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Comments / Review by : November 18, 2026

Subject: Ammonia Bunkering Guidelines

1. Background

1.1 Need for Ammonia Bunkering Guidelines

The global maritime industry is undergoing a significant transition towards low- and zero-carbon fuels in response to the International Maritime Organization's greenhouse gas reduction strategy and the increasing demand for sustainable shipping. Among the emerging alternative marine fuels, ammonia is being considered as a potential low- and near-zero-carbon marine fuel, particularly where produced from renewable or low-carbon sources.

The use of ammonia as a marine fuel has the potential to contribute towards reduction of greenhouse gas emissions and decarbonisation of shipping. At the same time, ammonia presents specific hazards associated with its toxicity, corrosivity, vapour release and, under certain conditions, flammability. These characteristics require dedicated safety measures beyond those normally applicable to conventional marine fuels.

As the number of ammonia-fuelled vessels and proposed ammonia bunkering facilities increases globally, the establishment of a comprehensive regulatory framework governing safe and environmentally responsible ammonia bunkering operations has become necessary.

At present, ammonia bunkering in India is at an emerging stage and the supporting infrastructure, operational procedures and regulatory framework are evolving. The absence of a standardised national framework may result in operational inconsistencies, safety risks, environmental concerns and regulatory uncertainty for shipowners, operators, bunker suppliers, terminal operators, port authorities and other stakeholders.

It is therefore necessary to establish comprehensive guidelines covering approval, design, storage, transfer, bunkering operations, risk assessment, toxic-release prevention, emergency preparedness and response, environmental protection, personnel competency and training, inspection, monitoring and enforcement.

The issuance of these Guidelines will facilitate the safe introduction and development of ammonia bunkering infrastructure across Indian ports and maritime facilities and support India's maritime decarbonisation objectives.

1.2 Ammonia as a Marine Fuel

1.2.1

Ammonia (NH_3) is a colourless substance with a characteristic pungent odour and is toxic to humans. It may be stored and transferred as a liquefied gas under pressure and/or at low temperature, depending upon the storage and bunkering arrangement.

1.2.2

Ammonia presents a significant toxic exposure hazard. Accidental release may result in rapid formation and dispersion of ammonia vapour and may cause serious injury to personnel. Accordingly, toxic exposure, vapour dispersion and emergency evacuation shall be specifically addressed in the risk assessment for every ammonia bunkering operation.

1.2.3

Ammonia is also capable of forming flammable mixtures under certain conditions. Accordingly, fire and explosion hazards, hazardous areas and ignition-source control shall be considered in addition to toxicity hazards.

1.2.4

The use of ammonia as fuel shall be governed by the applicable provisions of SOLAS, the IGF Code as applicable, and IMO MSC.1/Circ.1687, together with the requirements of the Administration and Recognised Organisation.

1.2.5

Ammonia supplied for bunkering shall comply with an agreed fuel specification suitable for the intended marine fuel system and engine/fuel consumer. Until a dedicated international marine ammonia fuel specification becomes applicable, the fuel specification shall be agreed between the supplier, receiving vessel and relevant technical/Recognised Organisation and shall be based on the manufacturer's requirements and applicable recognised standards.

1.2.6

These Guidelines address ammonia used as marine fuel and do not govern the carriage of ammonia as cargo except where such carriage is directly associated with an approved ammonia-fuel bunkering operation.

1.3 Purpose

The Directorate General of Maritime Administration (DGMA), recognising the importance of facilitating the transition towards cleaner marine fuels while ensuring the highest standards of safety, environmental protection and operational efficiency, hereby issues this Circular to establish the regulatory framework governing ammonia bunkering operations in India.

The provisions of this Circular are intended to facilitate the safe planning, approval, conduct, monitoring and oversight of ammonia bunkering activities in accordance with applicable provisions of the Merchant Shipping Act, 2025, Rules made thereunder and internationally accepted standards, codes and best practices.

These Guidelines aim to ensure the protection of life, property, port infrastructure, the public and the marine environment while facilitating the safe development of an ammonia bunkering ecosystem at Indian ports,

terminals, jetties, anchorages, offshore installations and other locations authorised by the Competent Authority.

2. Scope

2.1 This Circular applies to all ships calling at Indian ports, irrespective of flag, that are engaged in or receive ammonia bunkering services. It also applies to all ammonia bunker suppliers, bunker barges and bunker tankers, terminal operators, port authorities, road tanker operators, and other entities involved in the planning, approval, conduct or oversight of ammonia bunkering operations within Indian waters.

2.2 This Circular prescribes the minimum safety, operational, technical, environmental protection, emergency preparedness, personnel competency, training, inspection, reporting and monitoring requirements for ammonia bunkering operations. It also establishes a framework for the approval, registration, monitoring and enforcement of such operations.

2.3 These Guidelines shall apply to, but not be limited to, Ship-to-Ship (STS) ammonia bunkering, Truck-to-Ship (TTS) ammonia bunkering, Shore-to-Ship ammonia bunkering through fixed or flexible transfer systems, ammonia bunker vessels and barges, ammonia storage and terminal facilities, and other approved methods of supplying ammonia as a marine fuel.

3. Current State of Ammonia Bunkering

3.1 Ammonia bunkering in India is presently at an emerging stage, with the necessary infrastructure, supply chains, storage facilities and operational procedures still under development.

3.2 The principal challenges associated with ammonia bunkering include the development of suitable ammonia storage and transfer infrastructure, safe handling of ammonia as a toxic fuel, establishment of appropriate toxic and safety exclusion zones, development of reliable supply chains, availability of trained and competent personnel, adequate emergency response and medical preparedness, integration of bunkering operations with port traffic and terminal operations, and development and implementation of appropriate regulatory and technical standards.

3.3 These Guidelines establish a uniform national framework for ammonia bunkering while providing flexibility for site-specific requirements to be identified and addressed through appropriate risk assessment and approval by the Competent Authority.

