ประกาศกรมเจ้าท่า

ที่ ๑๔/๒๕๖๙

เรื่อง แนวปฏิบัติเฉพาะกาลว่าด้วยความปลอดภัยของเรือที่ใช้แอมโมเนียเป็นเชื้อเพลิง

ตามที่ข้อ ๗ ข้อ ๘ ข้อ ๑๐ ประกอบกับข้อ ๕ ของกฎข้อบังคับสำหรับการตรวจเรือ กำหนดหลักเกณฑ์ วิธีการ และเงื่อนไขในการออกใบสำคัญรับรองเกี่ยวกับความปลอดภัยแห่งชีวิตในทะเล พ.ศ. ๒๕๕๙ กำหนดให้การตรวจเรือ การออกและการสลักหลังใบสำคัญรับรองต้องเป็นไปตามข้อกำหนดของอนุสัญญาระหว่างประเทศว่าด้วยความปลอดภัยแห่งชีวิตในทะเล ค.ศ. ๑๙๗๔ และที่แก้ไขเพิ่มเติม (International Convention for the Safety of Life at Sea, 1974 (SOLAS), as amended) ซึ่งต่อมาองค์การทางทะเลระหว่างประเทศ (International Maritime Organization : IMO) ได้รับรองข้อมติเพื่อกำหนดแนวปฏิบัติภายใต้อนุสัญญา SOLAS 1974 เกี่ยวกับความปลอดภัยของเรือที่ใช้แอมโมเนียเป็นเชื้อเพลิง

เพื่อให้การปฏิบัติงานเกี่ยวกับการตรวจเรือ การออกและการสลักหลังใบสำคัญรับรองตามกฎข้อบังคับสำหรับการตรวจเรือ กำหนดหลักเกณฑ์ วิธีการ และเงื่อนไขในการออกใบสำคัญรับรองเกี่ยวกับความปลอดภัยแห่งชีวิตในทะเล พ.ศ. ๒๕๕๙ และประกาศกรมเจ้าท่า ที่ ๖๕/๒๕๖๔ เรื่อง แนวทางปฏิบัติในการตรวจและออกใบสำคัญรับรองเกี่ยวกับความปลอดภัยแห่งชีวิตในทะเล เป็นไปอย่างมีประสิทธิภาพ สอดคล้องกับข้อกำหนดของอนุสัญญา SOLAS 1974 อธิบดีกรมเจ้าท่าจึงประกาศกำหนดให้นำแนวปฏิบัติเฉพาะกาลว่าด้วยความปลอดภัยของเรือที่ใช้แอมโมเนียเป็นเชื้อเพลิง (Interim Guidelines for the Safety of Ships Using Ammonia As Fuel) ซึ่งรับรองโดยข้อมติของคณะกรรมการความปลอดภัยทางทะเล ที่ MSC.1/Circ.1687 ตามที่ปรากฏในภาคผนวกที่แนบท้ายประกาศนี้ มาใช้เป็นแนวปฏิบัติในการตรวจเรือที่ใช้แอมโมเนียเป็นเชื้อเพลิง และการออกใบสำคัญรับรองเกี่ยวกับความปลอดภัยแห่งชีวิตในทะเล ตามกฎข้อบังคับสำหรับการตรวจเรือดังกล่าว

ประกาศ ณ วันที่ ๙ กุมภาพันธ์ พ.ศ. ๒๕๖๙

กริชเพชร ชัยช่วย

อธิบดีกรมเจ้าท่า

E

INTERNATIONAL MARITIME ORGANIZATION

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MSC.1/Circ.1687
26 February 2025

INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL

1 The Maritime Safety Committee, at its 109th session (2 to 6 December 2024), having considered a proposal by the Sub-Committee on Carriage of Cargoes and Containers, at its tenth session, approved the *Interim guidelines for the safety of ships using ammonia as fuel*, as set out in the annex.

2 In doing so, the Committee recognized the importance of providing guidance for the safe use of ammonia as fuel on board ships, so as to provide, at least, the same level of safety and reliability as new and comparable conventional oil-fuelled main and auxiliary machinery installations.

3 The Committee also noted the provisional nature of the Interim Guidelines, as well as the approach to provide high-level goal-based guidance for the use of ammonia as fuel, not addressing all provisions in detail, recognizing the need for future revision once relevant experience is available.

4 Member States are invited to bring the Interim Guidelines to the attention of shipbuilders, manufacturers, shipowners, ship managers, masters and ship crews, bareboat charterers and all other parties concerned.

5 Member States are also invited to recount their experience gained through the use of these Interim Guidelines to the Organization for the Committee to keep the Interim Guidelines under review.

***

ANNEX

INTERIM GUIDELINES FOR THE SAFETY OF SHIPS USING AMMONIA AS FUEL

1 INTRODUCTION

1.1 The purpose of these *Interim guidelines for the safety of ships using ammonia as fuel* (Interim Guidelines) is to provide an international standard for ships using ammonia as fuel, other than ships covered by the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

1.2 The basic philosophy of these Interim Guidelines is to present provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using ammonia as fuel to minimize the risk to the ship, its crew and the environment, having regard to the nature of the fuels involved.

1.3 Throughout the development of these Interim Guidelines, it was recognized that the provisions therein must be based on sound naval architectural and engineering principles and the best understanding available of current operational experience, field data and research and development. These Interim Guidelines address all areas that need special consideration for the use of ammonia as fuel.

1.4 These Interim Guidelines follow the *Generic guidelines for developing IMO goal-based standards* (MSC.1/Circ.1394/Rev.2) by specifying goals and functional requirements for each section forming the basis for the design, construction and operation of ships using ammonia as fuel.

1.5 The current version of these Interim Guidelines includes provisions to meet the functional requirements for ammonia as fuel.

1.6 Chapters 5 to 20 contain goals and functional requirements but may not include specific provisions with details on how to achieve these functional requirements in all cases. In applying the goals and functional requirements in these chapters to a specific ship design, Administrations and the industry should take into account, and apply where relevant, the corresponding regulations of the International Code of Safety for Ships using Gases or Other Low-flashpoint Fuels (IGF Code). Where such regulations are determined not to be fit for purpose, the principles set out in SOLAS regulation II-1/55 should be used to determine appropriate alternative performance criteria that align with the goals and functional requirements provided in these Interim Guidelines.

1.7 These Interim Guidelines have been closely aligned with the IGF Code, adopted by resolution MSC.391(95), as amended, in particular chapter 3, which is mainly text taken from chapter 3 of the IGF Code, albeit modified to reflect the recommendatory nature of these Interim Guidelines.

1.8 Wherever in these Interim Guidelines reference is made to "gas supply" as contained in the IGF Code, it should be read as "ammonia supply".

2 GENERAL

2.1 Application

Unless expressly provided otherwise, these Interim Guidelines apply to ships using ammonia as fuel. These Interim Guidelines do not address ships using ammonia cargo as fuel.

2.2 Definitions

For the purpose of these Interim Guidelines, the terms used have the meanings defined in the following paragraphs. Terms not defined have the same meaning as in SOLAS chapter II-2 and the IGF Code.

2.2.1 *Ammonia* means an inorganic compound represented by the chemical formula NH_3. In these Interim Guidelines, ammonia either in its liquefied or gaseous state is referred to as ammonia.

2.2.2 *Fuel* means ammonia, either in its liquefied or gaseous state.

2.2.3 *Fuel consumer* means any unit within the ship using ammonia as a fuel.

2.2.4 *Source of release* means a point or location from which a gas, vapour, mist or liquid may be released into the atmosphere so that an explosive and/or toxic atmosphere could be formed.

2.2.5 *Toxic area* means an area in which ammonia is or may be expected to be present.

2.2.6 *Toxic space* means an enclosed or semi-enclosed space in which ammonia is or may be expected to be present. A gas-safe machinery space is not considered to be a toxic space.

2.2.7 *Enclosed space* means any space within which, in the absence of artificial ventilation, the ventilation will be limited, and any explosive and/or toxic atmosphere will not be dispersed naturally

2.3 Alternative design

2.3.1 These Interim Guidelines contain functional requirements for all appliances and arrangements related to the usage of ammonia as fuel.

2.3.2 Appliances and arrangements of ammonia fuel systems may deviate from those set out in these Interim Guidelines, provided such appliances and arrangements meet the intent of the goal and functional requirements concerned and provide an equivalent level of safety to the relevant sections.

2.3.3 The equivalence of the alternative design should be demonstrated as specified in SOLAS regulation II-1/55 and approved by the Administration. However, the Administration should not allow operational methods or procedures to be applied as an alternative to a particular fitting, material, appliance, apparatus, item of equipment or type thereof which is prescribed by these Interim Guidelines.

3 GOAL AND FUNCTIONAL REQUIREMENTS

3.1 Goal

The goal of these Interim Guidelines is to provide for safe and environmentally friendly design, construction and operation of ships and in particular their installations of systems for propulsion machinery, auxiliary power generation machinery and/or other purpose machinery using ammonia as fuel.

3.2 Functional requirements

3.2.1 The safety, reliability and dependability of the systems should be equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.

3.2.2 The probability and consequences of ammonia-related hazards should be limited to a minimum through arrangement and system design, such as ventilation, detection, containment and safety actions. In the event of ammonia leakage or failure of the risk-reducing measures, necessary safety actions should be initiated.

3.2.3 The design philosophy should ensure that risk-reducing measures and safety actions for the fuel installation do not lead to an unacceptable loss of power.

3.2.4 Hazardous areas, toxic areas and toxic spaces should be restricted, as far as practicable, to minimize the potential risks that might affect the safety of the ship, persons on board, and equipment.

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

3.2.6 Unintended accumulation of explosive, flammable or toxic gas concentrations should be prevented.

3.2.7 System components should be protected against external damage.

3.2.8 Sources of ignition in hazardous areas should be minimized to reduce the probability of explosions.

3.2.9 Sources of ammonia release should be minimized to reduce the probability of ammonia exposure to humans and the environment.

3.2.10 Measures to minimize the health hazards associated with exposure to ammonia should be provided.

3.2.11 Direct release of ammonia into the atmosphere during normal operation and during any foreseeable and controllable abnormal scenario should be avoided.

3.2.12 Safe and suitable fuel supply, storage and bunkering arrangements should be made, capable of receiving and containing the fuel in the required state without leakage. Other than when necessary for safety reasons, fuel supply, storage and bunkering arrangements should be designed to prevent venting under all normal operating conditions, including idle periods.

3.2.13 Piping systems, containment and overpressure relief arrangements that are of suitable design, construction and installation for their intended application should be provided.

3.2.14 Machinery, systems and components should be designed, constructed, installed, operated, maintained and protected to ensure safe and reliable operation.

