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**ECONOMIC COMMISSION FOR EUROPE**

INLAND TRANSPORT COMMITTEE

Working Party on Inland Water Transport

# Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels

**Resolution No. 61**

**Revision 2**

**Amendment 1**

**UNITED NATIONS**
**New York and Geneva, 2020**

## Note

Amendment No. 1 to the Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels (annex to resolution No. 61, revision 2) contains a consolidated text of the amendments preliminarily approved by the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation at its fifty-fourth and fifty-fifth sessions and adopted by the Working Party on Inland Water Transport at its sixty-third session as resolution No. 93 (ECE/TRANS/SC.3/210, paragraph 55).

# Additions to the Recommendations on Harmonized Europe-Wide Technical Requirements for Inland Navigation Vessels (annex to resolution No. 61, revision 2)

## I. Section 1-2, "Definitions"

1. Section 1-2 "Definitions", *add*

"112a. "Certified safe type electrical equipment": an electrical equipment which has been tested and approved by the competent authority regarding its safety of operation in an explosive atmosphere.

…

144. "Ramp" is a composite or single platform designed for entry and exit of vehicles of different types or passage of people (passengers) to and from one of the decks of the vessel.

145. "Ramp and associated equipment" is an equipment that includes a ramp, ramp control mechanisms, an automation system, a position display device and monitoring and measuring instruments."

## II. Chapter 8C, "Special provisions applicable to craft equipped with propulsion or auxiliary systems operating on fuels with a flashpoint equal to or lower than 55°C"

2. *Add* a new chapter 8C "Special provisions applicable to craft equipped with propulsion or auxiliary systems operating on fuels with a flashpoint equal to or lower than 55°C".

**"CHAPTER 8C**

**SPECIAL PROVISIONS APPLICABLE TO CRAFT EQUIPPED WITH PROPULSION OR AUXILIARY SYSTEMS OPERATING ON FUELS WITH A FLASHPOINT EQUAL TO OR LOWER THAN 55°C**

8C-1 General

8C-1.1 For the purpose of this chapter, "propulsion and auxiliary systems" means any system using fuel, including:

(a) fuel tanks, and tank connections;

(b) gas preparation systems;

(c) piping and valves;

(d) engines and turbines;

(e) control, monitoring and safety systems.

8C-1.2 By way of derogation from paragraphs 8-1.1.2, 8-1.5.1, 8-1.5.10, 8-1.5.11 and 8-1.5.14 and the provisions of chapter 8A propulsion and auxiliary systems operating on fuels with a flashpoint equal to or lower than 55° C may be installed on craft provided that the requirements for these fuels laid down in this chapter and appendix 10 have been complied with.

8C-1.3 Propulsion and auxiliary systems according to paragraph 8C-1.2 shall be constructed and installed under the supervision of the inspection body.

8C-1.4 For the purpose of discharging tasks pursuant to this chapter, the inspection body may employ a technical service in accordance with section 8C-7.

8C-1.5 Before commissioning of a propulsion or auxiliary system according to paragraph 8C-1.2, the following documents shall be submitted to the inspection body:

(a) a risk assessment according to appendix 10;

(b) a description of the propulsion or auxiliary system;

(c) drawings of the propulsion or auxiliary system;

(d) a diagram of the pressure and temperature within the system;

(e) an operating manual containing all applicable procedures, intended for practical use of the system;

(f) a safety rota according to paragraph 8C-3.4;

(g) a copy of the inspection certificate referred to in paragraph 8C-2.4.

8C-1.6 A copy of the documents mentioned in section 8C-5 shall be carried on board.

8C-2 Testing

8C-2.1 Propulsion and auxiliary systems operating on fuels with a flashpoint equal to or lower than 55° C shall be inspected by an inspection body:

(a) before commissioning;

(b) after any modification or repair;

(c) regularly, at least once a year.

The relevant instructions of the manufacturers shall be taken into account in the process.

8C-2.2 The inspections referred to in subparagraphs (a) and (c) of paragraph 8C-2.1 have to cover at least:

(a) a check of conformity of the propulsion and auxiliary systems with the approved drawings and in the case of subsequent checks, whether alterations in the propulsion or auxiliary system were made;

(b) if necessary a functional test of the propulsion and auxiliary systems for all operational possibilities;

(c) a visual check and a tightness check of all system components, in particular valves, pipelines, hoses, pistons, pumps and filters;

(d) a visual check of the electrical and electronic appliances of the installation;

(e) a check of the control, monitoring, and safety systems.

8C-2.3 The inspections referred to in subparagraph (b) of paragraph 8C-2.1shall include the concerned parts of paragraph 8C-2.2.

8C-2.4 For each inspection according to paragraph 8C-2.1, an inspection attestation shall be issued showing the date of inspection.

8C-3 Safety organization

8C-3.1 A safety rota shall be provided on board craft equipped with propulsion or auxiliary systems operating on fuel with a flashpoint equal to or lower than 55° C. The safety rota shall include safety instructions according to paragraph 8C-3.2 and a safety plan according to paragraph 8C-3.3 of the craft.

8C-3.2 These safety instructions shall include at least the following information:

(a) emergency shutdown of the system;

(b) measures to be taken in the event of accidental release of liquid or gaseous fuel, for instance, during bunkering;

(c) measures to be taken in the event of fire or other incidents on board;

(d) measures to be taken in the event of collision;

(e) use of safety equipment;

(f) raising the alert;

(g) evacuation procedures.

8C-3.3 The safety plan shall include at least the following information:

(a) hazardous areas;

(b) escape routes, emergency exits and gastight rooms;

(c) life-saving equipment and ship's boats;

(d) fire extinguishers, fire-fighting systems and sprinkler systems;

(e) alarm systems;

(f) emergency circuit breakers' controls;

(g) fire dampers;

(h) emergency power sources;

(i) ventilation system controls;

(j) controls for fuel supply lines;

(k) safety equipment.

8C-3.4 The safety rota shall:

(a) be duly stamped by the inspection body; and

(b) be prominently displayed at one or more appropriate points on board.

8C-4 Environmental requirements (left void)

8C-5 Marking

Operation rooms and system components shall be appropriately marked so that it is clear for what fuels they are being used.

8C-6 Independent propulsion

In the event of an automatic shutdown of the propulsion system or parts of the propulsion system, the craft shall be able to make steerageway under its own power.

8C-7 Technical services

8C-7.1 The technical services shall satisfy international standard ISO/IEC 17020:2012.

8C-7.2 Manufacturers and distributors of propulsion or auxiliary systems, or parts of these systems, cannot be recognised as technical services.

8C-7.3 The technical service's expertise must comply with the relevant requirements from appendix 10.

