall be recorded in the ship's operational documentation.

36.2 GENERAL REQUIREMENTS FOR SHIP STRUCTURE AND POWER PLANT

36.2.1 Any measures to ensure safety of a fuel cell power plant shall not lead to an unacceptable loss of power.

36.2.2 Fuel cell spaces shall be designed and located so that a fire or explosion in any such space would not lead to an unacceptable loss of power of the ship power plant or render equipment in other compartments inoperable.

36.2.3 A single failure in components of a power plant shall not lead to an unsafe or precarious situation.

36.2.4 Safe access shall be provided to the power plant components for their inspection and maintenance during operation.

36.2.5 The power plant design shall exclude possibility of capsizing, falling or unintentional shifting of its components under the operating conditions for which it is intended.

36.3 FUEL STORAGE TANKS

36.3.1 Storage tanks for primary and reformed fuel shall be selected given the aggregate state, the physical, chemical and toxic properties of fuel.

36.3.2 Fuel storage tanks shall not be located in the same space with oxidizer storage tanks (oxygen or compressed air) and in the fuel cell space.

36.3.3 The location of fuel storage tanks shall meet the requirements of 9.2.2 (for gas fuel including hydrogen fuel) or 23.2.1 (for methanol/ethanol).

36.3.4 The design of fuel storage tanks shall meet the requirements of 9.3 (for gas fuel including hydrogen fuel) or 23.3 (for methanol and ethanol).

36.4 DESIGN PRINCIPLES FOR FUEL CELL POWER PLANTS

36.4.1 Fuel cell spaces.

36.4.1.1 Fuel cell spaces shall be designed as gas-safe spaces (refer to 9.1.3) which may become gas-dangerous spaces under operating conditions other than normal.

36.4.1.2 Fuel cell spaces with respect to the electrical equipment installed therein shall be considered as hazardous zone 1 under the area classification listed in 36.6.2. In this case, the fuel cell stack may not be considered as a source of ignition if the stack surface temperature is kept below 300°C[1] in all operating conditions while the fuel cell power system is capable of immediately shutting off fuel supply to the fuel cell stack and de-energizing same under any load and operating condition (refer also to 36.7.11).

36.4.1.3 In cases where a space is not subject to the area classification listed in 36.6.2, the area classification according to standard IEC 60079-10-1:2020 shall be applied if agreed with the Register, while all electrical equipment shall comply with the accepted area classification.

36.4.1.4 If an inert gas system is used in accordance with 36.4.3.3, there is no need for an immediate (emergency) shutdown of the fuel supply in case of a leakage detection. In this case, the automatic changeover to other power supply systems shall be envisaged with a controlled shutdown of the fuel cell and the affected fuel supply system so to avoid damage to the fuel cell power system.

36.4.1.5 The design of fuel cell power systems shall comply with standards IEC 62282-2-100:2020 and IEC 62282-3-100:2019 or equivalent national standards.

36.4.2 Location, arrangement of and access to fuel cell spaces.

36.4.2.1 Fuel cell power plants shall be designed for automatic operation and equipped with all the monitoring and control means required for safe operation of the system.

36.4.2.2 It shall be possible to shutdown the fuel cell power system from an easily accessible location outside the fuel cell spaces.

36.4.2.3 Means shall be provided to safely remove the primary and reformed fuel from the fuel cell power system.

36.4.2.4 Means shall be provided to change over the fuel cell power plant into a safe state for maintenance and shutdown.

36.4.2.5 Auxiliary systems of the power systems where primary fuel or reformed fuel may leak directly into a system medium (e.g. cooling water) shall be equipped with appropriate means of detection and extraction fitted as close as possible to the media outlet from the system in order to prevent gas dispersion. Gas extracted from the auxiliary system media shall be vented to a safe location on the open deck.

36.4.2.6 The reforming equipment, if fitted, may be an integrated part of the fuel cell or arranged as a stand-alone unit with a reformed fuel piping connected to the fuel cell(s).

36.4.2.7 Fuel cell space enclosures shall be gastight towards other enclosed spaces in the ship.

36.4.2.8 Fuel cell spaces shall be located outside of accommodation spaces, service spaces, machinery spaces of category A and control rooms.