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

3.2.16 Fixed fuel vapour and/or leakage detection suitable for all spaces and areas concerned should be arranged.

3.2.17 Fire detection, protection and extinction measures appropriate to the hazards concerned should be provided.

3.2.18 Commissioning, trials and maintenance of fuel systems and gas utilization machinery should satisfy the goal in terms of safety, availability and reliability.

3.2.19 The technical documentation should permit an assessment of the compliance of the system and its components with the applicable rules, guidelines, design standards used and the principles related to safety, availability, maintainability and reliability.

3.2.20 A single failure in a technical system or component should not lead to an unsafe or unreliable situation.

4 GENERAL PROVISIONS

4.1 Goal

The goal of this chapter is to ensure that the necessary assessments of the risks involved are carried out in order to eliminate or mitigate any adverse effect on the persons on board, the environment or the ship.

4.2 Risk assessment

4.2.1 A holistic risk assessment should be conducted to ensure that risks arising from the use of ammonia as fuel affecting persons on board, the environment, the structural strength, or the integrity of the ship and its sub-systems are addressed. Consideration should be given to the hazards associated with physical layout, operation and maintenance, following any reasonably foreseeable failure.

4.2.2 The risk assessment should specifically consider the ammonia system integrity with a focus on its ability to prevent and isolate leakages and also evaluate potential toxicity hazards, ignition mechanisms and consequences of ignition. Special consideration should be given, but not limited to, the following specific ammonia-related hazards and topics:

.1 loss of function;

.2 component damage;

.3 fire;

.4 explosion;

.5 toxicity; and

.6 electric shock.

4.2.3 Risks, which cannot be eliminated, should be mitigated as necessary. Details of risks, and the means by which they are mitigated, should be documented to the satisfaction of the Administration.

4.3 Limitation of explosion consequences

4.3.1 An explosion in any space containing any potential sources of release and potential ignition sources should not:

.1 cause damage to or disrupt the proper functioning of equipment/systems located in any space other than that in which the incident occurs;

.2 damage the ship in such a way that flooding of water below the main deck or any progressive flooding occurs;

.3 damage work areas or accommodation in such a way that persons who stay in such areas under normal operating conditions are injured;

.4 damage ship personnel normally present in work or accommodation spaces under normal operating conditions;

.5 disrupt the proper functioning of control stations and switchboard rooms necessary for power distribution;

.6 damage life-saving equipment or associated launching arrangements;

.7 disrupt the proper functioning of fire-fighting equipment located outside the explosion-damaged space;

.8 affect other areas of the ship in such a way that chain reactions involving, inter alia, cargo, ammonia and bunker oil may arise; or

.9 prevent persons' access to life-saving appliances or impede escape routes.

5 SHIP DESIGN AND ARRANGEMENT

5.1 Goal

The goal of this chapter is to provide for safe location, space arrangements and mechanical protection of power generation equipment, fuel storage systems, fuel supply equipment and refuelling systems.

5.2 Functional requirements

5.2.1 This chapter is related to functional requirements in 3.2.1 to 3.2.3, 3.2.5 to 3.2.9, 3.2.13 to 3.2.16, 3.2.18 and 3.2.20. In particular, the following apply:

.1 the fuel tank(s) should be located in such a way that the probability for the tank(s) to be damaged following a collision or grounding is reduced to a minimum, taking into account the safe operation of the ship and other hazards that may be relevant to the ship;

.2 fuel containment systems, fuel piping and other fuel sources of release should be so located and arranged that released ammonia is led to a recovery system, treatment system or a safe location in the open air;

.3 the access or other openings to spaces containing fuel sources of release should be so arranged that flammable, asphyxiating or toxic gas cannot escape to spaces that are not designed for the presence of such gases taking into account the specific gravity and dispersion characteristics of ammonia gas;

.4 fuel piping and fuel supply system should be protected against mechanical damage;

.5 the propulsion and fuel supply system should be so designed that safety actions after any ammonia leakage do not lead to an unacceptable loss of power;

.6 the probability of an explosion in a machinery space with ammonia-fuelled machinery should be minimized; and

.7 the space where machinery and equipment fuel are installed should be designed to minimize the risk of exposure of persons on board to leaked ammonia.

5.3 General provisions

5.3.1 Fuel storage tanks should be protected against mechanical damage.

5.3.2 Fuel storage tanks and/or equipment located on an open deck should be located to ensure sufficient natural ventilation to prevent accumulation of ammonia.

5.3.3 Mustering stations and life-saving equipment, and access to such stations and equipment, should not be located in toxic areas as specified in 12*bis*.4.

5.3.4 Air intakes, outlets and other openings into the accommodation, service and machinery spaces, control stations and other non-toxic spaces in the ship should not be located in toxic areas as specified in 12*bis*.4.

5.4 Provisions for protection of fuel tanks from collision and grounding

Unless expressly provided otherwise, the requirements of 5.3.3, 5.3.4 and 5.3.5 of the IGF Code part A-1 should apply to ships using ammonia as fuel.

5.5 Provisions for machinery space arrangement

5.5.1 Machinery spaces containing ammonia fuel systems and/or ammonia-fuelled machinery should be arranged such that the spaces may be considered gas safe under all conditions, normal as well as abnormal conditions, i.e. inherently gas safe.

5.5.2 In a gas-safe machinery space, a single failure cannot lead to the release of fuel gas into the machinery space.

5.5.3 A gas-safe machinery space may be arranged as a conventional machinery space.

5.5.4 A single failure within the fuel system should not lead to a fuel release into the machinery space.

5.5.5 All fuel piping within machinery space boundaries should be enclosed in a gastight enclosure, taking into account paragraph 9.6 of the IGF Code part A-1.

5.5.6 Access to machinery spaces should not be arranged from toxic areas or toxic spaces.

5.6 Provisions for location and protection of fuel piping

5.6.1 Fuel pipes and fuel supply systems should not be located less than 800 mm from the ship's side.

5.6.2 Fuel piping should not be led directly through accommodation spaces, service spaces, electrical equipment rooms or control stations as defined in the SOLAS Convention, even though the piping is protected by secondary enclosures.

5.6.3 Fuel pipes led through ro-ro spaces, special category spaces and on open decks should be protected against mechanical damage.

5.7 Provisions for fuel preparation room design

5.7.1 Provisions for fuel preparation rooms

5.7.1.1 Fuel process equipment should be arranged in a fuel preparation room arranged in accordance with provisions in these Interim Guidelines. As an exemption to this provision, vaporizers, heat exchangers and motors for pumps submerged in tanks may also be located in tank connection spaces.

5.7.1.2 When fuel preparation rooms cannot be located on open deck, or accessed from open deck, access should be provided through an airlock in compliance with 5.11.

5.7.1.3 Fuel preparation rooms should be designed to safely contain fuel leakages. The fuel preparation room boundaries should be gastight towards other spaces in the ship.

5.7.1.4 The probable maximum leakage into the fuel preparation room should be determined based on detail design, detection and shutdown systems.

5.7.1.5 The material of the boundaries of the fuel preparation room should have a design temperature corresponding with the lowest temperature it can be subjected to in a probable maximum leakage scenario, unless the boundaries of the space, i.e. bulkheads and decks, are provided with suitable thermal protection.

5.7.1.6 The fuel preparation room should be fitted with ventilation arrangements ensuring that the space can withstand any pressure build-up caused by vaporization of the liquefied fuel.

5.7.1.7 The fuel preparation room entrance should be arranged with a sill height exceeding the liquid level resulting from a calculated maximum leakage, but should in no case be lower than 300 mm.

5.7.1.8 Fuel preparation room entrances should be arranged with water screens having constantly available water supply. The water screen should be possible to activate from a safe location outside the fuel preparation room toxic zone if an ammonia leak occurs. The water screens should be arranged on the outside of the fuel preparation room. The arrangement should include the means to safely manage any ammonia effluent produced in their operation.

5.7.1.9 A leakage in the fuel preparation room should not render necessary safety functions out of order due to low temperatures caused by the evaporation of leaking fuel.

5.7.1.10 Fuel preparation rooms should be designed to manage any ammonia release for personnel to enter safely.

5.7.2 Provisions for tank connection spaces

5.7.2.1 Fuel tank connections, flanges and tank valves should be located in a tank connection space arranged in accordance with the provisions in these Interim Guidelines. Apart from fuel process equipment allowed in tank connection spaces as defined in 5.7.1.1, tank connection spaces and fuel preparation rooms should not be combined.

5.7.2.2 Tank connection spaces should be designed to safely contain fuel leakages. The tank connection space boundaries should be gastight towards other spaces in the ship.

5.7.2.3 The material of the bulkheads of the tank connection space should have a design temperature corresponding with the lowest temperature it can be subject to in a probable maximum leakage scenario.

5.7.2.4 The probable maximum leakage into the tank connection space should be determined based on detail design, detection and shutdown systems.

5.7.2.5 Tank connection spaces should be fitted with ventilation arrangements ensuring that the spaces can withstand any pressure build-up caused by vaporization of the liquefied fuel.

5.7.2.6 Tank connection space entrances should be arranged with a sill height exceeding the liquid level resulting from a calculated maximum leakage, but should in no case be lower than 300 mm.

5.7.2.7 Tank connection space entrances should be arranged with water screens having constantly available water supply. The water screen should be possible to activate from a safe location outside the tank connection space toxic zone if an ammonia leak occurs. The water screens should be arranged on the outside of the tank connection spaces. The arrangement should include the means to safely manage any ammonia effluent produced in their operation.

5.7.2.8 Unless the access to the tank connection space is independent and direct from the open deck, it should be provided through a bolted hatch. The bolted hatch should be located in a protective entry space of gastight construction with a self-closing gastight door. The access should be arranged to facilitate the evacuation of an injured person from the tank connection space by personnel wearing breathing apparatus and PPE.

5.7.2.9 A leakage in the tank connection space should not render necessary safety functions out of order due to low temperatures caused by the evaporation of leaking fuel.

5.7.3 Provisions for fuel bunkering stations

5.7.3.1 The location and arrangement of the bunkering station, including whether open, enclosed, or semi-enclosed, should be subject to special consideration within the risk assessment. Depending on the arrangement this may include, but is not limited to:

.1 segregation from other areas of the ship;

.2 hazardous and toxic area plans for the ship;

.3 requirements for forced ventilation;

.4 requirements for leakage detection;

.5 safety actions related to leakage detection;

.6 access to bunkering station from non-hazardous areas through airlocks; and

.7 monitoring of bunkering station by direct line of sight or closed-circuit television (CCTV).

5.7.3.2 Mechanical spray shielding should be arranged around potential leakage sources from the ammonia system in the bunkering station.

5.7.3.3 The bunker station should be located in an area where sufficient space for efficient work and access is ensured for the personnel involved in bunkering and their equipment while wearing SCBA and PPE, and to ensure that, in an emergency, they have a clear escape route.