8C-7.4 The monitoring and testing according to sections 8C-1 and 8C-2 may be performed by different technical services provided that all the expertise described in paragraph 8C-7.3 is taken into account in the process.”

## III. Chapter 10A, “Ramps and ramp equipment”

3. *Add* a new chapter 10A “Ramps and ramp equipment”:

**“CHAPTER 10A**
**RAMPS AND RAMP EQUIPMENT**

10A-1 GENERAL PROVISIONS

10A-1.1 Ramps for the entry and exit of various types of vehicles must have longitudinal framing oriented towards the movement of vehicles during loading operations. The longitudinal external ramps must be rigid enough to withstand loading/unloading at trim of up to 3° or more. The strength and rigidity requirements must be determined by direct calculations.

10A-1.2 The external ramp should have framing, plaiting, outer plating in the lower part, fender beams, support axes, pads for lifting and lowering the ramp and other elements.

At the end of the ramp on the quay side, a hinged flap or finger flaps that facilitate the smooth entry of vehicles onto the ramp may be installed.

10A-1.3 The ramp deck should be made of structured steel sheeting or sheeting with round or square bars welded onto it to prevent skidding when loading. The ramp framing is to be designed in a way that is similar to the framing of the cargo deck.

10A-1.4 Fender beams with a height of not less than 0.35 m must be installed on the ramp for the entry and exit of vehicles. If the ramp is designed for the passage of passengers, it should be equipped with a removable guard rails with a height of at least 900 mm.

10A-1.5 External ramps must meet the following requirements:

(i) Allow vehicles to roll on and off the vessel and passengers to embark and disembark on foot;

(ii) Operate correctly at heel angles of up to 6° and trim angles of up to 3° or more;

(iii) Be power driven;

(iv) Have a mechanical securing system;

(v) Be protected against falling in the case of the failure of the hoisting gear;

(vi) Provide for compact and secure stowage of the ramp in the stowed position;

(vii) Have a signalling device that indicates that the ramp has reached its final position;

(viii) Include ramp position indicators;

(ix) Are arranged in such a way so that they may be operated by one person.

The requirements of indents (iii)–(x) do not apply to the ramps positioned with onshore crane equipment.

The requirements of indents (iii) and (vi)-(viii) do not apply to ramps that are positioned manually.

10A-1.6 Internal ramps must meet the following requirements:

(i) Allow vehicles to roll and passengers to pass on foot from one deck to another;

(ii) Operate correctly at heel angles of up to 5° and trim angles of up to 2° or more;

(iii) Be power driven;

(iv) Have a mechanical securing system while under way;

(v) Be protected against falling in the case of the failure of the hoisting gear;

(vi) Provide for compact and secure stowage of the ramp in the stowed position;

(vii) Have a signalling device that indicates that the ramp has reached its final position;

(viii) Include ramp position indicators;

(ix) Ensure that the ramps are placed in the required positions;

(x) Are arranged in such a way that they may be operated by one person.

The requirements of indents (iii) and (vi)–(viii) do not apply to manually driven ramps.

10A-1.7 When the external ramp is in working position, one end must be attached to the hull at deck level by means of a hinged support, while the other (free) end must be supported by the jetty support or, when embarking vehicles or passengers from an unprepared shore bank, the outer end of the ramp is to be positioned directly on the ground.

10A-1.8 The design loads on the ramp should be determined on the basis of the specifications of the vehicles to be transported on board the vessel and the means used for loading and unloading.

In the absence of data on wheels and their footprints, the design pressure on the ramp, [kPa], is calculated by the formula:

$$p = p_0/w,$$

Where

$p_0$ is the maximum air pressure in tires, [kPa]

$w$ is a factor and is taken to equal:

- A single wheel 1.00
- Twin wheels 1.20
- Triple wheels 1.27;

Wheel footprint area, [m$^2$], is calculated by the formula:

$$p = 0.5\,Q_0/p,$$

Where $Q_0$ is the static maximum axle load of the vehicle, [kN].

The design position of the wheel footprint for the purpose of calculating the strength of the plate is shown in figure 10A-1 and the strength of the stiffener in 10A-2.

Figure 10A-1

**Footprint area for the wheel load for the plate**

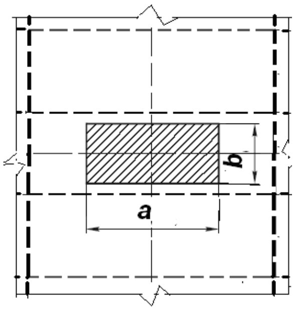
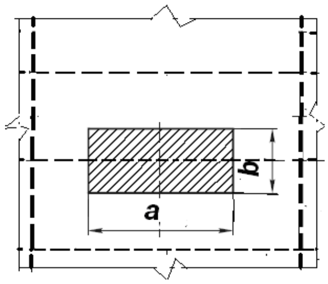



Figure 10A-2

**Footprint area for the wheel load for the stiffener**




Dimensions of the loading platform, [m], when vehicles move along the beam framing (see figs. 10A-1 and 10A-2) are determined by formulas:

$$a = \sqrt{kA},$$

$$b = \sqrt{A/k},$$

Where

$a$ is the length of wheel footprint (along the vehicle), [m];

$b$ is the width of the wheel footprint (across the vehicle), [m];

$k$ is a factor taken equal to:

- A single wheel 2.0
- Twin wheels 0.8
- Triple wheels 0.5.

10A-1.9 The external and internal ramps must be designed to withstand the loads specified in 10A-1.8.

The external ramp strength should be checked by the following calculations:

(i) Overall strength of the ramp as a span with one end freely supported on the vessel and the other on the shore or jetty, with vehicles under embarkation in the most unfavourable positions;

(ii) Strength of the longitudinal stiffeners supporting the ramp plating by treating them as beams supported on the transverse frame members;

(iii) Strength of the ramp plating.

Calculation of the strength of the ramp structure as a whole can be performed using software that implements the finite element method or other numerical methods.

Analogous calculations of the design strength shall be performed for internal ramps.

The panels and framing of internal ramps used as covers for deck openings must meet the same strength requirements as permanent decks for rolling vehicles.

10A-1.10 Permissible stress levels are taken as shown in table 10A-1.

Table 10A-1

| *Name and description of the structural member of the ramp* | | *Type of design load stress* | *Permissible stress expressed as a fraction of critical stress* |
|---|---|---|---|
| 1. | Web girders | Normal bending stresses | |
| | | • In a span | 0.70 |
| | | • On a support | 0.80 |
| | | Equivalent stress from combined bending and torsion | |
| | | • In a span | 0.80 |
| | | • On a support | 0.90 |
| 2. | Webs of a web frame | Shearing stress | 0.80 |
| 3. | Beam framing | Normal bending stresses | |
| | | • In a span | 0.85 |
| | | • On a support | 0.90 |

The relative deflection of the ramps during loading/embarkation operations must not exceed 0.004 *L*, where *L* is the length of the ramp between the supports.