36.4.2.9 Fuel cell spaces shall be designed to safely contain fuel leakages. The spaces shall be equipped with appropriate leakage detection systems and arranged so to avoid accumulation of hydrogen-rich gas[2] by having simple geometrical shape with no obstructions in the upper part.

36.4.2.10 Fuel cell spaces containing fuel reformers shall also comply with the requirements relevant for the primary fuel.

36.4.2.11 Where a separate and direct access to a fuel cell space from the open deck cannot be arranged, access to such space shall be through an air lock in accordance with 9.2.7.

36.4.2.12 No air lock is required for spaces where technical measures are taken to make access to the spaces unnecessary or unfeasible until the equipment inside is safely shutdown

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[1] The 300°C threshold is taken from ISO/IEC 80079-20-1:2017, where the maximum surface temperature is set to 450°C for Hydrogen and Liquified Natural Gas (LNG) and 300°C for methanol/ethanol and Liquified Petroleum Gas (LPG).

[2] Refer also to IEC 60079-10-1:2020.

and cut off from the fuel system with any leakage extracted while the inside atmosphere is confirmed gas-free.

36.4.2.13 The technical provisions required by 36.4.2.12 shall include at least the following:

.1 all controls required for safe operation and degassing of the equipment shall be remotely operated from outside the fuel cell space;

.2 all parameters required for safe operation and degassing, as well as providing audible and visual alarm at a manned location shall be remotely monitored;

.3 openings into a space shall be equipped with an interlock preventing operation with the space open;

.4 spaces shall be equipped with suitable arrangements for collecting and draining fuel leakage that are remotely operated from outside the space; and

.5 provisions shall be made that the fuel equipment inside can be cut off from the fuel system, drained of fuel and purged safely for maintenance.

36.4.3 Atmospheric control of fuel cell spaces.

36.4.3.1 General.

Atmospheric control of the fuel cell spaces shall be achieved by venting according to 36.4.3.2 or inerting according to 36.4.3.3.

36.4.3.2 Venting of the fuel cell spaces.

36.4.3.2.1 Fuel cell spaces shall be equipped with an effective mechanical ventilation system to maintain underpressure of the entire space, taking into consideration the density of potentially leaking fuel gases.

36.4.3.2.2 For the fuel cell spaces on open decks, overpressure mechanical ventilation shall be considered.

36.4.3.2.3 Ventilation rate in the fuel cell spaces shall be sufficient to dilute the average gas/vapour concentration below 25% of the LEL in all maximum probable leakage scenarios arising due to technical failures.

36.4.3.2.4 Any ducting used for venting the fuel cell spaces shall be separated from the ducting used for venting any other space.

36.4.3.2.5 Ventilation ducts from the fuel cell spaces containing reformed fuel piping or gas release sources shall be designed and located so that any possibility for gas accumulating is avoided.

36.4.3.2.6 Ventilation of the fuel cell space shall be provided with two or more fans, while each of them shall ensure the required ventilation capacity in the space upon loss of one fan. The required ventilation capacity shall also be ensured from the emergency source of power.

Electric motors for ventilation fans shall not be installed in ventilation ducts for hazardous spaces unless the motors are certified for the same hazard zone as the space served. Design of ventilation fans serving spaces containing fuel vapours shall comply with the requirements of 9.8.1.3.

36.4.3.2.7 In case of failure of one fan, automatic changeover to another fan shall be provided and indicated by an alarm.

36.4.3.2.8 In case of ventilation failure or loss of underpressure in the fuel cell space the fuel cell power system shall automatically perform a controlled shutdown of the fuel cell and cutoff of the fuel supply (refer also to 36.7.3.3).

36.4.3.2.9 Ventilation air inlets for the fuel cell spaces shall be located in areas which, in the absence of the considered inlet, would be non-hazardous.

36.4.3.2.10 Ventilation air intake for non-hazardous enclosed spaces shall be carried out from non-hazardous areas located at least 1,5 m off the boundaries of any hazardous area.

36.4.3.2.11 Ventilation air outlets from the fuel cell spaces shall be located in an open space which, in the absence of the considered outlet, would be of the same or lesser hazard than the space being ventilated.