5.8 Provisions for bilge systems

5.8.1 Bilge systems installed in areas where fuel covered by these Interim Guidelines can be present should be segregated from the bilge system of spaces where fuel cannot be present.

5.8.2 Where fuel is carried in a fuel containment system requiring a secondary barrier, suitable drainage arrangements for dealing with any leakage into the hold or insulation spaces through the adjacent ship structure should be provided. The bilge system should not lead to pumps in spaces having no risks of ammonia. Means of detecting such leakage should be provided.

5.8.3 The hold or interbarrier spaces of type A independent tanks for liquid gas should be provided with a drainage system suitable for handling liquid fuel in the event of fuel tank leakage or rupture.

5.9 Provisions for drip trays

5.9.1 Drip trays should be fitted where leakage may occur which can cause damage to the ship structure or where limitation of the area which is affected from a spill is necessary.

5.9.2 Drip trays should be made of suitable material.

5.9.3 The drip tray should be thermally insulated from the ship's structure so that the surrounding hull or deck structures are not exposed to unacceptable cooling, in case of leakage of liquid fuel.

5.9.4 Each tray should be fitted with a drain valve to enable water to be drained over the ship's side where the tray is installed in a location where water may be retained.

5.9.5 Each tray should have a sufficient capacity to ensure that the assumed maximum amount of spill according to the risk assessment can be handled.

5.9.6 Drip trays should be provided with means to safely drain or transfer spills that contain ammonia to be contained or treated.

5.10 Provisions for the arrangement of entrances and other openings in enclosed spaces

5.10.1 Direct access should not be permitted from a non-hazardous area to a hazardous area. Where such openings are necessary for operational reasons, an airlock which complies with 5.11 should be provided.

5.10.2 Direct access should not be permitted from a non-toxic space to a toxic area or space. Where such openings are necessary for operational reasons, an airlock which complies with 5.11 should be provided.

5.10.3 For inerted spaces, access arrangements should be such that unintended entry by personnel should be prevented. If access to such spaces is not from an open deck, sealing arrangements should ensure that leakages of inert gas to adjacent spaces are prevented.

5.10.4 Arrangements for fuel storage hold spaces, void space, fuel tanks and other spaces classified as hazardous/toxic areas or spaces should be such as to allow entry and inspection of any such space by ship personnel wearing PPE and breathing apparatus, as well as to allow for the evacuation of injured or unconscious ship personnel. Such arrangements should comply with the following:

.1 access should be provided as follows:

.1 access to all fuel tanks. Access should be directly from open decks as far as practicable;

.2 access through horizontal openings, hatches or manholes. The size should be sufficient to allow a person wearing a breathing apparatus to ascend or descend any ladder without obstruction, and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening is to be not less than 600 mm X 600 mm;

.3 access through vertical openings or manholes providing passage through the length and breadth of the space. The minimum clear opening should be not less than 600 mm × 800 mm at a height of not more than 600 mm from the bottom plating, unless gratings or other footholds are provided; and

.4 circular access openings to type C tanks are to have a diameter of not less than 600 mm.

.2 the sizes referred to in 5.10.4.1.2 and 5.10.4.1.3 may be decreased, if 5.10.4 can be met to the satisfaction of the Administration.

.3 where fuel is carried in containment systems requiring secondary barriers, 5.10.4.1.2 and 5.10.4.1.3 do not apply to spaces separated from hold spaces by a single gastight steel boundary. Such spaces are to be provided only with direct or indirect access from open decks, excluding any enclosed non-hazardous areas.

5.11 Provisions for airlocks

5.11.1 An airlock is a space enclosed by gastight bulkheads with two substantially gastight doors spaced at least 1.5 m and not more than 2.5 m apart. Unless subject to the requirements of the International Convention on Load Lines, the door sill should not be less than 300 mm in height. The doors should be self-closing without any holding back arrangements.

5.11.2 Airlocks should be mechanically ventilated at an overpressure relative to the adjacent hazardous/toxic area or space.

5.11.3 The airlock should be designed in a way that no gas can be released to safe spaces in case of the most critical event in the gas-dangerous space separated by the airlock. The events should be evaluated in the risk analysis according to 4.2.

5.11.4 Airlocks should have a simple geometrical form. They should provide free and easy passage and should have a deck area of not less than 1.5 m^2. Airlocks should not be used for other purposes, for instance as storerooms.

5.11.5 An audible and visual alarm system to give a warning on both sides of the airlock should be provided to indicate if more than one door is moved from the closed position.

5.11.6 For non-hazardous/non-toxic spaces with access from hazardous/toxic spaces below deck where the access is protected by an airlock, upon loss of underpressure in the hazardous/toxic space, access to the space is to be restricted until the ventilation has been reinstated. Audible and visual alarms should be given at a manned location to indicate both loss of pressure and opening of the airlock doors when pressure is lost.

6 FUEL CONTAINMENT SYSTEM

6.1 Goal

The goal of this chapter is to provide that ammonia storage is adequate so as to minimize the risk to personnel, the ship and the environment to a level that is equivalent to a conventional oil-fuelled ship.

6.2 Functional requirements

This chapter relates to functional requirements in 3.2.1, 3.2.2, 3.2.5, 3.2.7 and 3.2.8 to 3.2.18. In particular, the following apply:

.1 the fuel containment system should be so designed that a leak from the tank or its connections does not endanger the ship, persons on board or the environment. Potential dangers to be avoided include:

  .1 exposure of ship materials to temperatures below acceptable limits;

  .2 flammable fuels spreading to locations with ignition sources;

  .3 toxicity potential and risk of oxygen deficiency due to fuels and inert gases;

  .4 restriction of access to muster stations, escape routes and life-saving appliances (LSA); and

  .5 reduction in availability of LSA;

.2 the pressure and temperature in the fuel tank should be kept within the design limits of the containment system and possible carriage requirements of the fuel; and

.3 the fuel containment arrangement should be so designed that safety actions after any ammonia leakage do not lead to an unacceptable loss of power.

6.3 General provisions

6.3.1 The ammonia fuel should be stored in a refrigerated state at atmospheric pressure.

6.3.2 Tank connection spaces and fuel storage hold spaces other than for tank type C should be gastight towards adjacent spaces. These spaces should not be adjacent to accommodation spaces, service spaces, electrical equipment rooms and control stations by a single bulkhead or deck. "Adjacent" means linear contact and point contact.

6.3.3 Pipe connections to the fuel storage tank should be mounted above the highest liquid level in the tanks, except for type C fuel storage tanks. Connections below the highest liquid level may however, also be accepted for other tank types after special consideration by the Administration.

6.3.4 Piping between the tank and the first valve which release liquid in case of pipe failure should have safety equivalent to a type C tank, with dynamic stress not exceeding the values given in 6.4.15.3.1.2 of the IGF Code part A-1.

6.3.5 If piping is connected below the liquid level of the tank, it has to be protected by a secondary barrier up to the first valve.

6.3.6 Means should be provided whereby liquefied gas in the storage tanks can be safely emptied.

6.3.7 It should be possible to empty, purge and vent fuel storage tanks with fuel piping systems. Instructions for carrying out these procedures must be available on board. Inerting should be performed with an inert gas prior to venting with dry air to avoid an explosion-hazardous atmosphere in tanks and fuel pipes. For further information, the provisions of the IGF Code, part A-1, paragraph 6.10, should be taken into account.

6.4 Provisions for liquefied ammonia fuel containment

6.4.1 Unless expressly provided otherwise, the requirements of the IGF Code, part A-1, chapter 6.4, should apply to ships using ammonia as fuel.

6.4.2 The provision of 6.4.1.3 of the IGF Code part A-1 related to portable tanks should not apply to ships using ammonia as fuel.

6.5 Provisions for portable liquefied ammonia fuel tanks

The provisions of 6.5 of the IGF Code should not apply to ships using ammonia as fuel.

6.6 Provisions for compressed fuel containment

The provisions of 6.6 of the IGF Code should not apply to ships using ammonia as fuel.

6.7 Provisions for pressure relief system

6.7.1 General

6.7.1.1 All fuel storage tanks should be provided with a pressure relief system appropriate to the design of the fuel containment system and the fuel being carried. Fuel storage hold spaces, interbarrier spaces and tank connection spaces, which may be subject to pressures beyond their design capabilities, should also be provided with a suitable pressure relief system. Pressure control systems specified in 6.9 should be independent of the pressure relief systems.

6.7.1.2 Fuel storage tanks which may be subject to external pressures above their design pressure should be fitted with vacuum protection systems.

6.7.2 Pressure relief systems for liquefied ammonia fuel tanks

6.7.2.1 Liquefied ammonia fuel tanks should be fitted with a minimum of two pressure relief valves (PRVs) allowing for disconnection of one PRV in case of malfunction or leakage.

6.7.2.2 Interbarrier spaces should be provided with pressure relief devices.[1] For membrane systems, the designer should demonstrate adequate sizing of interbarrier space PRVs.

6.7.2.3 The opening pressure of the pressure relief valves (PRVs) should not be higher than the vapour pressure that has been used in the design of the tank. Valves comprising not more than 50% of the total relieving capacity may be set at a pressure up to 5% above MARVS to allow sequential lifting, minimizing unnecessary release of vapour.

6.7.2.4 The following temperature provisions apply to PRVs fitted to pressure relief systems:

.1 PRVs on fuel tanks with a design temperature below 0°C should be designed and arranged to prevent their becoming inoperative due to ice formation;

.2 the effects of ice formation due to ambient temperatures should be considered in the construction and arrangement of PRVs;

.3 PRVs should be constructed of materials with a melting point above 925°C. Lower melting point materials for internal parts and seals may be accepted provided that fail-safe operation of the PRV is not compromised; and

.4 sensing and exhaust lines on pilot-operated relief valves should be of suitably robust construction to prevent damage.

6.7.2.5 In the event of a failure of a fuel tank PRV, a safe means of emergency isolation should be available, as follows:

.1 procedures should be provided and included in the operation manual (refer to chapter 18);

.2 the procedures should allow only one of the installed PRVs for the liquefied gas fuel tanks to be isolated, physical interlocks should be included to this effect; and

.3 isolation of the PRV should be carried out under the supervision of the master. This action should be recorded in the ship's log, and at the PRV.

[1] Refer to IACS Unified Interpretation GC9 entitled "Guidance for sizing pressure relief systems for interbarrier spaces", 1988.

6.7.2.6 Each pressure relief valve installed on a liquefied ammonia fuel tank should be connected to a venting system, which should be:

.1 so constructed that the discharge will be unimpeded and normally be directed vertically upwards at the exit;

.2 arranged to minimize the possibility of water or snow entering the vent system; and

.3 arranged such that the height of vent exits should not be less than B/3 or 6 m, whichever is the greater, above the weather deck and 6 m above working areas and walkways. However, vent mast height could be limited to a lower value according to special consideration by the Administration.