10A-2 TECHNICAL REQUIREMENTS FOR THE DESIGN FOR THE RAMP HOISTING GEAR

10A-2.1 The drive mechanism of the ramp must be designed to withstand a lifting load equal to at least 1.5 times the weight of the ramp.

10A-2.2 The drive of the ramp hoisting gear must be so designed as to ensure that the ramp can be stopped and held in any given position.

10A-2.3 The power-driven ramp hoisting gear must be capable of slowing down the raising and lowering of the ramp when approaching the final positions, or buffer devices must be provided.

10A-2.4 The ramp hoisting gear must be power driven or manually driven.

The ramp may be lowered by means of a drive from a power source or under its own weight.

10A-2.5 The ramp must be equipped with an emergency lowering device that operates independently of the main hoisting gear drive. The emergency lowering device must be so designed as to ensure smooth and controlled lowering of the ramp under its own weight.

10A-2.6 Electrically driven ramps must have automatic brakes installed on the drive shaft that are activated in the event that the drive loses power or otherwise fails.

The automatic brake is not required if there is a self-locking gearbox.

10A-2.7 For hydraulic drives with pistons or blades that can be locked by oil pipe valves, a special braking device may not be used.

10A-2.8 Power-driven ramps at their final positions must be equipped with automatic drive disconnection devices.

10A-2.9 The strength of the drive parts must be checked under the application of forces from the maximum drive torque or the torque corresponding to the protection limit setting. The equivalent stress in the parts must not exceed 0.95 times the yield strength of the part material.

Under a nominal traction load, the stresses must not exceed 0.4 times the yield strength of the part material.

10A-3 ELECTRIC DRIVE AND ALARMS FOR RAMPS

10A-3.1 The electric drive of the ramps must be equipped with at least two safety cut-off devices, one in the wheelhouse and the other in the ramp control station.

10A-3.2 The wheelhouse must be equipped with a light signal for each ramp indicating the position of the ramp and visual and acoustic alarm system while a ramp is in motion. Ramps below the bulkhead deck that ensure a watertight seal must be equipped with a light signal indicating whether they are in an open or closed position or, separately, whether or not they are in a secure watertight position.

10A-3.3 Alarm systems must satisfy the following requirements:

(i) Provide an indication that the light signals for ramps are in working order and that they cannot be accidentally switched off;

(ii) Emit an alert signal when there is a power failure of the automation system for the ramp;

(iii) The circuits of the limit switches (sensors) for the ramp position are to be closed when a ramp is raised and stowed (if several sensors are installed on the same ramp they may be connected in a series);

(iv) The circuits of the limit switches (sensors) for the position of the cleats (securing devices) of a ramp that ensures a watertight seal are to be closed when the closing appliance is in the secure watertight position (if several sensors are installed on the same closing appliance they may be connected in a series);

(v) The circuits for the indicators ‘ramp closed/not closed’ and ‘secured/not secured’ must be independent but may be run in a single multicore cable;

(vi) In the event of a change in the position of any of the limit switches (ramp position sensors), an alarm should be activated: ‘ramp is not closed/not secured’ and ‘locking device is not locked’.

10A-3.4 The alarm system installed in the wheelhouse must be fitted with a means for selecting one of two operating modes, ‘alongside’ and ‘under way’, and must sound an audible alarm at the ramp control station if a ramp is in the open position while the vessel is under way and if a ramp below the bulkhead deck that ensures a watertight seal is not closed or secured or both.

10A-3.5 The power supply for the alarm must be independent of the power supply for the drive, and an emergency source of power must be provided for.

10A-3.6 Passenger and cargo vessels of combined (river-sea) navigation that have a watertight closing appliance must be provided with video surveillance equipment and acoustic alarms for water leakage. The video surveillance system is to provide for monitoring of the current position of the ramp and leakage through the closing appliance.”

# IV. Appendix 1 “List of European inland waterways divided geographically into zones 1, 2 and 3”

4. Chapter 1 “Zone 1”, *replace* the list of inland waterways of Ukraine *with*

“**UKRAINE**

Dniprovsko-Buzkyi Firth, up to the Ochakiv Port.

Pivdennyi Buh, downstream of Mykolaivskyi Sea Port.

Kakhovske Reservoir, from the dam of Kakhovska Hydroelectric Power Station to Bilenke settlement (273 river km).

Kremenchutske Reservoir, from the dam of Kremenchutska Hydroelectric Power Station to Topylivka settlement (626 river km).”

5. Chapter II “Zone 2”, *replace* the list of inland waterways of Ukraine *with*

**“UKRAINE**

Dnipro, downstream of the Kyiv Port (861 river km), Kanivske Reservoir, upstream of Ukrainka City (820 river km) and the section from the 943 river km toTeremtsi Pier (out of order) (951.5 river km).

Prypiat, downstream of Vydumka Pier (out of order) (11,5 river km) to the mouth.

Pivdennyi Buh, from Ternuvate settlement (96 river km) to Mykolaivskyi Sea Port.

Dnistrovskyi Firth.

Dnistrovske Reservoir, from the dam to Dnistrivka settlement (60 km from the dam).

Kakhovske Reservoir, upstream of Bilenke settlement (273 river km).

Dniprovske Reservoir.

Kremenchutske Reservoir, upstream of Topylivka settlement (626 river km).

Kamianske Reservoir.

Kanivske Reservoir, from the dam of Kanivska Hydroelectric Power Station to Ukrainka City (820 river km).

Kyivske Reservoir.

Pechenizke Reservoir.

Chervonooskilske Reservoir.

Burshtynske Reservoir.

Svitiaz Lake.”

6. Chapter III “Zone 3”, *replace* the list of inland waterways of Ukraine *with*

“UKRAINE

Dnipro, upstream of Teremtsi Pier (out of order) (951,5 river km), the section from the Kyiv Port (861 river km) to the dam of the Kyivska Hydroelectric Power Station, the Staryi Dnipro Arm (behind of Khortytsia Island).

Prypiat, upstream of Vydumka Pier (out of order) (11,5 river km).

Desna and other navigable tributaries of the Dnipro.

Pivdennyi Buh, upstream of Ternuvate settlement (96 river km).

Dnister, upstream of Ustia settlement (190 km from the dam).

Danube.

Ladyzhynske Reservoir.