4. Objectives

4.1 The primary objective of these Guidelines is to establish a comprehensive, uniform, and risk-based regulatory framework for Ammonia bunkering in India, ensuring the safe, efficient, and environmentally sound conduct of bunkering operations while facilitating the transition to cleaner marine fuels. The specific objectives are to:

i) establish a clear regulatory framework for approval, establishment, operation and oversight of ammonia bunkering facilities and services;

ii) prescribe minimum technical and safety requirements for storage, transfer, handling and bunkering of ammonia;

iii) establish standard procedures for risk assessment, operational planning, emergency preparedness, toxic-release response and contingency management;

iv) protect personnel, ships, port infrastructure, public safety and the marine environment;

v) establish appropriate toxic exclusion zones, safety zones, hazardous areas and monitoring zones;

vi) prescribe competency, training and certification requirements for personnel engaged in ammonia bunkering;

vii) establish inspection, monitoring, reporting, compliance and enforcement mechanisms; and

viii) facilitate the safe development of ammonia bunkering infrastructure and supply chains in support of India's maritime decarbonisation objectives.

4.2 By achieving these objectives, these Guidelines seek to foster the development of a safe, reliable, efficient, and sustainable Ammonia bunkering ecosystem in India, encourage investment and innovation in alternative marine fuels, enhance the competitiveness of Indian ports, and contribute to the decarbonisation of the maritime sector while ensuring the highest standards of safety and environmental protection.

5. Regulatory Framework

5.1 The regulatory framework for the approval, registration, and oversight of Ammonia bunker suppliers is set out in **Appendix I** to these Guidelines. The framework establishes a transparent, risk-based, and uniform process to ensure that Ammonia bunkering operations are conducted in a safe, secure, and environmentally responsible manner.

5.2 The approval and registration process shall include, inter alia:

(i) submission of an application to the Directorate General of Maritime Administration (DGMA), together with the prescribed documents, including details of the applicant, facility design, equipment specifications, operational procedures, risk assessment, safety management system, emergency preparedness and response plan, personnel competency, and any other information required under these Guidelines and relevant international standards, including the applicable guidance issued by the International Association of Ports and Harbors (IAPH);

(ii) technical evaluation of the application by the DGMA and authorisation of the Indian Register of Shipping (IRS), or any other Recognised Organisation authorised by the DGMA, to carry out interim, initial, renewal, and additional audits or inspections, as applicable;

(iii) issuance of an Interim Registration Certificate or a Full-Term Registration Certificate as a Ammonia Bunker Supplier upon satisfactory compliance with the applicable requirements of these Guidelines;

(iv) periodic audits, inspections, surveillance, and compliance verification to ensure continued conformity with the requirements of these Guidelines and the conditions of registration; and

(v) suspension, withdrawal, or cancellation of registration where the bunker supplier fails to comply with the applicable statutory requirements or the conditions of registration.

5.3 The approval and registration process is intended to ensure that Ammonia bunkering facilities, equipment, operational procedures, and management systems are designed, established, maintained, and operated in

accordance with the applicable statutory requirements and internationally accepted standards, thereby ensuring the safety of personnel, ships, port infrastructure, and the marine environment.

This Circular is issued with the approval of the competent authority.

(Pravin Kumar Roy)
Engineer & Ship Surveyor cum Dy. DG (Tech)

Encl. Appendix - 1

Appendix - I
DGS (Engineering) Circular No. xxx of 2026

Revision - 0 **Date: ----------**

Ammonia Bunkering Guidelines

Introduction:

This Appendix establishes the safety, technical, operational, and environmental requirements governing Ammonia bunkering operations within Indian waters. It applies to all approved Ammonia bunkering operations, including **ship-to-ship (STS), truck-to-ship (TTS), and shore-to-ship (pipeline)** bunkering conducted at ports, terminals, jetties, anchorages, offshore installations, and other locations authorised by the Directorate General of Maritime Administration (DGMA) or the Competent Authority.

The provisions of this Appendix are applicable to shipowners, ship managers, Masters, bunker suppliers, bunker receivers, bunker barges, bunker tankers, terminal operators, port authorities, trucking companies, Recognised Organisations, and all other stakeholders involved in the planning, approval, conduct, or oversight of Ammonia bunkering operations.

The objective of this Appendix is to establish a uniform and risk-based framework to ensure that Ammonia bunkering operations are carried out safely, efficiently, and in an environmentally responsible manner, while facilitating the adoption of Ammonia as an alternative marine fuel in accordance with national legislation and internationally accepted standards and best practices.

The provisions of this Appendix shall be read in conjunction with the Merchant Shipping Act, 2025, the rules and regulations made thereunder, relevant circulars and guidelines issued by the Directorate General of Maritime Administration (DGMA), applicable regulations of the concerned Port Authority, the

Petroleum Explosives Safety Organisation (PESO), environmental legislation, and any other applicable statutory requirements in force from time to time.

This Appendix has been developed in consultation with the relevant Ministries and Government agencies, Port Authorities, Recognised Organisations, industry stakeholders, bunker suppliers, shipowners, and other interested parties to facilitate the safe, efficient, and sustainable development of Ammonia bunkering in India.

References to legislation, regulations, codes, standards, and guidelines contained in this Appendix shall be construed as references to their latest applicable editions, amendments, or revisions, unless otherwise specified. In the event of any inconsistency between the provisions of this Appendix and any applicable statutory instrument, the provisions of the relevant legislation shall prevail.

Nothing contained in this Appendix shall relieve any shipowner, operator, Master, bunker supplier, terminal operator, or any other stakeholder from complying with the applicable requirements of national legislation, international conventions, classification society rules, or any additional conditions imposed by the DGMA, the Competent Authority, or the relevant Port Authority.

2. Applicable Standards and Reference Documents

These Guidelines have been developed with reference to the applicable international conventions, mandatory codes, industry standards, technical guidance documents, and national regulations governing the safe storage, handling, transfer, and bunkering of Ammonia as a marine fuel. Compliance with the latest applicable editions, amendments, and revisions of these instruments shall be ensured.