6.7.2.7 The outlet from the pressure relief valves should normally be located at least B (greatest moulded breadth) or 25 m, whichever is less, from the nearest:

.1 air intake, air outlet or opening to accommodation, service and control spaces, or other non-hazardous area; and

.2 exhaust outlet from machinery installations.

6.7.2.8 All other fuel gas vent outlets should also be arranged in accordance with 6.7.2.6 and 6.7.2.7. Means should be provided to prevent liquid overflow from gas vent outlets, due to hydrostatic pressure from spaces to which they are connected.

6.7.2.9 In the vent piping system, means for draining liquid from places where it may accumulate should be provided. The PRVs and piping should be arranged so that liquid cannot, under any circumstances, accumulate in or near the PRVs.

6.7.2.10 Suitable protection screens of not more than 13 mm square mesh should be fitted on vent outlets to prevent the ingress of foreign objects without adversely affecting the flow.

6.7.2.11 All vent piping should be designed and arranged not to be damaged by the temperature variations to which it may be exposed, forces due to flow or the ship's motions.

6.7.2.12 PRVs should be connected to the highest part of the fuel tank. PRVs should be positioned on the fuel tank so that they will remain in the vapour phase at the filling limit (FL) as given in 6.8, under conditions of 15° list and 0.015L trim, where L is defined in 2.2.25 of the IGF Code.

6.7.3 Sizing of pressure relieving system

6.7.3.1 *Sizing of pressure relief valves*

6.7.3.1.1 PRVs should have a combined relieving capacity for each liquefied gas fuel tank to discharge the greater of the following, with not more than a 20% rise in liquefied gas fuel tank pressure above the MARVS:

.1 the maximum capacity of the liquefied gas fuel tank inerting system if the maximum attainable working pressure of the liquefied gas fuel tank inerting system exceeds the MARVS of the liquefied gas fuel tanks; or

.2 vapours generated under fire exposure are computed using the following formula:

$$Q = FGA^{0.82}$$

where

Q = minimum required rate of discharge of air at standard conditions of 273.15 Kelvin (K) and 0.1013 MPa

F = fire exposure factor for different liquefied gas fuel types:

F = 1.0 for tanks without insulation located on deck;

F = 0.5 for tanks above the deck when insulation is approved by the Administration. (Approval will be based on the use of a fireproofing material, the thermal conductance of insulation, and its stability under fire exposure);

F = 0.5 for uninsulated independent tanks installed in holds;

F = 0.2 for insulated independent tanks in holds (or uninsulated independent tanks in insulated holds);

F = 0.1 for insulated independent tanks in inerted holds (or uninsulated independent tanks in inerted, insulated holds); and

F = 0.1 for membrane tanks;

G = gas factor according to formula:

$$G = \frac{12.4}{LD}\sqrt{\frac{ZT}{M}}$$

where

T = temperature in Kelvin at relieving conditions, i.e. 120% of the pressure at which the pressure relief valve is set;

L = latent heat of the material being vaporized at relieving conditions, in kJ/kg;

D = a constant based on relation of specific heats k and is calculated as follows;

$$D = \sqrt{k\left(\frac{2}{k+1}\right)^{\frac{k+1}{k-1}}}$$

where

k = ratio of specific heats at relieving conditions, and the value of which is between 1.0 and 2.2. If *k* is not known, *D* = 0.606 shall be used;

Z = compressibility factor of the gas at relieving conditions; if not known, Z = 1.0 shall be used;

M = molecular mass of the product.

The gas factor of each liquefied gas fuel to be carried is to be determined and the highest value shall be used for PRV sizing.

A = external surface area of the tank (m^2), as for different tank types, as shown in figure 6.7.3.

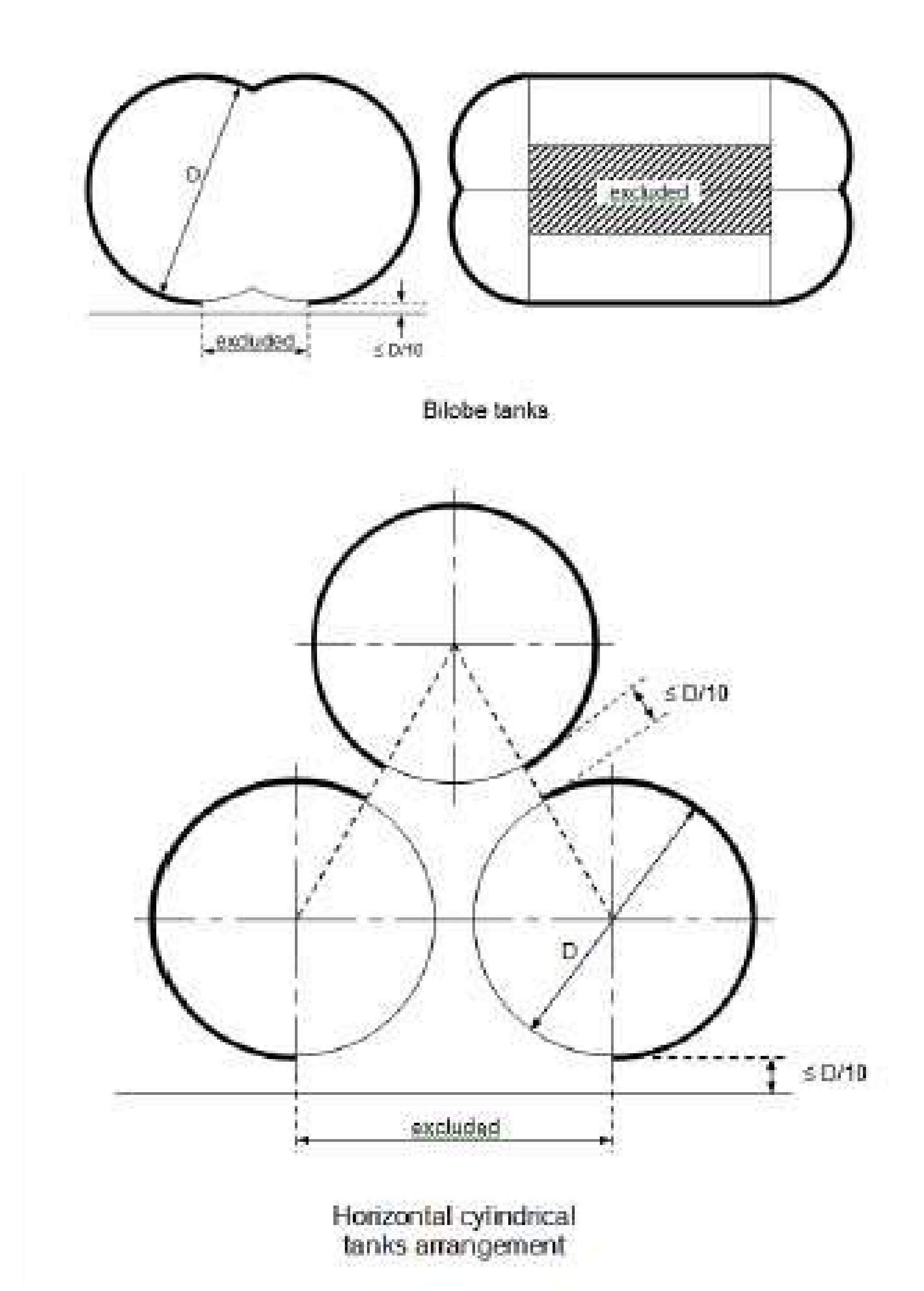

Figure 6.7.3

6.7.3.1.2 For tanks in fuel storage hold spaces separated from potential fire loads by cofferdams or surrounded by ship spaces with no fire load, the following should apply:

> If the pressure relief valves have to be sized for fire loads, the fire factors may be reduced to the following values:
>
> $F = 0.5$ to $F = 0.25$
>
> $F = 0.2$ to $F = 0.1$

6.7.3.1.3 The required mass flow of air at relieving conditions is given by:

$M_{air} = Q * \rho_{air}$ (kg/s)

where density of air (ρ_{air}) = 1.293 kg/m^3 (air at 273.15 K, 0.1013 MPa).

6.7.3.2 Sizing of vent pipe system

6.7.3.2.1 Pressure losses upstream and downstream of the PRVs should be taken into account when determining their size to ensure the flow capacity required by 6.7.3.1.

6.7.3.2.2 With regard to upstream pressure losses:

.1 the pressure drop in the vent line from the tank to the PRV inlet should not exceed 3% of the valve set pressure at the calculated flow rate, in accordance with 6.7.3.1;

.2 pilot-operated PRVs should be unaffected by inlet pipe pressure losses when the pilot senses directly from the tank dome; and

.3 pressure losses in remotely sensed pilot lines should be considered for flowing type pilots.

6.7.3.2.3 With regard to downstream pressure losses:

.1 where common vent headers and vent masts are fitted, calculations should include flow from all attached PRVs; and

.2 the built-up back pressure in the vent piping from the PRV outlet to the location of discharge to the atmosphere, and including any vent pipe interconnections that join other tanks, should not exceed the following values:

.1 for unbalanced PRVs: 10% of MARVS;

.2 for balanced PRVs: 30% of MARVS; and

.3 for pilot-operated PRVs: 50% of MARVS.

Alternative values provided by the PRV manufacturer may be accepted.

6.7.3.2.4 To ensure stable PRV operation, the blow-down should not be less than the sum of the inlet pressure loss and 0.02 MARVS at the rated capacity.

6.8 Provisions on loading limit for fuel tanks

6.8.1 Storage tanks for liquefied ammonia should not be filled to more than a volume equivalent to 98% full at the reference temperature as defined in 2.2.36 of the IGF Code.

A loading limit curve for actual fuel loading temperatures should be prepared from the following formula:

$LL = FL\ \rho_R/\rho_L$

where:

LL = loading limit as defined in 2.2.27 of the IGF Code, expressed in per cent;

FL = filling limit as defined in 2.2.16 of the IGF Code expressed in per cent, here 98%;

ρ_R = relative density of fuel at the reference temperature; and

ρ_L = relative density of fuel at the loading temperature.

6.8.2 In cases where the tank insulation and tank location make the probability very small for the tank contents to be heated up due to an external fire, special considerations may be made to allow a higher loading limit than calculated using the reference temperature, but never above 95%.

6.9 Provisions for maintaining fuel storage condition

6.9.1 Control of fuel temperature and tank pressure

6.9.1.1 The temperature of the liquefied ammonia in the fuel tanks should be maintained at a temperature of no more than -30°C at all times by means acceptable to the Administration. Systems and arrangements to be used for this purpose may include one, or a combination of, the following methods:

.1 reliquefaction of vapours;

.2 thermal oxidation of vapours; or

.3 liquefied ammonia fuel cooling.