36.4.3.3 Inerting of the fuel cell spaces.

36.4.3.3.1 Inerting shall be used for protection of the fuel cell spaces provided that:

.1 the fuel cell spaces are not be accessible during entire inerting period, while the sealing arrangements ensure no leakage of inert gas into adjacent spaces;

.2 the inerting system complies with the requirements of 9.9.4 and 9.9.5;

.3 pressure of inerting media shall always be kept positive and monitored;

.4 any change in the pressure that is indicating a breach of the external boundary of the fuel cell space, or a breach of the boundary with a space where fuel is running (e.g. a fuel cell stack, a reformer) shall activate a controlled shut-off of the fuel supply;

.5 fuel cell space shall be equipped with a mechanical exhaust ventilation to remove the inert gas after the release of inert medium has been initiated;

.6 access to the fuel cell space shall only be made possible when the space is completely vented by fresh air, the fuel supply shutoff, the fuel supply system depressurized or purged; and

.7 the inerting system shall not be made operable with a maintenance or inspection ongoing.

36.4.3.4 Arrangement of piping for the fuel cell power system.

All pipes containing hydrogen or reformed fuel for the fuel cell power systems, where fitted, shall:

.1 not be run through enclosed spaces outside of the fuel cell spaces;

.2 be of a fully welded design. The possibility of using other types of connections may be considered by the Register against a technical justification, including the risk assessment;

.3 be arranged to minimize the number of connections; and

.4 use fixed hydrogen detectors being capable of detecting a hydrogen leak in places where such leakage may occur (e.g. valves, flanges, seals).

36.4.3.5 Exhaust gas and exhaust air.

Ventilation systems for exhaust gases and exhaust air from the fuel cell power systems shall not be interconnected with any other ventilation systems serving other spaces and be led to a safe location in the open air.

36.5 FIRE SAFETY

36.5.1 General.

36.5.1.1 Fuel cell spaces shall be designed to feature a geometric shape minimizing accumulation of gases or formation of gas pockets.

36.5.1.2 For fire protection purposes, the fuel cell space shall be regarded as a machinery space of category A.

36.5.1.3 Probability of gas accumulation and explosion in the fuel cell spaces shall be minimized by taking measures which may include one or more of those below:

.1 purging of the fuel cell power system before initiating the reaction;

.2 purging of the power system after shutdown, as necessary;

.3 monitoring of failures in the fuel containment systems of the fuel cells;

.4 monitoring of potential contamination of air in the fuel lines of the fuel cells, or fuel of the fuel cells in air ducts;

.5 monitoring of pressure and temperature;

.6 implementing of a pre-programmed sequence to contain or manage the reaction propagation to other sections of the fuel cell system or to the surrounding space.

36.5.1.4 Consequences of failures leading to dangerous overpressure, e.g. ruptures of gas pipes or damage to gaskets, shall be eliminated by using suitable explosion-pressure relief devices such as blast valves and ESD arrangements.

36.5.2 Structural fire protection.

36.5.2.1 Fuel cell spaces shall meet the following requirements:

.1 access to such spaces shall be provided directly from the open deck or through a corridor and/or a stairway leading only to these spaces;

.2 spaces shall be located outside of accommodation spaces and control rooms;

.3 spaces shall be separated from adjacent spaces by gastight structures (decks and bulkheads);

.4 the spaces perimeter shall be of "A-60" class design except the spaces of category (10) as specified in 2.2.1.5.1, 2.3.3, 2.4.2, 2.5.3 or 2.6.3 of Part VI "Fire Protection" depending on the purpose of a ship. Where deemed impracticable, the Register may review alternative designs ensuring an equivalent level of safety.

36.5.2.2 Fuel cell spaces separated by a single bulkhead shall have sufficient strength to withstand the effects of a local gas explosion in either space, without affecting the integrity of the adjacent space and equipment within that space.

36.5.3 Fire-extinguishing equipment and systems.

36.5.3.1 Fuel cell spaces shall be equipped with a fixed fire extinguishing system that can be a carbon dioxide smothering system or an inert gas system. The Register may consider the possibility of using cryogenic nitrogen plants to extinguish hydrogen fires in enclosed spaces.