Dnistrovske Reservoir, from Dnistrivka settlement (60 km from the dam) to Ustia settlement (190 km from the dam).

Other river navigable inland waterways not mentioned as belonging to zones 1 and 2."

## V. Appendix 3 "Safety signs and signals to be used on board inland navigation vessels"

7. *In the end, add* sketch 9 "LNG warning"

| | | |
|---|---|---|
| Sketch 9<br>LNG warning |  | Colours: black/yellow |

## VI. Appendix 10, "Supplementary provisions applicable to craft operating on fuels with a flashpoint equal to or lower than 55° C"

8. *Add* a new appendix 10 "Supplementary provisions applicable to craft operating on fuels with a flashpoint equal to or lower than 55° C"

**"APPENDIX 10**

**SUPPLEMENTARY PROVISIONS APPLICABLE TO CRAFT OPERATING ON FUELS WITH A FLASHPOINT EQUAL TO OR LOWER THAN 55° C**

**Section I, Liquefied Natural Gas**

### 1. General

*1.1 Application*

1.1.1 The provisions of Section I apply to craft equipped with propulsion or auxiliary systems operating on liquefied natural gas according to paragraph 1.2.1 and address all areas that need special consideration for the usage of LNG as fuel.

*1.2 Definitions*

For the purposes of this Section, the following definitions shall apply:

1.2.1 *Liquefied natural gas (LNG)*: natural gas that has been liquefied by cooling it to a temperature of -161° C.

1.2.2 *LNG system:* all parts of the craft that may contain LNG or Natural Gas (NG), such as engines, fuel tanks and bunkering piping.

1.2.3 *LNG bunkering system:* the arrangement for the bunkering of LNG on board (bunkering station and bunkering piping).

1.2.4 *Bunkering station:* the area on board where all equipment used for bunkering are located, such as manifolds, valves, survey instruments, safety equipment, monitoring station, tools, etc.

1.2.5 *LNG containment system:* the arrangement for the storage of LNG including tank connections.

1.2.6 *Gas supply system:* the arrangement, including the gas preparation system, gas supply lines and valves, to supply gas on board to all gas consuming equipment.

1.2.7 *Gas preparation system:* the unit used to convert LNG into NG, its accessories and its piping.

1.2.8 *Hazardous areas*: zones 0, 1 and 2 as classified below:

1.2.8.1 Zone 0: area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.

1.2.8.2 Zone 1: area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occasionally occur in normal operation.

1.2.8.3 Zone 2: area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

1.2.9 *Enclosed room*: any room within which, in the absence of forced ventilation, the ventilation will be limited, and any explosive atmosphere will not be dispersed naturally.

1.2.10 *Semi-enclosed room:*a room limited by decks or bulkheads in such manner that the natural conditions of ventilation are notably different from those obtained on open deck.

1.2.11 *Pressure Relief Valve (PRV)*: a spring-loaded device which is activated automatically by pressure, the purpose of which is to protect the tank or piping against unacceptable excess of internal pressure.

1.2.12 *Dual fuel engines*: engines using LNG combined with fuel with a flashpoint above 55° C.

1.2.13 *ESD*: emergency shutdown.

1.2.14 *Master gas fuel valve*: an automatic shut-off valve in gas supply lines to engines.

1.2.15 *Secondary barrier:* the outer element of an LNG containment system or piping designed to afford temporary containment of any envisaged leakage through the primary barrier.

1.2.16 *Maximum working pressure*: the maximum pressure that is acceptable in an LNG fuel tank or piping during operation. This pressure equals the opening pressure of pressure relief valves or devices.

1.2.17 *Design pressure*: the pressure on the basis of which the LNG fuel tank or piping has been designed and built.

1.2.18 *Double block and bleed valve*: a set of two valves in a series in a pipe and a third valve enabling the pressure release from the pipe between those two valves. The arrangement may also consist of a two-way valve and a closing valve instead of three separate valves.

1.2.19 *Air lock*: a space enclosed by gastight steel bulkheads with two gastight doors, intended to separate a non-hazardous area from a hazardous area.

1.2.20 *Double wall piping*: piping with a double wall design for which the space between the walls is pressurized with inert gas and equipped to detect any leakage of one of the two walls.

1.2.21 *System components*: all components of the installation that may contain LNG or NG (fuel tanks, pipelines, valves, hoses, pistons, pumps, filters, instrumentation, etc.).

1.2.22 *Ventilated ducting*: a gas pipe installed in a pipe or duct equipped with mechanical exhaust ventilation.

1.2.23 *Gas warning equipment*: warning equipment to protect people and property from hazardous gases and gas-air mixtures. It consists of gas detectors to identify gases, a control unit for processing the signals and a display/alarm unit for displaying the status and warning.

### *1.3 Risk assessment*

1.3.1 A risk assessment shall be conducted on all concepts and configurations which are new or have been significantly modified. The risks arising from the use of LNG affecting people on board including passengers, the environment, the structural strength and the integrity of the craft shall be addressed. Reasonable consideration shall be given to the hazards associated with physical layout, operation, and maintenance, following a failure.

1.3.2 The risks are to be determined and assessed using a risk analysis technique recognised by the inspection body, such as international standards ISO 31000:2009 and ISO 31010:2010. Loss of function, component damage, fire, explosion, tank room flooding, vessel sinking, and electric overvoltage shall be considered as a minimum. The analysis must help to ensure that risks are eliminated wherever possible. Risks which cannot be eliminated entirely are to be mitigated to an acceptable level. The major scenarios and measures for eliminating or mitigating risks shall be described.

1.3.3 Classification of hazardous areas on board, divided into zones 0, 1 and 2, according to paragraph 1.2.8 shall be documented in the risk assessment.

### *1.4 General requirements*

1.4.1 A single failure in the LNG system shall not lead to an unsafe situation.

1.4.2 The LNG system shall be designed, constructed, installed, maintained and protected to ensure safe and reliable operation.

1.4.3 Components of the LNG system shall be protected against external damages.

1.4.4 Hazardous areas shall be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the craft, people on board, environment and equipment. In particular, hazardous areas are parts of the vessel not intended for passengers as referred to in paragraph 15-6.13.

1.4.5 Appropriate measures shall be taken to keep passengers away from hazardous areas.

1.4.6 Equipment installed in hazardous areas shall be minimized to that required for operational purposes and shall be suitably and appropriately certified.