The method chosen should be capable of maintaining the fuel temperature assuming no consumption for propulsion or power generation.

6.9.1.2 Venting of fuel vapour for control of the tank pressure is not acceptable, except in emergency situations.

6.9.2 Design of systems

6.9.2.1 For worldwide service, the upper ambient design temperature should be sea 32°C and air 45°C. For service in particularly hot or cold zones, these design temperatures should be increased or decreased, to the satisfaction of the Administration.

6.9.2.2 The overall capacity of the system should be such that it can control the temperature and pressure within the design conditions without venting to atmosphere.

6.9.3 Reliquefaction systems

6.9.3.1 The reliquefaction system should be arranged in one of the following ways:

.1 a direct system where evaporated fuel is compressed, condensed, and returned to the fuel tanks;

.2 an indirect system where fuel or evaporated fuel is cooled or condensed by refrigerant without being compressed;

.3 a combined system where evaporated fuel is compressed and condensed in a fuel/refrigerant heat exchanger and returned to the fuel tanks; or

.4 if the reliquefaction system produces a waste stream containing ammonia during pressure control operations within the design conditions, these waste gases should be disposed of without venting to the atmosphere.

6.9.4 Thermal oxidation systems

Thermal oxidation can be done by either consumption of the vapours according to the provisions for fuel consumers described in these Interim Guidelines or in a dedicated gas combustion unit. It should be demonstrated that the capacity of the oxidation system is sufficient to consume the required quantity of vapours.

6.9.5 Compatibility

Refrigerants or auxiliary agents used for refrigeration or cooling of fuel should be compatible with the fuel they may come in contact with (not causing any hazardous reaction or excessively corrosive products). In addition, when several refrigerants or agents are used, these should be compatible with each other.

6.9.6 Availability of systems

6.9.6.1 The availability of the system and its supporting auxiliary services should be such that in case of a single failure (of a mechanical non-static component or a component of the control systems) the fuel tank pressure and temperature can be maintained by another service/system.

6.9.6.2 Heat exchangers that are solely necessary for maintaining the pressure and temperature of the fuel tanks within their design ranges should have a standby heat exchanger unless they have a capacity in excess of 25% of the largest required capacity for pressure control and they can be repaired on board without external sources.

6.10 Reference to the IGF Code

The IGF Code chapter 6 should be taken into account, where applicable, in order to fulfil the functional requirements.

7 MATERIAL AND GENERAL PIPE DESIGN

7.1 Goal

The goal of this chapter is to ensure the safe handling of fuel, under all operating conditions, to minimize the risk to the ship, personnel and to the environment, having regard to the nature of the products involved.

7.2 Functional requirements

7.2.1 This chapter relates to functional requirements in 3.2.1, 3.2.5 to 3.2.10 and 3.2.13. In particular the following apply:

7.2.1.1 Fuel piping should be capable of absorbing thermal expansion or contraction caused by temperatures of the fuel without developing substantial stresses.

7.2.1.2 Provision should be made to protect the piping, piping system and components and fuel tanks from excessive stresses due to thermal movement and from movements of the fuel tank and hull structure.

7.2.1.3 If the fuel gas contains heavier constituents that may condense in the system, means for safely removing the liquid should be fitted.

7.2.1.4 Low-temperature piping should be thermally isolated from the adjacent hull structure, where necessary, to prevent the temperature of the hull from falling below the design temperature of the hull material.

7.2.1.5 Materials should be selected considering the relevant properties of ammonia. Consideration should be given to the corrosiveness of the fuel according to the relevant environment conditions, including stress corrosion cracking. System components other than piping that are likely to come into contact with and be degraded by ammonia in a leakage scenario should be compatible with ammonia.

7.2.1.6 Fuel piping should be designed to prevent fuel from unintended accumulation in piping in consideration of the characteristics of ammonia. In addition, fuel piping should be arranged for emptying, inerting and gas freeing.

7.3 General provisions

7.3.1 Fuel piping systems for liquid ammonia should as a minimum have a design pressure of 18 bar, corresponding to the vapour pressure of ammonia at 45°C, in order to prevent venting of ammonia in idle conditions. Fuel piping systems for gaseous ammonia should as a minimum have a design pressure of 10 bar. For fuel piping systems for liquid ammonia fitted with closed loop pressure relief arrangements routed back to the fuel storage tank, the minimum design pressure should as a minimum have a design pressure of 10 bar.

7.3.2 Expansion joints and bellows should not be used in ammonia fuel piping systems. Engine-mounted expansion bellows could be accepted based on evaluation, as reflected in the safety concept of the engine.

7.3.3 Anhydrous ammonia may cause stress corrosion cracking in containment and process systems made of carbon-manganese steel or nickel steel. To minimize the risk of this occurring, measures detailed in 17.12.2 to 17.12.7 of the IGC Code should be taken, as appropriate.

7.4 Reference to the IGF Code

The IGF Code chapter 7 should be taken into account, where applicable, in order to fulfil the functional requirements.

8 BUNKERING

8.1 Goal

The goal of this chapter is to provide for suitable systems on board the ship to ensure that bunkering can be conducted without causing danger to persons, the environment or the ship.

8.2 Functional requirements

8.2.1 This chapter relates to functional requirements in 3.2.1 to 3.2.12 and 3.2.14 to 3.2.18. In particular, the following should apply:

8.2.1.1 The piping system for transfer of fuel to the storage tanks should be designed such that any leakage from the piping system cannot cause danger to persons, the environment or the ship.

8.3 Provisions for bunkering station

8.3.1 General

8.3.1.1 Enclosed or semi-enclosed bunkering stations should be gastight towards adjacent spaces. The term "adjacent" includes linear contact and point contact.

8.3.1.2 Air intakes and openings in accommodation spaces, service spaces, engine rooms and control stations should not be located in hazardous and toxic areas associated with bunkering stations.

8.3.1.3 Connections and piping should be so positioned and arranged that any damage to the bunkering piping does not cause damage to the ship's fuel containment system resulting in an uncontrolled fuel discharge.

8.3.1.4 Bunkering piping should not be led through accommodation spaces, service spaces, electrical equipment rooms or control stations. Where bunkering piping is arranged in other enclosed spaces, bunkering piping should pass through a secondary enclosure meeting the requirements of 9.5.1.

8.3.1.5 Arrangements should be made for safe management of any spilled fuel.

8.3.1.6 Suitable means should be provided to relieve the pressure and remove ammonia contents from pump suctions and bunker lines. Ammonia is to be discharged to the fuel tanks or other suitable location.

8.3.1.7 The surrounding hull or deck structures should not be exposed to unacceptable cooling, in case of leakage of fuel.

8.3.2 Ship's fuel hoses

8.3.2.1 Liquid and vapour hoses used for fuel transfer should be compatible with the fuel and suitable for the fuel temperature.

8.3.2.2 Hoses subject to tank pressure, or the discharge pressure of pumps or vapour compressors, should be designed for a bursting pressure not less than five times the maximum pressure the hose can be subjected to during bunkering. Hoses should be regularly visually inspected, and hydrostatic pressure tested periodically at not more than a five-year interval.

8.3.2.3 Where fuel hoses are stored on the open deck or in a storage room, arrangements should be made for safe storage of the hoses.

8.4 Provisions for manifold

8.4.1 The bunkering manifold should be designed to withstand the external loads during bunkering. The connections at the bunkering station should be arranged in order to achieve a dry-disconnect operation in one of the followings ways:

.1 a dry-disconnect/connect coupling;

.2 a manual connect coupler or hydraulic connect coupler, used to connect the bunker system to the receiving vessel bunkering manifold presentation flange; or

.3 a bolted flange to flange assembly.

8.4.2 When intended to use either of the connections specified in paragraphs 8.4.1.2 and 8.4.1.3, these should be combined with operating procedures that ensure a dry-disconnect is achieved. The arrangement should be subject to special consideration informed by a bunkering arrangement risk assessment conducted at the design stage and considering dynamic loads at the bunkering manifold connection, the safe operation of the ship and other hazards that may be relevant to the ship during bunkering operation. The fuel handling manual required by 18.2.1.3 shall include documentation that the bunkering arrangement risk assessment was conducted, and that special consideration was granted under this requirement.

8.4.3 An emergency release coupler (ERC)/emergency release system (ERS) or equivalent means should be provided, unless installed on the bunkering supply side of the bunkering line. It should enable a quick physical disconnection "dry break-away" of the bunker system in an emergency event.

8.5 Provisions for bunkering system

8.5.1 An arrangement for purging fuel bunkering lines with inert gas should be provided.

8.5.2 The bunkering system should be so arranged that no gas is discharged to the atmosphere during filling of storage tanks. Vapour return line, where fitted, should be sized adequately taking into consideration the expansion ratio of the fuel during bunkering operations.

8.5.3 A manually operated stop valve and a remote operated shutdown valve in series, or a combined manually operated and remote valve should be fitted in every bunkering line close to the connecting point. It should be possible to operate the remote valve in the control location for bunkering operations and/or from another safe location.

8.5.4 A bunkering-safety link (BSL), or an equivalent means for automatic and manual ESD communication to the bunkering source should be fitted.

8.5.5 Means should be provided for draining any fuel from the bunkering pipes upon completion of operation.

8.5.6 Bunkering lines should be arranged for inerting and gas freeing. Means to confirm the absence of residual liquid should be provided. When not engaged in bunkering, the bunkering pipes should be free of gas, or residual liquid, unless the consequences of not gas freeing are evaluated and approved by the Administration.

8.5.7 In case bunkering lines are arranged with a cross-over, it should be ensured by suitable isolation arrangements that no fuel is transferred inadvertently to the ship side not in use for bunkering.

8.5.8 If not demonstrated to be required at a higher value due to pressure surge considerations a default time as calculated in accordance with 16.7.3.7 of the IGF Code from the trigger of the alarm to full closure of the remote operated valve required by 8.5.3 should be adjusted.

8.5.9 Sampling valves, if fitted, should be arranged at suitable locations in the bunkering line to allow verification procedures to confirm that the bunkering line is safe before opening any flanges. A double shut-off, blank flange or plug should be installed on sampling valves in the bunkering line.

9 FUEL SUPPLY TO CONSUMERS

9.1 Goal

The goal of this chapter is to ensure the safe and reliable distribution of fuel to the fuel consumers.

9.2 Functional requirements

This chapter is related to functional requirements in 3.2.1 to 3.2.6, 3.2.8 to 3.2.12 and 3.2.14 to 3.2.18. In particular, the following apply:

.1 the fuel supply system should be designed so as to avoid direct release of ammonia to the atmosphere during normal operation and during any foreseeable and controllable abnormal scenario, while providing safe access for operation and inspection. The causes and consequences of ammonia gas release should be given special consideration when carrying out the risk assessment required by 4.2;

.2 the piping system for fuel transfer to the fuel consumers should be designed in a way that a failure of one barrier cannot lead to a leak from the piping system into the surrounding area causing danger to the persons on board, the environment or the ship;

.3 fuel lines outside the machinery spaces should be installed and protected so as to minimize the risk of injury to personnel and damage to the ship in case of leakage;

.4 the fuel supply system should be designed and arranged not to cause unintentional phase changes within the fuel supply system; and

.5 operational gas releases should be collected and handled by a suitable ammonia release mitigation system.