The principal reference documents include, but are not limited to, the following:

1. **SOLAS, 1974**, as amended – International Convention for the Safety of Life at Sea.
2. **MARPOL, 1973/78**, as amended – International Convention for the Prevention of Pollution from Ships.
3. **IGF Code** – International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels.
4. **IBC Code** – International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk.
5. **ISM Code** – International Management Code for the Safe Operation of Ships and for Pollution Prevention.
6. **STCW Convention and STCW Code**, as amended – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.
7. **International Safety Guide for Oil Tankers and Terminals (ISGOTT)**, latest edition.
8. **Oil Companies International Marine Forum (OCIMF)**, Guidance and Recommendations.
9. **Chemical Distribution Institute (CDI)**, Guidance and Safety Standards
10. **INTERTANKO Chemical Tanker Committee (CTC)**, Guidance and Best Practices.
11. **ICS Tanker Safety Guide (Chemicals)**, Handling and Management of Chemical Cargoes.
12. **IAPH Ammonia Bunkering Technical Reference and Checklists**, including operational guidance, risk assessment methodologies, and bunker safety checklists.
13. **Class Rules and Guidance Notes** issued by Recognised Organisations for ships using Ammonia as fuel and Ammonia bunkering vessels.
14. **ISO Standards** applicable to marine fuel transfer systems, hoses, couplings, emergency shutdown systems, risk management, and bunkering operations.
15. **ISO 31000** – Risk Management – Guidelines.

16. **ISO 45001** – Occupational Health and Safety Management Systems.
17. **ISO 14001** – Environmental Management Systems.
18. **IEC 60079 Series** – Explosive Atmospheres.
19. **NFPA 30** – Flammable and Combustible Liquids Code.
20. **NFPA 11**, **NFPA 15**, and other applicable NFPA standards relating to fire protection for flammable liquid installations.
21. **Bureau of Indian Standards (BIS)** specifications and standards applicable to the storage, transfer, handling, transportation, and safety of Ammonia and hazardous chemicals.
22. ISO/AWI 26201 – Specification for bunkering of ammonia-fuelled vessels, when published.
23. **Merchant Shipping Act, 2025**, the Rules made thereunder, and all relevant Circulars, Orders, and Guidelines issued by the Directorate General of Maritime Administration (DGMA).
24. Applicable environmental legislation, including the **Environment (Protection) Act, 1986**, the **Water (Prevention and Control of Pollution) Act, 1974**, the **Air (Prevention and Control of Pollution) Act, 1981**, and other statutory requirements issued by the Ministry of Environment, Forest and Climate Change (MoEFCC).
25. Relevant requirements of the concerned Port Authority and any additional conditions imposed by the Competent Authority.
26. Any other equivalent international standards, recognised industry practices, or guidance documents accepted by the Directorate General of Maritime Administration (DGMA), where demonstrated to provide an equivalent or higher level of safety.

3. Definitions

For the purpose of these Guidelines, unless the context otherwise requires, the following terms shall have the meanings assigned to them below:

a) Ammonia: "Ammonia" means ammonia (NH_3) intended for use as a marine fuel, including anhydrous ammonia in the form in which it is supplied for bunkering. Ammonia shall be treated as a toxic and hazardous fuel, and its quality shall comply with the applicable fuel quality specifications and relevant regulatory requirements.

b) Bunkering Operation: The transfer of Ammonia as marine fuel from a bunker supply facility to a receiving vessel, including all associated activities such as pre-transfer checks, connection and disconnection of transfer equipment, fuel transfer, purging, draining, inerting (where applicable), and post-transfer verification.

c) Ammonia Bunker Supplier (ABS): The organisation or entity approved by the Directorate General of Maritime Administration (DGMA) to supply Ammonia as marine fuel to receiving vessels, irrespective of the mode of delivery.

d) Ammonia Bunker Receiving Vessel (ABR): A ship designed, constructed, or approved to receive and use Ammonia as fuel during bunkering operations.

e) Truck-to-Ship (TTS) Bunkering: The transfer of Ammonia from an approved road tanker to a receiving vessel.

f) Shore-to-Ship (Pipeline) Bunkering: The transfer of Ammonia from a shore-based storage facility or terminal through a fixed or flexible pipeline system to a receiving vessel.

g) Ship-to-Ship (STS) Bunkering: The transfer of Ammonia from a bunker vessel, bunker barge, or another approved bunker supply ship to a receiving vessel.

h) Safety Zone: A predefined area established around the bunkering operation within which access is controlled and ignition sources, non-essential personnel, and incompatible activities are restricted to minimise risks arising from the accidental release, fire, or other hazardous incidents involving Ammonia.

i) Toxic Zone: An area established on the basis of ammonia dispersion and exposure consequences within which personnel access and activities are controlled to prevent unacceptable exposure.

j) Monitoring Zone: An area established around the bunkering operation for monitoring ammonia concentrations and detecting any migration beyond the designated toxic/safety zone.

k) Hazardous Area: An area in which an explosive atmosphere may occur due to the presence of flammable vapours released during Ammonia storage, handling, or bunkering operations, requiring the use of suitably certified equipment and controls.

l) Competent Authority: The Directorate General of Maritime Administration (DGMA), the relevant Port Authority, or any other authority authorised under applicable legislation to regulate or oversee Ammonia bunkering operations.

m) Approved: Approved by the Directorate General of Maritime Administration (DGMA) and, where applicable, by the relevant Port Authority, Petroleum and Explosives Safety Organisation (PESO), or any other Competent Authority.

n) STCW Convention: The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended.

o) Indian Waters: Waters under the sovereignty, sovereign rights, or jurisdiction of India, as defined under the applicable maritime legislation.

p) PESO: Petroleum and Explosives Safety Organisation, Government of India.

q) Simultaneous Operations (SIMOPS): The conduct of bunkering operations concurrently with one or more other authorised shipboard, terminal, or port activities, subject to a documented risk assessment and the approval of the Competent Authority.

r) Person in Charge (PIC): The competent person designated by the bunker supplier or the receiving vessel who has overall responsibility and authority for the safe conduct, coordination, and supervision of the bunkering operation on behalf of the respective organisation.

s) Emergency Shutdown (ESD): A system designed to automatically or manually stop the transfer of Ammonia and isolate the transfer system in the event of an emergency or unsafe operating condition.

t) Recognised Organisation (RO): An organisation authorised by the Directorate General of Maritime Administration (DGMA) to carry out statutory surveys, audits, inspections, and certification on its behalf.

u) Risk Assessment: A systematic process for identifying hazards, evaluating associated risks, and determining appropriate control measures to ensure that Ammonia bunkering operations are conducted safely.