36.5.3.2 Fire extinguishing system shall be suitable for use with a specific primary and reformed fuel and also with applied fuel cell technology.

Water-spraying system with an application rate of 10 $l/m^2/min$ shall be provided for cooling down the pressurized hydrogen gas equipment and cylinders.

Protection of ships equipped with liquefied hydrogen tanks by fire extinguishing systems shall be in accordance with the requirements of 9.7.4 and 9.7.5.

36.5.3.3 Fixed fire extinguishing systems shall be selected having due regard to the fire growth potential of the protected spaces and are to be readily available. Controls for starting of these systems shall be located in easily accessible places outside the protected spaces.

36.5.3.4 A fixed fire detection and alarm system complying with the requirements of Part VI "Fire Protection" as well as a fixed hydrogen detection and alarm system shall be provided.

36.5.3.5 The type and arrangement of the fire detection system shall be selected with due consideration to the fuels and combustible gases which may be present in fuel cell power plant.

36.5.3.6 Fuel cell spaces shall typically be fitted with multi-criteria[1] fire detectors for rapid fire detection when using gas fuels, as well as with detectors of pre-explosive hydrogen concentrations installed in hazardous areas and connected to the visual and sound alarm system featuring output signals to the alarm panels located in CCS, navigation bridge and the continuously manned fire station.

36.5.4 Fire dampers.

36.5.4.1 Air inlet and outlet openings shall be provided with automatic closing fire dampers that are manually operable from outside the fuel cell spaces as well as by a signal from the fire detection and alarm system.

36.5.4.2 The fire dampers shall be closed before the fire extinguishing system actuation.

36.5.5 Fire-fighting outfit.

36.5.5.1 Fire-fighting outfit shall meet the requirements of 9.7.7. Powder fire extinguishers shall be suitable for B, C and E class fires.

33.5.5.2 Additionally, a portable hydrogen gas analyzer shall be provided on the ship.

36.6 ELECTRICAL EQUIPMENT

36.6.1 General.

36.6.1.1 Fuel cells shall meet the applicable requirements of Section 26 of Part XI "Electrical Equipment".

36.6.1.2 Where electrical equipment including components of fuel cell systems is installed in hazardous areas, it shall be selected, installed and serviced in accordance with applicable standards approved by the Register[2] and meet the requirements of 2.9 of Part XI "Electrical Equipment".

36.6.1.3 Fuel cell power plants as well as the related control systems shall be designed so that a single failure would not lead to disability to maintain pressure in fuel tanks and temperature of the ship hull structures within normal operating limits.

36.6.1.4 Means shall be provided for protection of the fuel cell plant against overload, short circuits and reverse current.

36.6.1.5 Installation of electrical equipment on the ship shall ensure the safe connection of units to the ship hull.

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1 For the selection of fire detectors refer to ISO/TR 15916:2015.

2 Refer to standards IEC 60079-10-1:2020 Explosive atmospheres. Part 10-1: Classification of areas — Explosive gas atmospheres and guidance and informative examples given in IEC 60092-502:1999 Electrical Installations in Ships – Tankers – Special features for tankers.

36.6.1.6 Cable transits shall be sealed to prevent ingress of gas or vapour.

36.6.1.7 Electrostatic intrinsic safety associated with rotating or reciprocating machinery including the installation of conductive transfer belts, shall be ensured.

36.6.1.8 Electrical continuity shall be maintained in the hydrogen-related piping system.

36.6.1.9 All systems shall be earthed. Means shall be provided to ensure that all individual components are permanently earthed when connected to a continuous hydrogen-related piping system.

36.6.1.10 All power systems with the voltage above 24 V arranged in hazardous areas shall be equipped with explosion-proof enclosures.

36.6.2 Classification of hazardous areas.

36.6.2.1 In order to facilitate the selection of appropriate electrical equipment and for designing suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2, according to 36.6.2.2, 36.6.2.3 and 36.6.2.4. In cases where the requirements of 36.6.2.2, 36.6.2.3 and 36.6.2.4 are not applicable, the provisions of 36.4.1.3 shall be followed.