1.4.7 Unintended accumulation of explosive or flammable gas concentrations shall be prevented.

1.4.8 Sources of ignition in hazardous areas shall be excluded to reduce the probability of explosions.

1.4.9 A detailed operating manual of the LNG system shall be provided on board craft using LNG as fuel and which as minimum:

(a) contains practical explanations about LNG bunkering system, LNG containment system, LNG piping system, Gas supply system, engine room, ventilation system, leakage prevention and control, monitoring and safety system;

(b) describes the bunkering operations, especially valves operation, purging, inerting and gas freeing;

(c) describes the relevant method of electrical insulation during bunkering operations;

(d) describes the details of risks identified in the risk assessment as referred to in 1.3 and the means by which they are mitigated.

1.4.10 A fire or explosion caused by released gas in LNG containment systems and engine rooms shall not render the essential machinery or equipment in other compartments inoperable.

*1.5 Knowledge technical service*

The knowledge of the technical service referred to in paragraph 8C-1.4 shall cover at least the following areas:

(a) fuel system including tanks, heat exchangers, pipelines;

(b) strength (longitudinal and local) and stability of the craft;

(c) electrical and control systems;

(d) ventilation system;

(e) fire safety;

(f) gas warning equipment.

*1.6 Marking*

Doors to rooms where LNG is used shall bear on the outside a symbol for “LNG warning” in accordance with sketch 9 of appendix 3, at least 10 cm in height.

## 2. Vessel Arrangements and System Design

*2.1 LNG containment system*

2.1.1 The LNG containment system shall be separated from engine rooms or other high fire risk areas.

2.1.2 LNG fuel tanks shall be located as close as possible to the longitudinal centreline of the vessel.

2.1.3 The distance between the ship’s wall of the craft and the LNG fuel tank shall not be less than 1.00 m. If LNG fuel tanks are located:

(a) below deck, the craft shall have a double wall and a double bottom construction at the location of the LNG fuel tanks. The distance between the ship’s wall and the inner wall of the craft shall not be less than 0.60 m. The depth of the double bottoms shall not be less than 0.60 m;

(b) on open deck, the distance shall be at least B/5 from the vertical planes defined by the ship's sides of the craft.

2.1.4 The LNG fuel tank shall be an independent tank designed in accordance with international standards ISO 20421, ISO 21009-2:2008 in combination with dynamic loads, or the International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) (type C tank). The inspection body can accept other equivalent standards of a member State.

2.1.5 Tank connections shall be mounted above the highest liquid level in the tanks. The inspection body can accept connections below the highest liquid level.

2.1.6 If tank connections are below the highest liquid level of the LNG fuel tanks, drip trays shall be placed below the tanks that meet the following requirements:

(a) the capacity of the drip tray shall be sufficient to contain the volume which could escape in the event of a pipe connection failure;

(b) the material of the drip tray shall be suitable stainless steel;

(c) the drip tray shall be sufficiently separated or insulated from the hull or deck structures, so that the hull or deck structures are not exposed to unacceptable cooling in case of leakage of LNG.

2.1.7 The LNG containment system shall be provided with a secondary barrier. No secondary barrier is required for the LNG containment systems where the probability for structural failures and leakages through the primary barrier is extremely low and can be neglected.

2.1.8 If the secondary barrier of the LNG containment system is part of the hull structure it may be a boundary of the tank room subject to necessary precautions against leakage of cryogenic liquid.

2.1.9 The location and construction of the LNG containment system and the other equipment on open deck shall assure sufficient ventilation. Accumulation of escaped NG shall be prevented.

2.1.10 If condensation and icing due to cold surfaces of LNG fuel tanks may lead to safety or functional problems, appropriate preventive or remedial measures shall be taken.

2.1.11 Each LNG fuel tank is to be fitted with at least two pressure relief valves that can prevent an overpressure if one of the valves is closed off due to malfunctioning, leakage or maintenance.

2.1.12 If fuel release into the vacuum space of a vacuum insulated LNG fuel tank cannot be excluded, the vacuum space shall be protected by a suitable pressure relief valve. If LNG fuel tanks are located in enclosed or semi-enclosed rooms, the pressure relief device shall be connected to a vent system.

2.1.13 The exhaust outlets of the pressure relief valves shall be located not less than 2.00 m above the deck at a distance of not less than 6.00 m from the accommodation, passenger areas and work stations, which are located outside the hold or the cargo area. This height may be reduced when within a radius of 1.00 m round the pressure relief valves outlet there is no equipment, no work is being carried out, signs indicate the area and appropriate measures to protect the deck are being taken.

2.1.14 It shall be possible to safely empty the LNG fuel tanks, even if the LNG system is shut down.

2.1.15 It shall be possible to purge gas and vent LNG fuel tanks including gas piping systems. It shall be possible to perform inerting with an inert gas (e.g. nitrogen or argon) prior to venting with dry air, to exclude an explosion hazardous atmosphere in LNG fuel tanks and gas piping.

2.1.16 LNG fuel tanks' pressure and temperature shall be maintained at all times within their design range.

2.1.17 If the LNG system is switched off, the pressure in the LNG fuel tank, shall be maintained below the maximum working pressure of the LNG fuel tank for a period of 15 days. It shall be assumed that the LNG fuel tank was filled at filling limits according to section 2.9 and that the craft remains in idle condition.

2.1.18 LNG fuel tanks shall be electrically bonded to the craft's structure.

*2.2 Engine rooms*

2.2.1 For engine rooms one of the following concepts shall be applied:

(a) gas safe engine room;

(b) explosion safe engine room; or

(c) ESD protected engine room.

2.2.2 Requirements for gas safe engine rooms

2.2.2.1 Gas safe engine rooms shall be gas safe under all conditions ("inherently gas safe"). A single failure within the LNG system shall not lead to a leakage of gas into the engine room. All gas piping within engine room boundaries shall be enclosed in a gas tight enclosure, e.g. double wall piping or ventilated ducting.

2.2.2.2 In case one barrier fails, the gas supply to the relevant part of the LNG system shall be shut down automatically.

2.2.2.3 The ventilation system of ventilated ducting shall:

(a) guarantee a sufficient capacity to ensure that the gross volume of air inside the ventilated ducting can be changed at least 30 times per hour;

(b) be equipped to detect gas presence continuously in the space between inner and outer pipes;

(c) be independent of all other ventilation systems, in particular the ventilation system of the engine room.

2.2.2.4 A gas safe engine room shall be considered as a non-hazardous area, unless the risk assessment according to 1.3 demonstrates otherwise.

2.2.3 Requirements for explosion safe engine rooms

2.2.3.1 Arrangements in explosion safe engine rooms shall be such that the rooms are considered gas safe under normal conditions. A single failure within the LNG system shall not lead to a gas concentration over 20 per cent of the lower explosive limit (LEL) into the engine room.

2.2.3.2 In the event of gas being detected or the ventilation system fails, the gas supply to the relevant part of the LNG system shall be shut down automatically.