4. Application

4.1 These Guidelines shall apply to all Ammonia bunkering operations conducted within Indian waters, including operations at ports, terminals, jetties, anchorages, offshore installations, and any other locations authorised by the Directorate General of Maritime Administration (DGMA) or the Competent Authority.

4.2 These Guidelines shall apply to, but are not limited to, the following entities and vessels:

(a) Ammonia bunker supply vessels, bunker barges, and bunker tankers;

(b) Ammonia bunker receiving vessels, including Indian and foreign-flag vessels receiving Ammonia as marine fuel within Indian waters;

(c) Ammonia bunker suppliers registered or approved by the DGMA;

(d) Road tanker operators and trucking companies engaged in Truck-to-Ship (TTS) Ammonia bunkering operations;

(e) Terminal operators and facility operators engaged in Shore-to-Ship (Pipeline) Ammonia bunkering operations;

(f) Port Authorities and operators responsible for the regulation, coordination, and oversight of Ammonia bunkering activities;

(g) Shipowners, ship managers, Masters, officers, and crew involved in the planning or execution of Ammonia bunkering operations;

(h) Recognised Organisations authorised by the DGMA to conduct audits, inspections, surveys, or certification related to Ammonia bunkering; and

(i) Any other person, organisation, contractor, or service provider whose activities may affect the safety, security, or environmental protection of Ammonia bunkering operations.

4.3 Compliance with these Guidelines shall not exempt any person or organisation from complying with the applicable provisions of the Merchant Shipping Act, 2025, the rules made thereunder, relevant Port Authority regulations, PESO requirements, environmental legislation, or any other applicable statutory requirements.

5. Bunker Supplier Registration Process

5.1 Approval from Directorate General of Maritime Administration:

i. The Directorate General of Shipping (DGS) issued Merchant Shipping Notice (MSN) No. 3 of 2014, which prescribes the procedure for registration of bunker suppliers. For registration as a bunker supplier authorized to supply Ammonia as marine fuel, the applicant shall, in addition to the requirements specified in the MSN, establish a Quality Management System (QMS) and obtain ISO 9001:2015 certification for the

scope of **"Ammonia Bunkering"** from a certification body accredited by the National Accreditation Board for Certification Bodies (NABCB). Existing bunker suppliers, as well as new applicants seeking registration with the Directorate General of Maritime Administration (DGMA) for the supply of Ammonia bunkers, shall comply with the procedures prescribed in the aforesaid MSN.

ii. The applicant shall conduct a practical demonstration of Ammonia bunkering operations. Based on the application and supporting documents submitted, the DGMA may authorize the Indian Register of Shipping (IRS) to witness the demonstration and submit a verification report. Upon receipt of a satisfactory verification report with the recommendation of the IRS, the DGMA may issue an **Interim Bunker Supplier Registration Certificate**, which shall be valid for a period of six months.

iii. The bunker supplier shall apply to the DGMA for an Initial Audit at least thirty (30) days before the expiry of the Interim Bunker Supplier Registration Certificate. The detailed procedure for the Initial Audit shall be as prescribed in Merchant Shipping Notice No. 3 of 2014. The DGMA may authorize the IRS to conduct the Initial Audit, which shall, inter alia, verify the following:

a) Compliance with the requirements applicable to Ammonia bunkering operations carried out after the issuance of the Interim Bunker Supplier Registration Certificate;

b) Documentary evidence demonstrating that the bunker supplier has successfully carried out Ammonia bunkering operations for at least two vessels during the validity period of the Interim Certificate; and

c) Incorporation and implementation of all applicable amendments, circulars, notifications, and other statutory requirements issued by the DGMA or any other competent authority.

iv. Based on the recommendation of the IRS following a satisfactory Initial Audit, the DGMA may issue a **Bunker Supplier Registration Certificate** valid for a period of five (5) years.

v. During the validity of the Bunker Supplier Registration Certificate, the bunker supplier shall undergo Annual Surveillance Audits in accordance with Merchant Shipping Notice No. 3 of 2014. In addition, the bunker supplier registered for Ammonia bunkering shall provide a practical demonstration of its Ammonia bunkering facilities and operations during every alternate Annual Surveillance Audit. Failure to satisfactorily demonstrate the facility and operations may result in the DGMA initiating appropriate action, including suspension or withdrawal of the Bunker Supplier Registration Certificate.

5.2 Role of PESO:

The Licensed Bunker Supplier (LBS) shall obtain and maintain all necessary approvals, licences, authorisations and clearances from the **Petroleum and Explosives Safety Organisation (PESO)**, as applicable, for shore-based transportation, storage, handling and transfer of Ammonia in connection with bunkering operations. Such approvals shall cover, as applicable, Ammonia tank trucks, storage tanks and facilities, pipelines, transfer systems, loading/unloading arrangements and other associated shore-based infrastructure.

The LBS shall ensure that all such facilities, equipment and arrangements comply with the applicable requirements prescribed by PESO and other competent authorities and that the relevant approvals remain valid throughout the period of operation.

Where there is any substantive modification, alteration, expansion or change in the Ammonia bunkering facilities, infrastructure, equipment, capacity, transportation arrangements or operating procedures that may affect the safety or risk profile of the facility, the LBS shall obtain revised or fresh approvals from PESO and/or other competent authorities, as applicable, prior to implementing such changes.