9.3 Provisions on redundancy of fuel supply

9.3.1 For single fuel installations, the fuel supply system should be arranged with full redundancy and segregation all the way from the fuel tanks to the fuel consumer, so that a leakage in one system does not lead to an unacceptable loss of power.

9.3.2 For single fuel installations, the fuel storage should be divided between two or more tanks. The tanks should be located in separate compartments.

9.3.3 For type C tank only, one tank may be accepted if two completely separate tank connection spaces are installed for the one tank.

9.4 Provisions on safety functions of fuel supply system

9.4.1 Fuel storage tank inlets and outlets should be provided with valves located as close to the tank as possible. Valves required to be operated during normal operation[2] which are not accessible should be remotely operated. Tank valves, whether accessible or not, should be automatically operated when the safety system required in 15.2.2 is activated.

9.4.2 The main fuel supply line and return lines to each fuel consumer or set of consumers should be equipped with a manually operated stop valve and an automatically operated "master fuel valve" coupled in series or a combined manually and automatically operated valve. The valves should be situated in the part of the piping that is outside the machinery space containing fuel consumers and placed as near as possible to the installation for heating the fuel, if fitted. The master fuel valve should automatically cut off the fuel supply when activated by the safety system required in 15.2.2.

9.4.3 The automatic master fuel valve should be operable from safe locations on escape routes inside a machinery space containing a fuel consumer, the engine control room, if applicable; outside the machinery space, and from the navigation bridge.

9.4.4 The fuel supply lines to fuel preparation rooms should be equipped with automatically operated shut-off valves situated at the bulkhead inside the fuel preparation room.

9.4.5 Each fuel consumer should be provided with "double block and bleed" valves arrangement. These valves should be arranged as outlined in .1 or .2 so that when the safety system required in 15.2.2 is activated, this will cause the shutoff valves that are in series to close automatically and the bleed valve to open automatically, and:

.1 the two shutoff valves should be in series in the fuel pipe to the fuel consuming equipment. The bleed valve should be in a pipe that vents to a suitable ammonia release mitigation system that portion of the fuel piping that is between the two valves in series; or

.2 the function of one of the shutoff valves in series and the bleed valve can be incorporated into one valve body, so arranged that the flow to the fuel utilization unit will be blocked and the ventilation opened.

9.4.6 The two valves should be of the fail-to-close type, while the ventilation valve should be fail-to-open.

9.4.7 The fuel supply system should include an ammonia release mitigation system capable of collecting and handling ammonia releases, including but not limited to:

.1 bleed from double block and bleed arrangements on the fuel piping systems;

.2 releases from the opening of pressure relief valves in the fuel piping system; and

.3 releases from purging and draining operations of fuel pipes.

---

[2] Normal operation in this context is when fuel is supplied to fuel consumers and during bunkering operations.

9.4.8 The release mitigation system should be capable of reducing the ammonia concentration to below 110 ppm. Discharges from the release mitigation system should be arranged in accordance with 6.7.2.7.

9.4.9 Where fuel supply systems supply ammonia in the liquid state, relevant bleed lines and vent lines should be led to the fuel tank or gas-liquid separator or similar device to prevent ammonia liquid from being released to the atmosphere.

9.4.10 The double block and bleed valves should also be used for normal stop of the engine.

9.4.11 In cases where the master fuel valve is automatically shut down when the safety system as required in 15.2.2 is activated, the complete fuel supply branch downstream of the double block and bleed valve should be automatically purged through the ammonia release mitigation system.

9.4.12 There should be one manually operated shutdown valve in the fuel supply line to each engine upstream of the double block and bleed valves to assure safe isolation during maintenance on the engine. Where fuel is recirculated from each engine to the fuel supply piping, one manually operated shutoff valve should also be provided downstream of the double block bleed valve in the fuel return piping for each engine.

9.4.13 For single-engine installations and multi-engine installations, where a separate master valve is provided for each engine, the master fuel valve and the double block and bleed valve functions can be combined.

9.4.14 Where gaseous ammonia fuel is supplied to a consumer, provisions should be made to prevent ammonia condensate from entering the consumer.

9.5 Provisions for fuel distribution outside of machinery space

9.5.1 Fuel pipes should be protected by a secondary enclosure. This enclosure can be a duct or a double wall piping system. The duct or double wall piping system should be fitted with gas detection as required in 15.8. Other solutions providing an equivalent safety level may also be accepted by the Administration.

9.5.2 The provision in 9.5.1 need not to be applied for fuel pipes located in a fuel preparation room or tank connection space.

9.5.3 Where gas detection as required in 15.8.2.2 is not fit for purpose, the secondary enclosures around liquefied fuel pipes shall be provided with leakage detection by means of pressure or temperature monitoring systems, or any combination thereof.

9.5.4 The provision in 9.5.1 also applies for fuel vent pipes, except for open-ended fully welded fuel vent pipes in open air.

9.6 Reference to the IGF Code

The IGF Code chapter 9 should be taken into account, where applicable, in order to fulfil the functional requirements.

10 POWER GENERATION INCLUDING PROPULSION AND OTHER FUEL CONSUMERS

10.1 Goal

The goal of this chapter is to provide safe and reliable delivery of mechanical, electrical or thermal energy.

10.2 Functional requirements

10.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.12, 3.2.14, 3.2.17 and 3.2.18. In particular, the following apply:

.1 the exhaust systems should be configured to prevent any accumulation of unburnt fuel;

.2 unless designed with the strength to withstand the worst-case overpressure due to ignited fuel leaks, engine components or systems containing or likely to contain an ignitable ammonia gas and air mixture should be fitted with suitable pressure relief systems. Dependent on the particular engine design this may include the air inlet manifolds and scavenge spaces;

.3 the explosion venting should be led away from where persons may normally be present;

.4 all fuel consumers should have a separate exhaust system; and

.5 the possibility of ammonia leakage from fuel consumers into the auxiliary system, such as cooling water systems and its consequences, should be minimized.

10.3 Reference to the IGF Code

The IGF Code chapter 10 should be taken into account, where applicable, in order to fulfil the functional requirements.

11 FIRE SAFETY

11.1 Goal

The goal of this chapter is to provide for fire protection, detection and fighting for all system components related to the storage, conditioning, transfer and use of ammonia as ship fuel.

11.2 Functional requirements

11.2.1 This chapter is related to functional requirements in 3.2.2, 3.2.4, 3.2.5, 3.2.6, 3.2.7, 3.2.13, 3.2.15, 3.2.16 and 3.2.18.

11.3 Reference to the IGF Code

The IGF Code chapter 11 should be taken into account, where applicable, in order to fulfil the functional requirements.

12 EXPLOSION PREVENTION

12.1 Goal

The goal of this chapter is to provide for the prevention of explosions and for the limitation of effects from explosion.

12.2 Functional requirements

12.2.1 This chapter is related to functional requirements in 3.2.2 to 3.2.5, 3.2.7, 3.2.8, 3.2.13, 3.2.15 and 3.2.18. In particular the following apply:

12.2.2 The probability of explosions should be reduced to a minimum by:

.1 reducing the number of sources of ignition; and

.2 reducing the probability of the formation of ignitable mixtures.

12.3 Reference to the IGF Code

The IGF Code chapter 12 should be taken into account, where applicable, in order to fulfil the functional requirements.

12bis PREVENTION OF EXPOSURE TO TOXICITY

12*bis*.1 Goal

The goal of this chapter is to provide for the prevention of exposure to toxic gases.

12*bis*.2 Functional requirements

12*bis*.2.1 This chapter is related to functional requirements in 3.2.2 to 3.2.5, 3.2.7, 3.2.9, 3.2.14 and 3.2.17. In particular, the following apply:

12*bis*.2.2 The probability of exposure to toxic gases should be reduced to a minimum by considering arrangement and location of:

.1 potential sources of ammonia release, such as valves flanges and fittings;

.2 outlet from pressure relief valves;

.3 openings from spaces where ammonia leakages may occur;

.4 bunker stations;

.5 active or passive systems to prevent ammonia propagation to adjacent spaces or areas;

.6 openings to the vessel interior needing to be protected from intake of toxic gas; and

.7 safe havens, life-saving appliances and emergency escapes.

12*bis*.3 General provisions for toxic exposure protection

12*bis*.3.1 Toxic area and space classification is a method of analysing and classifying the areas where ammonia vapour is or may be expected to be present. The objective of the classification is to limit the risk of direct exposure to ammonia for persons on board.

12*bis*.3.2 Toxic areas and spaces are defined to allow for a safe arrangement preventing cross-contamination from ammonia releases, and to facilitate safe arrangement of life-saving appliances, emergency escapes, air intakes, outlets and other openings into the accommodation, service and machinery spaces, control stations and other non-toxic spaces.

12*bis*.4 Provisions for toxic area and space classification

12*bis*.4.1 Toxic areas include, but are not limited to:

.1 areas on open deck within 10 m of any flanges, valves, and other potential leakage sources in ammonia fuel systems;

.2 areas on open deck within B or 25 m, whichever is less, from outlets from the pressure relief valves installed on a liquefied fuel gas tank and all other fuel gas vent outlets;

.3. areas on open deck within B or 25 m, whichever is less, from outlets from interbarrier spaces for tanks of IMO type A;

.4 areas on open deck within 10 m from outlets from interbarrier spaces for tanks of IMO type B;

.5 areas on open deck within 10 m from outlets from secondary enclosures around ammonia piping, ventilation outlets from tank connection spaces and fuel preparation rooms and other spaces containing ammonia leakage sources;

.6 areas on open deck within 5 m from inlets to secondary enclosures around ammonia piping, ventilation inlets to tank connection spaces and fuel preparation rooms and other spaces containing ammonia leakage sources; and

.7 areas on open deck within 5 m from entrance openings to spaces containing ammonia leakage sources.

12*bis*.4.2 Toxic spaces include, but are not limited to:

.1 the interiors of fuel tanks, any pipework for pressure-relief or other venting systems for fuel tanks, pipes and equipment containing fuel;

.2 tank connection spaces, interbarrier spaces and fuel storage hold spaces for tank containment systems requiring secondary barriers;

.3 fuel preparation rooms;

.4 annular space of secondary enclosures around fuel pipes; and

.5 enclosed and semi-enclosed spaces in which potential sources of release, such as single-walled piping containing fuel, are located.