2.2.3.3 The ventilation system shall:

(a) guarantee a sufficient capacity to maintain gas concentration below 20 per cent of the LEL in the engine room, and to ensure that the gross volume of air inside the engine room can be changed at least 30 times per hour;

(b) be independent of all other ventilation systems.

2.2.3.4 Under normal operation the engine room shall be permanently ventilated with at least 15 changes of the gross volume of air inside the engine room per hour.

2.2.3.5 Explosion safe engine rooms shall be designed to provide a geometrical shape that minimizes the accumulation of gases or formation of gas pockets. A good air circulation shall be ensured.

2.2.3.6 An explosion safe engine room shall be considered as Zone 2, unless the risk assessment according to 1.3 demonstrates otherwise.

2.2.4 Requirements for the ESD protected engine rooms

2.2.4.1 Arrangements in ESD protected engine rooms shall be such that the rooms are considered gas safe under normal conditions, but under certain abnormal conditions may have the potential to become subject to gas hazards.

2.2.4.2 In the event of abnormal conditions involving gas hazards, ESD of non-safe equipment (ignition sources) and gas machinery shall be automatically executed, while equipment or machinery in use or active during these conditions shall be of a certified safe type.

2.2.4.3 The ventilation system shall:

(a) guarantee a sufficient capacity to ensure that the gross volume of air inside the engine room can be changed at least 30 times per hour;

(b) be designed to handle the probable maximum leakage scenario due to technical failures; and

(c) be independent of all other ventilation systems.

2.2.4.4 Under normal operation the engine room shall be permanently ventilated with at least 15 changes of the gross volume of air inside the engine room per hour.

If gas is detected in the engine room, the number of air changes shall automatically be increased to 30 changes per hour.

2.2.4.5 If the craft is equipped with more than one propulsion engine, these engines shall be located in at least two separate engine rooms. These engine rooms shall have no common partitions. However, common partitions may be accepted if it can be documented that consequences of a single failure will not affect both rooms.

2.2.4.6 Fixed gas warning equipment arranged to automatically shutdown the gas supply to the engine room concerned and to disconnect all non-explosion protected equipment or installations shall be fitted.

2.2.4.7 ESD protected engine rooms shall be designed to provide a geometrical shape that minimizes the accumulation of gases or formation of gas pockets. A good air circulation shall be ensured.

2.2.4.8 An ESD protected engine room shall be considered as Zone 1, unless the risk assessment according to 1.3 demonstrates otherwise.

*2.3 LNG and NG piping systems*

2.3.1 LNG and NG piping through other engine rooms or non-hazardous enclosed areas of the craft shall be enclosed in double wall piping or ventilated ducting.

2.3.2 LNG and NG piping shall not be located less than 1.00 m from the vessel's side and 0.60 m from the bottom.

2.3.3 All piping and all components which can be isolated with valves from the LNG system in a liquid full condition shall be provided with pressure relief valves.

2.3.4 Piping shall be electrically bonded to the vessel's structure.

2.3.5 Low temperature piping shall be thermally isolated from the adjacent hull structure, where necessary. Protection against accidental contact shall be provided.

2.3.6 The design pressure of piping shall not be less than 150 per cent of the maximum working pressure. The maximum working pressure of piping inside rooms shall not exceed 1,000 kPa. The design pressure of the outer pipe or duct of gas piping systems shall not be less than the design pressure of the inner gas pipe.

2.3.7 Gas piping in ESD protected engine rooms shall be located as far away as practicable from the electrical installations and tanks containing flammable liquids.

*2.4 Drainage systems*

2.4.1 Drainage systems for areas where LNG or NG can be present shall:

(a) be independent and separate from the drainage system of areas where LNG and NG cannot be present;

(b) not lead to pumps in non-hazardous areas.

2.4.2 Where the LNG containment system does not require a secondary barrier, suitable drainage arrangements for the tank rooms that are not connected to the engine rooms shall be provided. Means of detecting any LNG leakage shall be provided.

2.4.3 Where the LNG containment system requires a secondary barrier, suitable drainage arrangements for dealing with any leakage of LNG into the interbarrier spaces shall be provided. Means of detecting such leakage shall be provided.

*2.5 Drip trays*

2.5.1 Suitable drip trays shall be fitted where leakage can cause damage to the craft's structure or where limitation of the area that is affected from a spill is necessary.

*2.6 Arrangement of entrances and other openings*

2.6.1 Entrances and other openings from a non-hazardous area to a hazardous area shall only be permitted to the extent necessary for operational reasons.

2.6.2 For entrances and openings to a non-hazardous area within 6.00 m from the LNG containment system, the gas preparation system or the outlet of a pressure relief valve, a suitable airlock shall be provided.

2.6.3 Air locks shall be mechanically ventilated at an overpressure relative to the adjacent hazardous area. Doors shall be of the self-closing type.

2.6.4 Air locks shall be designed in a way that no gas can be released to non-hazardous areas in case of the most critical events in the hazardous areas separated by the air lock. The events shall be evaluated in the risk assessment according to 1.3.

2.6.5 Air locks shall be free of obstacles, shall provide easy passage and shall not be used for other purposes.

2.6.6 An acoustic and optical alarm shall be given on both sides of the air lock if more than one door is moved from the closed position or if gas is detected in the air lock.

*2.7 Ventilation systems*

2.7.1 Ventilators in hazardous areas shall be of a certified safe type.

2.7.2 Electric motors driving ventilators shall comply with the required explosion protection in the installation area.

2.7.3 An acoustic and optical alarm shall be triggered at a permanently manned location (e.g. wheelhouse) in the event of any loss of the required ventilating capacity.

2.7.4 Any ducting used for the ventilation of hazardous areas shall be separate from that used for the ventilation of non-hazardous areas.

2.7.5 Required ventilation systems shall have at least two ventilators with independent power supply, each of sufficient capacity, to avoid any gas accumulation.

2.7.6 Air for hazardous rooms shall be taken from non-hazardous areas.

2.7.7 Air for non-hazardous rooms shall be taken from non-hazardous areas at least 1.50 m away from the boundaries of any hazardous area.

2.7.8 Where the inlet duct passes through a hazardous room, the duct shall have over-pressure relative to this room. Overpressure shall not be required when structural measures on the duct ensure that gases will not leak into the duct.

2.7.9 Air outlets from hazardous rooms shall be located in an open area which is of the same or less hazard than the ventilated room.

2.7.10 Air outlets from non-hazardous rooms shall be located outside hazardous areas.

2.7.11 In enclosed rooms the ventilation exhaust ducts shall be located at the top of these rooms. Air inlets shall be located at the bottom.