6. Regulatory Requirements:

6.1 The Ammonia Bunker Supplier (LBS) shall plan and execute Ammonia bunkering operations in accordance with the following international standards, codes, guidelines, and best practices, as applicable to the mode of delivery (ship-to-ship, truck-to-ship, or shore-to-ship):

i. IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687), as amended, for the design, operation, and bunkering of ammonia-fuelled ships.

ii. International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), as applicable to the carriage and handling of Ammonia as a hazardous chemical.

iii. ISGOTT (International Safety Guide for Oil Tankers and Terminals), including guidance on:
a) Ship/shore safety checklists and communications;
b) Cargo transfer procedures and operational safety;
c) Hazard identification, risk assessment, and emergency response; and
d) Emergency Shutdown (ESD) arrangements and linked ship/shore systems, where applicable.

iv. NFPA 30 – Flammable and Combustible Liquids Code, and other applicable NFPA standards governing the storage, handling, transfer, and fire protection requirements for flammable liquids.

v. ISO 31000 – Risk Management – Guidelines, and ISO 45001 – Occupational Health and Safety Management Systems, where applicable, for the management of operational and occupational safety risks associated with Ammonia bunkering.

vi. Applicable Indian statutory requirements, the Petroleum and Explosives Safety Organisation (PESO), the Directorate General of Maritime Administration (DGMA), the concerned Port Authority, and any other competent authority.

vii. Any other internationally or nationally recognized standards, codes, guidelines, or industry best practices, including those published by the Oil Companies International Marine Forum (OCIMF), Chemical Distribution Institute (CDI), INTERTANKO Chemical Tanker Committee (CTC), ICS Tanker Safety Guide (Chemicals), the International Organization for Standardization (ISO), and the International Maritime Organization (IMO), PESO, or any other competent authority.

6.2 The LBS shall ensure that valid insurance coverage is maintained for all Ammonia bunkering operations, including transportation, storage, handling, and transfer of Ammo. The insurance shall provide adequate coverage, as required by the concerned Port Authority, Flag Administration, or other competent authority, for liabilities arising from:
i. Personal injury or loss of life;
ii. Loss of or damage to property, vessels, cargo, and bunkering equipment;
iii. Marine and environmental pollution, including costs associated with containment, clean-up, remediation, and restoration;

iv. accidental release or leakage of ammonia;
iv. Fire, explosion, and other operational hazards associated with Ammonia handling; and
v. Any other liabilities arising from Ammonia bunkering operations.

6.3 The LBS shall ensure that all hoses, loading arms, transfer pipelines, valves, couplings, pumps, compressors and associated equipment used for ammonia bunkering are designed, selected, installed, inspected, tested and maintained in accordance with the manufacturer's recommendations, applicable international standards and the requirements of the competent authority. All such equipment shall be suitable for ammonia service and shall be compatible with the physical, chemical and temperature characteristics of ammonia.

All hoses, loading arms, transfer pipelines, valves, couplings, pumps, compressors and associated equipment shall:

a) be compatible with ammonia and suitable for the intended service;

b) be suitable for the design pressure, temperature and operating conditions;

c) be designed and constructed to prevent leakage and accidental release of ammonia;

d) be inspected, tested and maintained at prescribed intervals in accordance with the manufacturer's recommendations and applicable standards;

e) have appropriate certification and documentation demonstrating their suitability for ammonia service; and

f) be provided with appropriate safeguards, where applicable, to minimise the consequences of leakage, rupture or accidental release of ammonia.

Flexible transfer hoses shall be inspected and pressure-tested at intervals specified by the manufacturer and applicable international standards and, in any case, at intervals not exceeding twelve (12) months, unless a different interval is specifically permitted by the applicable standard or approved by the competent authority. The testing shall be carried out by a competent person having appropriate technical qualifications and experience in the inspection and pressure testing of ammonia transfer systems. Records of all inspections, tests, maintenance and certifications shall be maintained by the LBS and made available for inspection upon request.

6.4 The LBS shall ensure that a valid Safety Data Sheet (SDS), prepared in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) and applicable national regulations, is available for each consignment of Ammonia supplied. The SDS shall be made readily accessible to all personnel involved in the bunkering operation and to the Ammonia Bunker Receiving Vessel (LBR) prior to the commencement of bunkering.

6.5 The Person-in-Charge (PIC) nominated by the LBS and the Person-in-Charge nominated by the Ammonia Bunker Receiving Vessel (LBR) shall be jointly responsible for the safe planning, coordination, execution, monitoring, and completion of the Ammonia bunkering operation. Both PICs shall ensure compliance with the approved bunkering plan, applicable statutory requirements, and established safety procedures throughout the operation.

6.6 Prior to the commencement of bunkering, the LBS and the LBR shall jointly review and agree upon the bunkering operation in accordance with an approved Ammonia Bunkering Management Plan, including the bunkering procedure, communication protocol, emergency response arrangements, risk control measures, transfer rates, emergency shutdown (ESD) arrangements, and the completion of the applicable ship/shore safety checklist.

6.7 The LBS and the LBR shall each nominate a competent Person-in-Charge (PIC) for the bunkering operation. In addition, the concerned Port Authority or Terminal Operator, as applicable, shall designate a Single Point of Contact (SPOC) to facilitate coordination among the LBS, LBR, emergency response agencies, and other stakeholders, and to address operational issues or emergencies arising during the bunkering operation.

6.8 The LBS shall establish and maintain an effective Quality Management System (QMS) to ensure custody control and product integrity of Ammonia throughout the entire supply chain, including receipt, storage, transportation, transfer, and delivery to the receiving vessel. The QMS shall provide for traceability, quantity and quality assurance, contamination prevention, and proper documentation at every stage of the supply chain. Where any process affecting product quality or operational safety, including terminal operations, storage, transportation by bunker vessel or tank truck, or transfer operations, is outsourced, such processes shall be identified within the QMS. The LBS shall remain fully responsible for ensuring that outsourced activities are effectively controlled and carried out in compliance with these Guidelines and all applicable statutory requirements.