36.6.2.2 When using the equipment in potentially flammable environment, it shall be of explosion-proof design in accordance with standard IEC 60079-20-1:2020 and comply with the temperature classes and groups given in Table 36.6.2.2.

Table 36.6.2.2

Temperature classes and equipment groups

	Temperature class	Equipment group
Natural gas	T1	IIA
LPG (propane, butane)	T2	IIA
Hydrogen	T1	IIC
Methanol	T2	IIA
Ethanol	T2	IIB
Ammonia	T1	IIA

36.6.2.3 Zone 0: the interiors of buffer tanks, reformers, pipes and equipment containing low-flashpoint fuel or reformed fuel, any piping for pressure relief or other tank venting.

36.6.2.4 Zone 1:

.1 areas on open deck, or semi-enclosed spaces on deck, within 3 m of any hydrogen or reformed fuel or purge gas outlets or the fuel cell space ventilation outlets;

.2 areas on open deck, or semi-enclosed spaces on deck, within 3 m of fuel cell exhaust gas and exhaust air outlets;

.3 areas on open deck or semi-enclosed spaces on deck within 1,5 m of the entrances to the fuel cell spaces, ventilation outlets of the fuel cell spaces and other openings into zone 1 spaces;

.4 areas on open deck or semi-enclosed spaces within 3 m where other sources of release of hydrogen or reformed fuel are located;

.5 fuel cell spaces;

.6 enclosed or semi-enclosed spaces where fuel pipes are located, for example, ducts around the fuel pipes, regardless of their location.

36.6.2.5 Zone 2:

.1 areas within 1,5 m surrounding open or semi-enclosed spaces of zone 1 as specified above, if not otherwise stated.

.2 air locks.

36.6.2.6 Ventilation ducts shall have the same area classification as the space being ventilated.

36.6.3 Termination of fuel cells.

36.6.3.1 The outgoing circuits of the fuel cells shall be equipped with a disconnecting switch. Contactors are not allowed as disconnecting devices.

36.6.3.2 It shall be possible to disconnect the fuel cell from the electrical load under any load condition.

36.7 CONTROL, ALARM AND SAFETY SYSTEMS

36.7.1 General provisions on control, alarm and safety systems.

36.7.1.1 Control, alarm and safety systems, in addition to the requirements of this Chapter, shall meet the requirements of 26.5.3 of Part XI "Electrical Equipment".

36.7.1.2 Safety-related systems of fuel cells shall be designed as being independent from any other control and alarm systems or shall function in compliance with the standards, which application is agreed with the Register[1].

36.7.1.3 The fuel cell functioning shall be monitored according to the manufacturer's recommendations.

36.7.2 Detection of gas and/or vapours.

36.7.2.1 A fixed gas and/or vapour detection system shall be provided for:

.1 fuel cell spaces;

.2 air locks (if any);

.3 expansion tanks and degassing vessels in the auxiliary systems of the fuel cell power system where primary fuel or reformed fuel may leak directly into a system medium (e.g. cooling water); and;

.4 other enclosed spaces where primary or reformed fuel may accumulate.

36.7.2.2 The detection systems shall be continuously monitoring for gas and/or vapour. The number of detectors in the fuel cell space shall be considered given the size, layout and ventilation of the space. The detectors shall be located where gas/vapour may accumulate and/or in the ventilation outlets. Gas/vapour dispersal analysis or a similar method shall be used to find the best arrangements of detectors for the gas and/or vapour detection system.

36.7.2.3 Two independent gas/vapour detectors located close to each other are required for redundancy. Where the gas/vapour detector is of the self-monitoring type, it is allowed to have a single gas detector installed.

36.7.2.4 Gas/vapour detection shall be performed continuously, with no latency.

36.7.2.5 Detection of gas/vapour concentration above 20% LEL in a fuel cell space shall cause an alarm triggered.

36.7.2.6 Detection of gas/vapour concentration above 40% LEL in a fuel cell space shall cause the fuel cell power system shutdown, the ignition sources cut off and automatically closure of all the valves required to isolate the leakage. If not certified for operation in zone 1 hazardous areas (refer to 36.4.1.2), the fuel cell stack shall be immediately electrically isolated while the valves in the primary fuel system feeding liquid or gaseous fuel to the fuel cell space be closed down automatically.