*2.8 LNG bunkering system*

2.8.1 The LNG bunkering system shall be so arranged that no gas is discharged to the atmosphere during filling of LNG fuel tanks.

2.8.2 The bunkering station and all valves used for bunkering, shall be located on an open deck so that sufficient natural ventilation is provided.

2.8.3 The bunkering station shall be positioned and arranged so that any damage to the gas piping does not cause damage to the craft's LNG containment system.

2.8.4 Suitable means shall be provided to relieve the pressure and remove liquid contents from pump suctions and bunker piping.

2.8.5 Hoses used for the bunkering of LNG shall be:

(a) compatible with LNG, in particular suitable for the LNG temperature;

(b) designed for a bursting pressure not less than five times the maximum pressure they can be subjected to during bunkering.

2.8.6 The bunkering manifold shall be designed to withstand normal mechanical loads during bunkering. The connections shall be of dry-disconnect type in accordance with international standard ISO 16904, equipped with appropriate additional safety dry break-away couplings.

2.8.7 It shall be possible to operate the master LNG bunkering valve during bunkering operations from a safe control station on the craft.

2.8.8 Bunkering piping shall be arranged for inerting and gas freeing.

*2.9 Filling limits of LNG fuel tanks*

2.9.1 The level of LNG in the LNG fuel tank shall not exceed the filling limit of 95 per cent full at the reference temperature. The reference temperature means the temperature corresponding to the vapour pressure of the fuel at the opening pressure of the pressure relief valves.

2.9.2 A filling limit curve for LNG filling temperatures shall be prepared from the following formula:

$$LL = FL \cdot \rho_R / \rho_L$$

where:

| | | |
|---|---|---|
| $LL$ | = | loading limit, maximum allowable liquid volume relative to the LNG fuel tank volume to which the tank may be loaded, [%], |
| $FL$ | = | filling limit, [%], here 95%, |
| $\rho_R$ | = | relative density of fuel at the reference temperature, |
| $\rho_L$ | = | relative density of fuel at the loading temperature. |

2.9.3 For craft exposed to significant wave heights or significant motion on account of operations, the filling limit curve shall be adapted accordingly, based on the risk assessment according to 1.3.

*2.10 Gas supply system*

2.10.1 The gas supply system shall be so arranged that the consequences of any release of gas will be minimized, while providing safe access for operation and inspection.

2.10.2 The parts of the gas supply system which are located outside the engine room shall be designed in a way that a failure of one barrier cannot lead to a leak from the system into the surrounding area causing immediate danger to the people on board, the environment or the craft.

2.10.3 LNG fuel tank inlets and outlets shall be provided with valves located as close to the tank as possible.

2.10.4 The gas supply system to each engine or set of engines shall be equipped with a master gas fuel valve. The valves shall be situated as close as practicable to the gas preparation system but in any case, outside the engine room.

2.10.5 The master gas fuel valve shall be operable

(a) within and outside the engine room;

(b) from the wheelhouse.

2.10.6 Each gas consuming equipment shall be provided with a set of double block and bleed valves to assure safe isolation of the fuel supply system. The two block valves shall be of the fail-to-close type, while the ventilation valve shall be fail-to-open type.

2.10.7 For multi-engine installations, where a separate master gas fuel valve is provided for each engine and for one-engine installation, the master gas fuel valve and the double block and bleed valve functions can be combined. One shutdown valve of the double block and bleed valves shall also be manually operated.

*2.11 Exhaust system and gas supply shut down*

2.11.1 The exhaust system shall be configured to keep accumulation of unburned gaseous fuel as low as possible.

2.11.2 Unless designed with the strength to withstand the worst case overpressure due to ignited gas leaks, engine components or systems that can contain an ignitable gas and air mixture shall be fitted with suitable pressure relief devices.

2.11.3 If the gas supply is not changed-over to gasoil before stopping, the gas supply system from the master gas fuel valve to the engine, and the exhaust system shall be purged in order to discharge any residual gas which may be present.

2.11.4 A means shall be provided to monitor and detect incorrect operation of the ignition system, poor combustion or mis-firing that may lead to unburned gaseous fuel in the exhaust system during operation.

2.11.5 If incorrect operation of the ignition system, poor combustion or mis-firing is detected, the gas supply system shall be shut down automatically.

2.11.6 The exhaust pipes of gas or dual fuel engines shall not be connected to the exhaust pipes of other engines or systems.

2.11.7 In case of a normal stop or an ESD, the gas supply system shall be shut off not later than the ignition source. It shall not be possible to shut off the ignition source without first or simultaneously closing the gas supply to each cylinder or to the complete engine.

2.11.8 In case of shut-off of the gas supply system in a dual fuel engine, the engine shall be capable of continuous operation on gasoil only without interruption.

## 3. Fire Safety

*3.1 General*

3.1.1 Fire detection, protection and extinction measures appropriate to the hazards concerned shall be provided.

3.1.2 The gas preparation system shall be regarded as an engine room for fire protection purposes.

*3.2 Fire alarm system*

3.2.1 A suitable fixed fire alarm system shall be provided for all rooms of the LNG system where fire cannot be excluded.

3.2.2 Smoke detectors alone are not sufficient for rapid detection of a fire.

3.2.3 The fire detection system shall have the means to identify each detector individually.

3.2.4 The gas safety system shall shut down the relevant parts of the gas supply system automatically, upon fire detection in rooms containing gas installations.

*3.3 Fire protection*

3.3.1 Accommodation, passenger areas, engine rooms and escape routes shall be shielded with Type A60 partitions, where the distance is less than 3.00 m to LNG fuel tanks and bunkering stations located on deck.

3.3.2 The boundaries of LNG fuel tank rooms and ventilation ducts to such rooms below the bulkhead deck shall comply with Type A60. However, where the room is adjacent to tanks, voids, auxiliary engine rooms of little or no fire risk, sanitary and similar spaces, the insulation may comply with Type A0.

*3.4 Fire prevention and cooling*

3.4.1 A water spray system shall be installed for cooling and fire prevention to cover exposed parts of LNG fuel tank(s) located on open deck.

3.4.2 If the water spray system is part of the firefighting systems mentioned in paragraph 10-3.6, the required fire pump capacity and working pressure shall be sufficient to ensure the operation of both the required numbers of hydrants and hoses and the water spray system simultaneously. The connection between water spray system and the firefighting systems mentioned in paragraph 10-3.6 shall be provided through a screw-down non-return valve.

3.4.3 If firefighting systems mentioned in paragraph 10-3.6 are installed on board a craft where the LNG fuel tank is located on open deck, isolating valves shall be fitted in the firefighting systems in order to isolate damaged sections of the firefighting systems. Isolation of a section of firefighting systems shall not deprive the fire line ahead of the isolated section of water.