6.9 The LBS shall establish, implement, and maintain documented procedures for the identification, collection, indexing, storage, protection, retrieval, retention, and disposal of all records and documentary evidence generated in connection with Ammonia bunkering operations. Such records shall include, but not be limited to, bunker delivery documentation, Safety Data Sheets (SDS), certificates of quality and quantity, transfer checklists, custody transfer records, inspection and maintenance records, hose testing certificates, training records, incident and near-miss reports, and any other records required under these Guidelines or by the competent authority. All records shall be retained for a minimum period of five (5) years, or such longer period as may be prescribed by the Directorate General of Maritime Administration (DGMA), the concerned Port Authority, or any other competent authority, and shall be made available for inspection upon request.

6.10 Documentation Requirements

To demonstrate the capability to systematically plan and safely execute Ammonia bunkering operations, the Licensed Ammonia Bunker Supplier (LBS) shall submit the following documents, as applicable to the mode of delivery, to the concerned Port Authority and other competent authorities, at least 24 hours prior to the commencement of each bunkering operation, unless otherwise specified by the Port Authority.

6.10.1. Bunker Supply Vessel Documentation (Applicable for Ship-to-Ship Bunkering)

a) Valid Certificate of Registry.

b) Valid International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, or other applicable statutory certificate authorizing the carriage of Ammonia.

c) Valid statutory certificates required under the IBC Code, SOLAS Convention, MARPOL Convention, ISM Code, STCW Convention, and other applicable IMO instruments.

d) Valid Class Certificate issued by a Recognized Organization (RO) or Classification Society authorized by the Flag Administration.

e) Documentary evidence demonstrating compliance with the IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687), as amended.

6.10.2 Road Tanker Documentation (Applicable for Truck-to-Ship Bunkering)

a) Valid licences and approvals issued by the Petroleum and Explosives Safety Organisation (PESO) for the transportation of Ammonia by road tanker.

b) Valid registration, fitness, and statutory certificates for the road tanker issued by the competent authority.

c) Valid certificates demonstrating compliance with applicable Bureau of Indian Standards (BIS) specifications and other statutory requirements governing the transportation of hazardous chemicals by road.

d) Valid driver licence and records of training and competency for the transportation and handling of Ammonia and other hazardous chemicals.

e) Safety Data Sheet (SDS), Transport Emergency (TREM) Card, and emergency response information accompanying each road tanker.

6.10.3 Terminal Operator Documentation (Applicable for Shore-to-Ship Bunkering)

a) Valid approvals, licences, and authorizations issued by PESO, and other competent authorities for the establishment and operation of the Ammonia terminal, storage facilities, loading arms, pipelines, and associated infrastructure, as applicable.

b) Valid certificates demonstrating compliance with applicable national regulations, recognized engineering standards, and relevant BIS specifications governing the design, operation, inspection, and maintenance of Ammonia storage, transfer systems, and pipeline infrastructure.

c) Approved operating procedures, emergency response plan, fire protection plan, inspection and maintenance records, and integrity management programme for the terminal and associated transfer facilities.

6.11 Safety Requirements

The objective of these requirements is to prevent fire, explosion, toxic exposure, pollution and other accidents during Ammonia bunkering and to ensure that bunkering operations are carried out safely and in accordance with applicable statutory requirements, international conventions, recognised standards and the vessel's Safety Management System.

6.12 Bunkering Station Requirements

(a) The bunkering station shall be located in the open air or in a mechanically ventilated space and shall be arranged to minimise the possibility of accidental release and accumulation of ammonia vapour, and to

prevent ammonia from reaching accommodation spaces, service spaces, machinery spaces, control stations, air intakes or other occupied or enclosed spaces.

(b) The bunkering station shall be suitably arranged to prevent accidental release or leakage of ammonia from spreading to adjacent areas and shall provide adequate ventilation, safe access and escape routes for personnel.

(c) The bunkering station shall be provided with suitable drainage and containment arrangements to minimise the consequences of an accidental release of liquid ammonia.

(d) The bunkering station shall be provided with appropriate ammonia detection, alarm and emergency shutdown arrangements, as applicable, to enable the rapid detection and isolation of an accidental release.

(e) The arrangement of the bunkering station shall facilitate safe emergency response and provide suitable means for personnel to evacuate the area in the event of an ammonia release.

6.13 Fire Protection and Fire fighting

(a) The bunkering station on both the receiving vessel and the bunker tanker/barge shall be provided with suitable fire protection and fire-fighting arrangements in accordance with the applicable requirements of the IBC Code, IGF Code, IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687), approved fire-control plan and the results of the risk assessment. The arrangements shall take into account the characteristics and hazards associated with ammonia, including the potential for toxic vapour release and, under suitable conditions, ammonia fire.

(b) Suitable portable fire extinguishing appliances, including dry chemical powder extinguishers or other extinguishing media appropriate for the identified fire hazards, shall be readily available at the bunkering station.

(c) A fire hose connected to the fire main and ready for immediate use shall be provided at the bunkering station, unless an equivalent fixed water-spray, water-mist or other approved fire-extinguishing system is provided. Water spray or deluge arrangements, where provided, shall also be capable of assisting in the dispersion or dilution of ammonia vapour and protecting personnel and equipment from the effects of an accidental release, as appropriate.

(d) Fixed or portable water-spray arrangements shall be provided, where required by the applicable requirements or risk assessment, to control the consequences of an accidental ammonia release and to protect adjacent equipment, escape routes and personnel.

(e) Fixed gas detection and alarm arrangements shall be provided at the bunkering station and in spaces where ammonia may accumulate, as applicable. The detection system shall be capable of detecting ammonia concentrations at appropriate locations and initiating visual and audible alarms, and shall be integrated with the emergency shutdown system where required.

(f) Fire detection and alarm arrangements shall be provided for spaces containing ammonia fuel-system components in accordance with the applicable requirements of the IBC Code, IGF Code, IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687) and the vessel's approved

fire-control plan. The arrangement shall take into account the specific characteristics of ammonia and the possibility of an accidental ammonia release.

(g) Appropriate personal protective equipment, including respiratory protection suitable for ammonia exposure, shall be readily available at the bunkering station for use by personnel involved in bunkering operations and emergency response.