36.7.3 Ventilation performance.

36.7.3.1 In order to monitor the ventilation system performance, the system of detection of the ventilation flow and pressure shall be installed in a fuel cell space. Presence of a signal indicating the exhaust fan motor operation shall not be deemed a sufficient condition to verify the system performance.

36.7.3.2 When ventilation performance is downgraded below the permissible level, an alarm shall be triggered.

36.7.3.3 Loss of ventilation in a fuel cell space shall cause an automatic shutdown of the fuel cell within a limited period of time. The shutdown time period shall be identified based on the risk analysis on a case-by-case basis.

36.7.4 Liquid detection.

36.7.4.1 Bilge wells in the fuel cell spaces shall be equipped with level sensors.

36.7.4.2 When liquid is detected in a bilge well, an alarm shall be triggered.

36.7.5 Manual emergency shutdown.

36.7.5.1 Manual activation of emergency shutdown shall be arranged in the following locations:

.1 navigation bridge;

.2 onboard safety centre;

.3 Central Control Station (CCS);

.4 fire control station; and

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[1] For example, refer to ISO 13849-1:2015-06.

.5 adjacent to the exit from the fuel cell space.

36.7.5.2 Actuation of the emergency-shutdown push button shall interrupt the fuel feed to the fuel cell space and de-energize the ignition sources inside the fuel cell space.

36.7.6 Loss of fuel cell coolant.

36.7.6.1 Loss of fuel cell coolant shall cause an automatic shutdown of the fuel cell by the control system within a limited period of time.

36.7.6.2 To prevent a potential coolant release into the fuel cell space, the coolant pipe shall feature a secondary shell or the equipment inside the space be provided with other means of protection. Measures shall be developed for the safe removal of a potential coolant leakage.

36.7.7 Fire detection.

Detection of fire inside the fuel cell space shall initiate automatic shutdown and cutoff of the fuel supply.

36.7.8 Fuel cell high-temperature shutdown.

For the fuel cell spaces rated as hazardous zone 1 where the fuel cell stack is not certified for operation in hazardous zone 1, the exceeding of the fuel cell stack surface temperature above 300 °C shall immediately cause shutdown of the fuel cell power plant.

36.7.9 Monitoring and control of inerting.

36.7.9.1 A system for monitoring the required pressure of inert gas shall be installed in the inerted fuel cell spaces.

36.7.9.2 The pressure drop in the inerted space inside the secondary shell of a piping for gaseous hydrogen shall cause the automatic closing of the corresponding fuel valves.

36.7.10 Monitoring of a safe atmosphere.

36.7.10.1 Oxygen content monitoring shall be provided in rooms accessible to service personnel. Means shall be provided in rooms inaccessible to service personnel to ensure sufficient oxygen concentration prior to entry.

36.7.11 Safety actions.

Where leakage is detected and/or in case of failure, the safety system shall automatically perform control actions specified in Table 36.7.11.

Table 36.7.11

Parameter monitored	Alarm signal	Shutdown of fuel cell space valve	Cutoff of ignition source	Signal to other control/safety systems for additional actions
Loss of fuel cell coolant	X	X		
Detection of liquid leakage inside fuel cell space	X			
20% LEL inside fuel cell space	X			
40% LEL inside fuel cell space (including detection of hydrogen leakage)	X	X	X	If not certified for operation in zone 1 hazardous areas, the fuel cell stack shall be immediately electrically isolated
Ventilation failure or loss of negative pressure inside fuel cell space	X	X		The fuel cell shall be automatically shutdown by the plant control system
Fire detection inside fuel cell space	X	X	X	Shutdown of ventilation, activation of fire extinguishing system
Emergency shutdown button	X	X	X	
Fuel cell stack surface temperature >300 °C	X	X	X	Where the fuel cell stack is not certified for zone 1
Air lock — when more than one door open or the door is open at ventilation failure	X (alarm activated by a signal logics)			

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