3.4.4 The water spray system shall also provide coverage for boundaries of the superstructures, unless the tank is located 3.00 m or more from the boundaries.

3.4.5 The water spray system shall be designed to cover all areas as specified above with an application rate of 10 l/min/m2 for horizontal projected surfaces and 4 l/min/m2 for vertical surfaces.

3.4.6 The water spray system shall be capable of being put into operation from the wheelhouse and from the deck.

3.4.7 The nozzles shall be arranged to ensure an effective distribution of water throughout the area being protected.

*3.5 Fire extinguishing*

In addition to the requirements of paragraph 10-3.1, two additional portable dry powder fire extinguishers of at least 12 kg capacity shall be located near the bunkering station. They shall be suitable for Class C fires.

## 4. Electrical Systems

4.1 Equipment for hazardous areas shall be of an appropriate type according to zones where such equipment is installed.

4.2 Electrical generation and distribution systems and associated control systems shall be designed so that a single failure will not result in the release of gas.

4.3 The lighting system in hazardous areas shall be divided between at least two branch circuits. All switches and protective devices shall interrupt all poles and phases and shall be located in a non-hazardous area.

4.4 Submerged gas pump motors and their supply cables may be fitted in LNG containment systems. Arrangements shall be made to alarm in low liquid level and automatically shut down the motors in the event of low-low liquid level. The automatic shutdown may be accomplished by sensing low pump discharge pressure, low motor current, or low liquid level. This shutdown shall give an acoustic and optical alarm in the wheelhouse. Gas pump motors shall be capable of being isolated from their electrical supply during gas-freeing operations.

## 5. Control, Monitoring and Safety Systems

*5.1 General*

5.1.1 Suitable control, alarm, monitoring and shutdown systems shall be provided to ensure safe and reliable operation.

5.1.2 The gas supply system shall be fitted with its own set of independent gas control, gas monitoring and gas safety systems. All elements of these systems shall be capable of being functionally tested.

5.1.3 The gas safety system shall shut down the gas supply system automatically, upon failure in systems essential for the safety and upon fault conditions which may develop too fast for manual intervention.

5.1.4 The safety functions shall be arranged in a dedicated gas safety system that is independent of the gas control system.

5.1.5 Instrumentation devices shall be fitted to allow a local and a remote reading of essential parameters, where they are necessary to ensure a safe operation of the whole LNG system including bunkering.

*5.2 LNG bunkering system and LNG containment system monitoring*

5.2.1 Each LNG fuel tank shall be fitted with:

(a) at least two liquid level indicators, which shall be arranged so that they can be maintained in an operational condition;

(b) a pressure indicator capable of indicating throughout the operating pressure range and which is clearly marked with the maximum working pressure of the LNG fuel tank;

(c) a high liquid level alarm operating independently of other liquid level indicators which shall give an acoustic and optical alarm when activated;

(d) an additional sensor operating independently of the high liquid level alarm which shall automatically actuate the master LNG bunkering valve in a manner that will both avoid excessive liquid pressure in the bunkering piping and prevent the tank from becoming full of liquid.

5.2.2 Each pump discharge line and each liquid and vapour gas shore connection shall be provided with at least one local pressure indicator. In the pump discharge line, the indicator shall be placed between the pump and the first valve. The permissible maximum pressure or vacuum value shall be indicated on each indicator.

5.2.3 A high-pressure alarm shall be provided for the LNG containment system and at the pump. Where vacuum protection is required, a low-pressure alarm shall be provided.

5.2.4 Control of the bunkering shall be possible from a safe control station remote from the bunkering station. At this control station the LNG fuel tank pressure and level shall be monitored. Overfill alarm, high and low-pressure alarm and automatic shutdown shall be indicated at this control station.

5.2.5 If the ventilation in the ducting enclosing the bunkering lines stops, an acoustic and optical alarm shall be actuated at the control station.

5.2.6 If gas is detected in the ducting enclosing the bunkering piping an acoustic and optical alarm and emergency shut-down shall be actuated at the control station.

5.2.7 Appropriate and sufficient suitable protective clothing and equipment for bunkering operations shall be available on board according to operating manual.

*5.3 Engine operation monitoring*

5.3.1 Indicators shall be fitted in the wheelhouse and the engine room for:

(a) operation of the engine in case of a gas-only engine; or

(b) operation and mode of operation of the engine in the case of a dual fuel engine.

*5.4 Gas warning equipment*

5.4.1 Gas warning equipment shall be designed, installed and tested in accordance with a recognized standard, such as international standard IEC 60079-29-1:2016.

5.4.2 Permanently installed gas detectors shall be fitted in:

(a) tank connection areas including fuel tanks, pipe connections and first valves;

(b) ducts around gas piping;

(c) engine rooms containing gas piping, gas equipment or gas consuming equipment;

(d) the room containing the gas preparation system;

(e) other enclosed rooms containing gas piping or other gas equipment without ducting;

(f) other enclosed or semi-enclosed rooms where gas vapours may accumulate including interbarrier spaces and tank rooms of independent LNG fuel tanks other than type C;

(g) air locks; and

(h) ventilation inlets to rooms in which gas vapours may accumulate.

5.4.3 By derogation to paragraph 5.4.2, permanently installed sensors which detect gas by difference of pressure can be used for interbarrier spaces in double wall piping.

5.4.4 The number and redundancy of gas detectors in each room shall be considered taking size, layout and ventilation of the room into account.

5.4.5 Permanently installed gas detectors shall be located where gas may accumulate and in the ventilation outlets of these rooms.

5.4.6 An acoustic and optical alarm shall be activated before the gas concentration reaches 20 per cent of the lower explosive limit. The gas safety system shall be activated at 40 per cent of the lower explosive limit.

5.4.7 Acoustic and optical alarms from the gas warning equipment shall be actuated in the wheelhouse.

*5.5 Safety functions of gas supply systems*

5.5.1 If the gas supply system is shut off due to activation of an automatic valve, it shall not be opened until the reason for the disconnection is ascertained and the necessary actions taken. Instructions to this effect shall be placed at a prominent position at the control station for the shut-off valves in the gas supply lines.

5.5.2 If the gas supply system is shut off due to a gas leak, it shall not be opened until the leak has been found and the necessary actions have been taken. Instructions to this effect shall be placed at a prominent position in the engine room.

5.5.3 The gas supply system shall be arranged for manual remote emergency stop from the following locations as applicable:

(a) wheelhouse;

(b) control station of the bunkering station;

(c) any permanently manned location."