(h) The bunkering station shall be arranged to facilitate rapid isolation of the ammonia transfer system and emergency shutdown of bunkering operations in the event of fire, gas detection or accidental release of ammonia.

6.14 Spill Containment and Pollution Response

(a) The bunkering manifold on the bunker tanker/barge and, where applicable, the receiving vessel shall be fitted with a suitable drip tray or spill pan capable of containing leakage from the transfer connection. Where provided, drainage shall lead to an appropriate holding or containment tank and shall not discharge directly overboard.

(b) Suitable spill-response equipment shall be readily available at the bunkering station, including scupper plugs, suitable absorbent materials, portable pumps, absorbent pads and booms, Ammonia-resistant protective clothing, non-sparking shovels and scoops, mops, suitable containers and other equipment identified by the shipboard risk assessment and emergency response procedures.

(c) A gutter plate, coaming or equivalent containment arrangement shall be provided to prevent any accidental Ammonia spill from spreading beyond the bunkering area.

(d) Spill response shall be carried out in accordance with a documented shipboard emergency response procedure specifically addressing Ammonia releases and shall be integrated, where applicable, with the vessel's existing pollution emergency plan.

(e) Any significant Ammonia spill shall be reported to and dealt with in coordination with the competent authorities in accordance with the applicable pollution-response requirements. For spills occurring in Indian waters, the applicable requirements of the Indian Coast Guard, port authority and State Pollution Control Board shall be followed.

6.15 Emergency Shutdown System and Ship-Shore/Ship-to-Ship Link

(a) The Ammonia transfer system shall be connected to an Emergency Shutdown (ESD) system on both the delivering and receiving sides.

(b) For ship-to-ship bunkering, the ESD systems of the bunker tanker/barge and receiving vessel shall be interconnected through a suitable ship-to-ship link or equivalent approved communication system to ensure coordinated shutdown upon activation by either party. For shore-to-ship transfer, an equivalent ship-shore link shall be provided.

(c) The ESD system shall be capable of automatic activation, as appropriate, upon detection of fire, Ammonia leakage or vapour concentration above the predetermined alarm level, receiving-tank high-level/overflow condition, abnormal transfer pressure, failure of critical transfer equipment or other

conditions identified by the risk assessment. The system shall also permit manual activation from designated locations by either party.

(d) The bunker tanker/barge and receiving vessel shall be provided with an Emergency Release System (ERS), where required by the approved design and risk assessment, incorporating suitable Emergency Release Couplings (ERCs) in the liquid and, where applicable, vapour-return connections. The system shall be designed to separate safely at a predetermined load and to minimise release of Ammonia following disconnection.

(e) Bunkering shall not commence, or shall be suspended if already in progress, unless at least two independent and effective means of communication are continuously available between the delivering and receiving parties.

(f) The ERS shall be located and arranged so as to permit safe operation and emergency disconnection, including in the event that the receiving vessel is required to make an emergency departure. Where the ESD systems are interconnected, the shutdown sequence shall be agreed between the parties and documented in the pre-bunkering checklist.

An ESD function test shall be carried out before commencement of each bunkering operation, unless an approved equivalent testing arrangement is provided. The agreed ESD sequence and test results shall be recorded.

ESD activation criteria shall include, as applicable:

- receiving tank high-level/overflow alarm;
- excessive tank pressure;
- Ammonia liquid or vapour leakage;
- fire detection;
- loss of required ventilation;
- abnormal transfer pressure or flow;
- excessive movement of the vessels;
- failure of the transfer hose, arm or associated equipment;
- manual activation by either party; and
- loss of essential power or other critical system failure.

(g) All personnel engaged in Ammonia bunkering shall wear suitable PPE in accordance with the applicable statutory requirements, recognised industry standards, Safety Management System and risk assessment. PPE shall be appropriate to the task and the hazardous, safety or monitoring zone in which the personnel are working.

(h) Emergency showers and eyewash stations shall be readily accessible from the bunkering station. The vessel/facility's emergency and medical response procedures shall include specific first-aid measures for Ammonia exposure through ingestion, inhalation, skin contact and eye contact, based on the applicable Safety Data Sheet (SDS).

6.16 Ammonia Vapour and Liquid Leak Detection

(a) Fixed Ammonia vapour detection systems shall be provided at the bunkering station and at other locations identified by the risk assessment as having the potential for accumulation of Ammonia vapour.

(b) The detection system shall provide an alarm at a concentration sufficiently below the Lower Explosive Limit (LEL) of Ammonia in air to provide adequate time for corrective action and safe shutdown. The alarm set points shall be established in accordance with the applicable statutory requirements, approved design and risk assessment.

(c) Personnel directly involved in Ammonia bunkering shall carry suitable personal gas-detection equipment capable of detecting Ammonia vapour, where required by the risk assessment. Occupational exposure limits shall be controlled in accordance with applicable occupational-health requirements and the current SDS for the Ammonia supplied.

(d) Liquid leakage at the transfer interface shall be continuously monitored by personnel. CCTV or other remote monitoring arrangements should be provided where practicable to enhance surveillance of the manifold and transfer connection.

(e) Detection of Ammonia leakage or vapour concentration above the specified alarm level shall initiate the actions specified in the bunkering emergency procedure, including, where applicable, activation of the ESD system, cessation of transfer, isolation of the source and evacuation of personnel from the affected area.

6.17 Reports of Maritime Traffic Impact Assessment (MTIA) and Quantitative Risk Assessment (QRA)

(a) The Licensed Ammonia Bunker Supplier (LBS), in consultation with the concerned Port Authority and Terminal Operator, as applicable, shall prepare a Maritime Traffic Impact Assessment (MTIA) and a Quantitative Risk Assessment (QRA) prior to the commencement of Ammonia bunkering operations at a new location or whenever significant changes are made to the bunkering facilities, operational procedures, traffic patterns, or other risk parameters. The MTIA and QRA shall be periodically reviewed and updated, as necessary, based on operational experience, incident investigations, technological developments, and changes to the assumptions or input parameters. The assessments shall identify and evaluate all risks to personnel, vessels, port infrastructure, property, and the marine environment associated with the proposed Ammonia bunkering operation and prescribe appropriate risk mitigation measures.