12*bis*.4.3 In addition to the toxic area requirements in this section, a dispersion analysis should be carried out in order to determine the extent of a toxic area. The gas dispersion analysis should demonstrate that ammonia concentrations exceeding 220 ppm do not reach:

.1 air intakes, outlets and other openings into the accommodation;

.2 service and machinery spaces;

.3 control stations;

.4 other non-toxic spaces in the ship; and

.5 other areas, as specified by the Administration.

12*bis*.4.4 The toxic area determined by the dispersion analysis should extend the minimum area as defined in 12*bis*.4.1, or lead to additional mitigation measures.

12*bis*.4.5 The dispersion analysis boundary conditions should be approved by the Administration. The analysis should include discharges from the pressure relief valves protecting the tank containment system, discharges from secondary barriers around fuel tanks and discharges from secondary enclosures around ammonia leakage sources.

12*bis*.5 Provisions for safe havens

A safe haven providing refuge in case of a release of ammonia should be arranged in one or more enclosed spaces with a cumulative total capacity to accommodate all persons on board. Safe havens should be arranged, as necessary, at essential locations for the ship's operation. The space should be designed to minimize the risk of exposure to ammonia during release of ammonia. This may be achieved by measures including, but not limited to, arrangement of ventilation systems or by arranging self-sustaining air supply for the space.

13 VENTILATION

13.1 Goal

The goal of this chapter is to provide for the ventilation required for safe operation of ammonia-fuelled machinery and equipment where ammonia is used as fuel.

13.2 Functional requirements

13.2.1 This chapter is related to functional requirements in 3.2.2, 3.2.5, 3.2.8, 3.2.9, 3.2.11, 3.2.13, 3.2.14 and 3.2.17.

13.3 Reference to the IGF Code

The IGF Code chapter 13 should be taken into account, where applicable, in order to fulfil the functional requirements.

14 ELECTRICAL INSTALLATIONS

14.1 Goal

The goal of this chapter is to provide for electrical installations that minimize the risk of ignition in the presence of a flammable atmosphere.

14.2 Functional requirements

14.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.4, 3.2.7, 3.2.8, 3.2.12, 3.2.13 and 3.2.16 to 3.2.18. In particular, the following apply:

14.2.2 Electrical generation and distribution systems, and associated control systems, should be designed such that a single fault will not result in the loss of ability to maintain fuel tank pressure and temperature within normal operating limits.

14.3 Reference to the IGF Code

The IGF Code chapter 14 should be taken into account, where applicable, in order to fulfil the functional requirements.

15 CONTROL, MONITORING AND SAFETY SYSTEMS

15.1 Goal

The goal of this chapter is to provide for the arrangement of control, monitoring and safety systems that support an efficient and safe operation of the ammonia-fuelled installation as covered in the other chapters of these Interim Guidelines.

15.2 Functional requirements

15.2.1 This chapter is related to functional requirements in 3.2.1, 3.2.2, 3.2.12, 3.2.13 to 3.2.15, 3.2.17 and 3.2.18 of these Interim Guidelines. In particular, the following apply:

.1 the control, monitoring and safety systems of the ammonia-fuelled installation should be so arranged that the remaining power for propulsion and power generation is in accordance with 9.3.1 in the event of single failure;

.2 an ammonia safety system should be arranged to close down the fuel supply system automatically, upon failure in systems as described in table 1 and upon other fault conditions which may develop too fast for manual intervention;

.3 the safety functions should be arranged in a dedicated gas safety system that is independent of the gas control system in order to avoid possible common cause failures. This includes power supplies and input and output signal;

.4 the safety systems including the field instrumentation should be arranged to avoid spurious shutdown, e.g. as a result of a faulty gas detector or a wire break in a sensor loop; and

.5 where two or more fuel supply systems are required to meet the provisions, each system should be fitted with its own set of independent fuel control and fuel safety systems.

15.3 General provisions

Suitable instrumentation devices should be fitted to allow a local and a remote reading of essential parameters to ensure a safe management of the whole fuel gas equipment including bunkering.

15.4 Provisions for bunkering and fuel tank monitoring

15.4.1 *Level indicators for fuel tanks*

15.4.1.1 With regard to level indicators for fuel tanks:

.1 each fuel tank should be fitted with liquid level gauging device(s), arranged to ensure a level reading is always obtainable whenever the fuel tank is operational. The device(s) should be designed to operate throughout the design pressure range of the liquefied gas fuel tank and at temperatures within the fuel operating temperature range;

.2 where only one liquid level gauge is fitted, it should be arranged so that it can be maintained in an operational condition without the need to empty or gas-free the tank; and

.3 fuel tank liquid level gauges may be of the following types:

  .1 indirect devices, which determine the amount of fuel by means such as weighing or in-line flow metering; or

  .2 closed devices, which do not penetrate the fuel tank, such as devices using radioisotopes or ultrasonic devices.

15.4.2 Overflow control

15.4.2.1 With regard to overflow control:

.1 each fuel tank should be fitted with a high liquid level alarm operating independently of other liquid level indicators and giving an audible and visual warning when activated;

.2 an additional sensor operating independently of the high liquid level alarm should automatically actuate a shutoff valve in a manner that will both avoid excessive liquid pressure in the bunkering line and prevent the fuel tank from becoming liquid full;

.3 the position of the sensors in the fuel tank should be capable of being verified before commissioning. At the first occasion of full loading after delivery and after each dry-docking, testing of high-level alarms should be conducted by raising the fuel liquid level in the fuel tank to the alarm point;

.4 all elements of the level alarms, including the electrical circuit and the sensor(s), of the high, and overfill alarms, should be capable of being functionally tested. Systems should be tested prior to fuel operation; and

.5 where arrangements are provided for overriding the overflow control system, they should be such that inadvertent operation is prevented. When this override is operated, a continuous visual indication is to be provided at the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.3 The vapour space of each fuel tank should be provided with a direct pressure reading gauge. Additionally, an indirect pressure indication should be provided on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.4 The pressure indicators should be clearly marked with the highest and lowest pressure permitted in the fuel tank.

15.4.5 A high-pressure alarm and, if vacuum protection is required, a low-pressure alarm should be provided on the navigation bridge and at a continuously manned central control station or onboard safety centre. Alarms should be activated before the set pressures of the safety valves are reached.

15.4.6 Each fuel pump discharge line and each liquid and vapour bunker manifold should be provided with at least one local pressure indicator.

15.4.7 The local pressure indicators should be provided to indicate the pressure between ship's bunker manifold valves and hose connections to the bunkering facility.

15.4.8 Fuel storage hold spaces and interbarrier spaces without open connection to the atmosphere should be provided with pressure indicator.

15.4.9 For submerged fuel pump motors and their supply cables, arrangements should 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-low liquid level. This shutdown should give an audible and visual alarm on the navigation bridge, continuously manned central control station or onboard safety centre.

15.4.10 Each fuel tank should be provided with devices to measure and indicate the temperature of the fuel.

15.5 Provisions for bunkering control

15.5.1 Control of the bunkering should be possible from a safe location remote from the bunkering station. At this location the tank pressure, tank temperature, and tank level should be monitored. Remotely controlled valves required by 8.5.3 should be capable of being operated from this location. Overfill alarm and automatic shutdown should also be indicated at this location.

15.5.2 If ammonia leakage is detected in the secondary enclosure around the bunkering lines, an audible and visual alarm should be provided at the bunkering control location. The bunker valve and other valves required to isolate the leakage should be automatically closed by the safety system in accordance with table 1.

15.6 Provisions for gas compressor monitoring

15.6.1 Gas compressors should be fitted with audible and visual alarms both on the navigation bridge and in the engine control room. As a minimum, the alarms should include low gas input pressure, low gas output pressure, high gas output pressure and compressor operation.

15.6.2 Where bulkhead penetrations are used to separate the drive from a hazardous space, temperature monitoring for the bulkhead shaft glands and bearings should be provided, which automatically give a continuous audible and visual alarm on the navigation bridge or in a continuously manned central control station.

15.7 Provisions for gas engine monitoring

15.7.1 In addition to the instrumentation provided in accordance with part C of SOLAS chapter II-1, indicators should be fitted on the navigation bridge, the engine control room and the manoeuvring platform for:

.1 operation of the engine in case of ammonia-only engines; or

.2 operation and mode of operation of the engine in the case of dual fuel engines.

15.8 Provisions for leakage detection

15.8.1 Where gas detection should cause shutdown in accordance with table 1, detector voting should be applied where two units should detect gas to activate shutdown. A failed detector should be considered as an active detection.

15.8.2 Permanently installed gas detectors should be fitted in:

.1 tank connection spaces;

.2 all secondary enclosures around fuel pipes;

.3 machinery spaces containing gas piping, gas equipment or gas consumers;

.4 fuel preparation rooms;

.5 bunkering stations and other enclosed spaces containing fuel piping or other fuel equipment not protected by a secondary enclosure;

.6 other enclosed or semi-enclosed spaces where fuel vapours may accumulate including interbarrier spaces and fuel storage hold spaces of independent tanks other than type C;

.7 airlocks and entry spaces to tank connection spaces;

.8 gas heating circuit expansion tanks;

.9 motor rooms for compressors as specified in 15.6.2 (if fitted);

.10 at ventilation inlets to accommodation and machinery spaces where required based on the risk assessment in 4.2;

.11 at ventilation inlets for safe haven; and

.12 at outlet from tank pressure relief valves.

15.8.3 The number of detectors in each space should be considered taking into account the size, layout and ventilation of the space, and each space shall be covered by a sufficient number of detectors to allow for voting in accordance with table 1.

15.8.4 The detection equipment should be located where gas may accumulate and in the ventilation outlets. Gas dispersal analysis should be used to find the best location of gas detectors.

15.8.5 Gas detection equipment should be designed, installed and tested in accordance with a recognized standard.

15.8.6 Fuel piping should also be arranged with the detection of liquid leakages in the secondary enclosure at the lowest point.

15.8.7 Each tank connection space, fuel preparation room and bunker station should be provided with liquid leakage detection. Alarm should be given at high liquid level and low temperature indication should activate the safety system.

15.8.8 An audible and visible alarm should be activated at an ammonia vapour concentration of 110 ppm as specified in table 1. The safety system should be activated at an ammonia vapour concentration of 220 ppm with actions as specified in table 1. In addition, at an ammonia vapour concentration, a visual local indication should be given at all entrances to enclosed spaces affected.

15.8.9 Audible and visible alarms from the leakage detection equipment should be located on the navigation bridge, in the continuously manned central control station and inside and outside the space where the leakage is detected.

15.8.10 Gas detection required by this section should be continuous without delay.

15.9 Provisions for prevention of condensation in fuel supply line

15.9.1 Where gaseous ammonia fuel is supplied to a consumer, the following should be monitored:

.1 fuel pipe wall temperature; and

.2 fuel pressure.

15.9.2 The control system should be capable of calculating the dynamic dew point based on measurements of fuel pressure and fuel pipe wall temperature. If fuel pipe wall temperature falls within 10°C of the calculated dew point of the fuel, the fuel system should shut down and fuel system should be purged of ammonia fuel.

15.10 Provisions for ventilation

Any reduction of the required ventilating capacity in tank connection spaces, fuel preparation rooms or other enclosed spaces containing fuel piping or other fuel equipment not protected by a secondary enclosure should give an audible and visual alarm on the navigation bridge or in a continuously manned central control station or safety centre. Loss of ventilation should result in automatic closing of valves as specified in table 1.

15.11 Provisions for safety functions of fuel supply systems

15.11.1 If the fuel supply is shut off due to activation of an automatic valve, the fuel supply should not be opened until the reason for the disconnection is ascertained and the necessary precautions taken. A readily visible notice giving instruction to this effect should be placed at the operating station for the shutoff valves in the fuel supply lines.

15.11.2 A caution placard or signboard should be permanently fitted in the machinery space containing gas-fuelled engines, stating that heavy lifting, implying danger of damage to the fuel pipes, should not be done unless the fuel supply lines are free from ammonia.

15.11.3 Compressors, pumps and fuel supply should be arranged for manual remote emergency stop from the following locations as applicable:

.1 navigation bridge;

.2 cargo control room;

.3 onboard safety centre;

.4 engine control room;

.5 fire-control station; and

.6 adjacent to the exit of fuel preparation rooms.

15.11.4 The ammonia compressor should also be arranged for manual local emergency stop.

Table 1: Monitoring of ammonia fuel installation

Parameter	Alarm	Automatic shutdown of bunker valve	Automatic shutdown of tank valve(s)	Automatic shutdown of fuel preparation room valve(s)	Automatic shutdown of master valve(s)	Comments
Ammonia detection in enclosed spaces at 25 ppm	X (see comment)					Local indication at all entrances to the space, no alarm at the alarm system
High-level fuel tank	X					
High-high level fuel tank	X	X	X			
Submerged fuel pumps, low level in tank	X					Stop fuel pumps at low-low liquid level
Ammonia detection in bunker station at 110 ppm	X					
Ammonia detection in bunker station at 220 ppm		X				
Liquid leakage detection in bunker station	X	X				Close valve at low temperature
Ammonia detection in secondary enclosure around bunkering lines at 110 ppm	X					
Ammonia detection in secondary enclosure around bunkering lines at 220 ppm		X	X			

Parameter	Alarm	Automatic shutdown of bunker valve	Automatic shutdown of tank valve(s)	Automatic shutdown of fuel preparation room valve(s)	Automatic shutdown of master valve(s)	Comments
Liquid leakage detection in secondary enclosure around bunkering lines	X	X	X			
Ammonia detection in tank connection space at 110 ppm	X					
Ammonia detection on two detectors in tank connection space at 220 ppm	X		X			
Liquid leakage detection in tank connection space	X		X			Close valve at low temperature
Ammonia detection in fuel preparation room at 110 ppm	X					
Ammonia detection on two detectors in fuel preparation room at 220 ppm	X			X		
Liquid leakage detection in fuel preparation room	X			X		Close valve at low temperature
Ammonia detection in	X					

Parameter	Alarm	Automatic shutdown of bunker valve	Automatic shutdown of tank valve(s)	Automatic shutdown of fuel preparation room valve(s)	Automatic shutdown of master valve(s)	Comments
secondary enclosure of fuel supply piping at 110 ppm						
Ammonia detection on two detectors in secondary enclosure of fuel supply piping at 220 ppm	X		X	X	X	All valves required to isolate the leakage should close. Transient releases which are expected in normal operation of the consumers should not cause shutdown of the consumers.
Liquid leakage detection in secondary enclosure of fuel supply pipes	X		X	X	X	All valves required to isolate the leakage should close
Reduced ventilation in tank connection space	X					
Loss of ventilation in tank connection space			X			
Reduced ventilation in fuel preparation room	X					
Loss of ventilation in				X		

Parameter	Alarm	Automatic shutdown of bunker valve	Automatic shutdown of tank valve(s)	Automatic shutdown of fuel preparation room valve(s)	Automatic shutdown of master valve(s)	Comments
fuel preparation room						
Manually activated emergency shutdown of master fuel valve(s) engine	X				X	
Ammonia concentration from discharge of ARMS at 110 ppm	X					

An alarm as indicated in table 1 should include an audible and visual alarm at a manned location in accordance with the 2009 Code on Alerts and Indicators.

16 MANUFACTURE, WORKMANSHIP AND TESTING

The provisions of the IGF Code, part B-1, chapter 16, should apply to ships using ammonia as fuel, where appropriate.

17 DRILLS AND EMERGENCY EXERCISES

17.1 Drills and emergency exercises on board should be conducted at regular intervals.

17.2 Such ammonia-related exercises could include, for example:

.1 tabletop exercise;

.2 review of fuelling procedures based on the fuel handling manual;

.3 responses to potential contingencies;

.4 tests of equipment intended for contingency response; and

.5 reviews that assigned seafarers are trained to perform assigned duties during fuelling and contingency response.

17.3 Ammonia-related exercises may be incorporated into periodical drills required by SOLAS.

17.4 The response and safety system for hazards and accident control should be reviewed and tested.

18 OPERATION

18.1 Goal

The goal of this chapter is to ensure that operational procedures for the loading, storage, operation, maintenance and inspection of systems for ammonia minimize the risk to persons, the ship, and the environment, and that they are consistent with practices for a conventional oil-fuelled ship whilst taking into account the nature of ammonia.

18.2 Functional requirements

18.2.1 This chapter relates to the functional requirements in 3.2.1 to 3.2.3, 3.2.10, 3.2.12, 3.2.15, 3.2.16 and 3.2.17 of these Interim Guidelines. In particular, the following apply:

.1 a copy of these Interim Guidelines, or national regulations incorporating the provisions of the same, should be on board every ship covered by these Interim Guidelines;

.2 maintenance procedures and information for all ammonia-related installations should be available on board;

.3 the ship should be provided with operational procedures including a suitably detailed fuel handling manual, such that trained personnel can safely operate the fuel bunkering, storage and transfer systems; and

.4 the ship should be provided with suitable emergency procedures.

18.3 Reference to the IGF Code

The IGF Code chapter 18 should be taken into account, where applicable, in order to fulfil the functional requirements.

19 TRAINING

19.1 Goal

The goal of this chapter is to ensure that seafarers on board ships to which these Interim Guidelines apply are adequately qualified, trained and experienced.

19.2 Functional requirements

19.2.1 The company should ensure that seafarers on board ships using ammonia fuel should have completed training to attain the abilities that are appropriate to the capacity to be filled, and duties and responsibilities to be taken up.

19.2.2 The master, officers, ratings and other personnel on ships using ammonia fuel should have received training and be qualified in the use of gaseous fuel in accordance with the STCW Convention and the STCW Code, taking into account the specific hazards of ammonia.

20 PERSONNEL PROTECTION

20.1 Goal

The goal of this chapter is to ensure that protective equipment is provided for persons on board, considering both routine operations and emergency situations and possible short- or long-term effects of ammonia exposure.

20.2 Functional requirements

20.2.1 This chapter relates to functional requirements in 3.2.1, 3.2.12 and 3.2.16. In particular the following apply:

.1 for the protection of crew members who are engaged in operations, maintenance of ammonia fuel systems, and emergency response, the ship should have on board protective equipment suitable for ammonia exposure, taking the exposure risk of different operations into account;

.2 for the protection and treatment of crew members affected by ammonia leakages, the ship should have on board suitable emergency equipment; and

.3 suitable respiratory and eye protection for emergency escape purposes should be provided for every person on board.

20.3 Protective equipment

20.3.1 Suitable protective equipment, including eye protection, to a recognized national or international standard, should be provided for the protection of crew members engaged in normal operations related to the ammonia fuel system.

20.3.2 Personal protective and safety equipment required in this chapter should be kept in suitable, clearly marked lockers located in readily accessible places.

20.4 Emergency equipment

20.4.1 Suitably marked decontamination showers and eyewashes should be available in convenient locations:

.1 close to bunkering stations;

.2 close to exit from tank connection spaces;

.3 close to exit from fuel preparation rooms;

.4 in machinery spaces for ammonia-fuelled consumers; and

.5 close to lifeboat embarkation stations.

20.4.2 The showers and eyewashes should be operable in all ambient conditions. A heating system with temperature control is required if pipe routeing of the water supply exposes the piping to freezing conditions. Water supply capacity should be sufficient for simultaneous use of at least two units. Thermal insulation is not considered as an alternative to a system with temperature control.

20.4.3 A stretcher that is suitable for hoisting an injured person from spaces, such as tank hold spaces, should be kept in a readily accessible location.

20.4.4 The ship should have onboard medical first aid equipment, including oxygen resuscitation equipment, based on the requirements of the *Medical First Aid Guide* (MFAG) for ammonia.

20.4.5 Suitable respiratory and eye protection for emergency escape purposes should be provided for every person on board, subject to the following:

.1 filter-type respiratory protection is unacceptable;

.2 self-contained breathing apparatus should have at least 15 minutes of service time; and

.3 emergency escape respiratory protection should not be used for fire-fighting or cargo handling purposes and should be marked to that effect.

20.5 Safety equipment

20.5.1 Sufficient, but not less than three complete sets of safety equipment, should be provided in addition to fire-fighter's outfits required by SOLAS regulation II-2/10.10. These additional sets should provide adequate personal protection to permit entry and work in a gas-filled space, and be equipped with two-way portable radiotelephone apparatus comprising of earpiece with microphone and push-to-talk units. This equipment should consider the nature of ammonia.

20.5.2 Each complete set of safety equipment should consist of:

.1 one self-contained positive pressure air breathing apparatus incorporating full face mask not using stored oxygen and having a capacity of at least 1,200 litres of free air. Each set should be compatible with that required by SOLAS regulation II-2/10.10;

.2 gastight protective clothing, boots and gloves to a recognized standard;

.3 steel-cored rescue line with belt; and

.4 explosion-proof lamp.

20.5.3 An adequate supply of compressed air should be provided and should consist of:

.1 at least one fully charged spare air bottle for each breathing apparatus required by 20.5.1;

.2 an air compressor of adequate capacity capable of continuous operation, suitable for the supply of high-pressure air of breathable quality; and

.3 a charging manifold capable of dealing with sufficient spare breathing apparatus air bottles for the breathing apparatus required by 20.5.1.

20.5.4 The compressed air equipment should be inspected at least once a month by a responsible officer and the inspection should be logged in the ship's records. This equipment should also be inspected and tested by a competent person at least once a year.

___