(b) The QRA shall determine the appropriate safety distances, hazard exclusion zones, and operational control measures based on credible accident scenarios associated with Ammonia bunkering. The assessment shall consider, as applicable, Ammonia leakage or spills, pool fires, jet fires, flash fires, vapour cloud formation, vapour cloud explosions (where credible), toxic vapour exposure, environmental contamination, and escalation to adjacent facilities or vessels**.** Site-specific environmental and meteorological conditions, vessel traffic, proximity to occupied areas, and emergency response capabilities shall be taken into account. The results of the consequence analysis, including fire effects, thermal radiation, explosion overpressure (where applicable), toxic exposure, and environmental impacts, shall be used to establish the required safety zones and operational restrictions.

(c) The MTIA and QRA shall be carried out in accordance with internationally recognized risk assessment methodologies and the applicable guidance contained in the IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687)**,** the IBC Code**,** IGF Code**,** ISGOTT, and other relevant

guidance issued by the Directorate General of Maritime Administration (DGMA), the Petroleum and Explosives Safety Organisation (PESO), the concerned Port Authority, or other competent authorities. The studies shall be undertaken by competent persons or organizations having demonstrable expertise in port operations, hazardous chemical handling, and quantitative risk assessment.

6.18 Ammonia Bunkering Management Plan

The Licensed Ammonia Bunker Supplier (LBS) shall preare, implement, and maintain a comprehensive Ammonia Bunkering Management Plan (MBMP) in consultation with the concerned Port Authority, Terminal Operator (where applicable), and other stakeholders. The MBMP shall establish the procedures, responsibilities, risk control measures, and emergency arrangements for the safe planning and execution of Ammonia bunkering operations during the pre-bunkering, bunkering, and post-bunkering phases. The plan shall be developed in accordance with the IMO Interim Guidelines for the Safety of Ships Using Ammonia as Fuel (MSC.1/Circ.1687)**,** the IBC Code**,** IGF Code**,** ISGOTT, applicable Classification Society requirements, and the applicable requirements of DGMA, PESO, and the concerned Port Authority.

The MBMP shall, as a minimum, include the following:

a) A description of the proposed bunkering operation, including the mode of delivery (ship-to-ship, truck-to-ship, or shore-to-ship), the proposed bunkering location, equipment to be used, operational procedures, and the defined operational envelope, including limiting weather, sea state, current, visibility, and wind conditions. The plan shall also specify the conditions under which bunkering operations shall be suspended or terminated, including cyclones, severe weather, lightning, earthquakes, or other natural or operational emergencies.

b) The quantity, grade, specification, and quality requirements of the Ammonia to be supplied, together with the applicable fuel quality verification procedures.

c) A comprehensive risk assessment identifying hazards associated with Ammonia bunkering, together with preventive, mitigation, and emergency response measures.

d) Detailed operating procedures covering pre-transfer inspections, ship/shore safety checks, communication protocols, transfer procedures, emergency shutdown (ESD), completion of transfer, draining, purging (where applicable), disconnection, and post-transfer verification.

e) A compatibility assessment procedure and checklist to verify the compatibility of the bunker supply facility and the receiving vessel, including transfer equipment, connections, communication systems, transfer rates, emergency shutdown arrangements, and operational limitations.

f) Valid inspection, testing, calibration, and certification records for all bunkering equipment, including transfer hoses or loading arms, pumps, valves, flow meters, emergency shutdown systems, leak detection systems, gas and vapour detection systems, fire detection and alarm systems, communication equipment, pressure and temperature monitoring instruments, and other safety-critical equipment, as applicable to the mode of delivery.

g) Training, familiarization, competency requirements, emergency drills, and records of qualifications and certifications for all personnel involved in Ammonia bunkering operations.

h) Procedures governing the selection, availability, inspection, maintenance, and mandatory use of appropriate Personal Protective Equipment (PPE) suitable for Ammonia handling, including chemical-resistant clothing, gloves, eye and face protection, respiratory protection where required, and emergency decontamination arrangements.

i) Procedures to ensure the availability and operational readiness of intrinsically safe electrical equipment and lighting, explosion-protected communication devices, and other hazardous-area equipment within the designated bunkering safety zone.

j) A comprehensive emergency response and contingency plan addressing Ammonia leakage, spills, toxic exposure, fire, explosion, medical emergencies, environmental pollution, equipment failure, emergency shutdown, evacuation, and coordination with the Port Authority, terminal operator, emergency services, and other relevant agencies.

k) Procedures for documenting all bunkering activities, including pre-bunkering meetings, safety checklists, permits to work, transfer records, custody transfer documentation, quantity and quality records, incidents, near misses, emergency drills, and simultaneous operations (SIMOPS) conducted within or adjacent to the designated bunkering area.

l) Procedures for post-bunkering inspection, reconciliation of transferred quantities, management of residual Ammonia, disposal of waste generated during bunkering, and reporting of any abnormal events, non-conformities, or incidents.

6.19 Bunkering Compatibility Checklist / Report

The Licensed Ammonia Bunker Supplier (LBS) shall prepare and submit a Ammonia Bunkering Compatibility Checklist/Report confirming the compatibility of the bunkering systems, equipment, procedures, communication, and emergency arrangements between the LBS and the Ammonia Bunker Receiving Vessel (LBR), or the receiving facility, as applicable to the mode of delivery (ship-to-ship, truck-to-ship, or shore-to-ship).

The Checklist/Report shall, as a minimum, confirm:

a) Compatibility of transfer equipment, connections, and operating parameters.

b) Availability and functionality of communication and emergency shutdown (ESD), where applicable.

c) Agreement on the quantity and specification of Ammonia to be supplied.

d) Completion of the pre-bunkering safety checks and compliance with applicable statutory and Port Authority requirements.

e) Confirmation that designated Persons-in-Charge (PICs) have conducted the pre-transfer meeting and agreed on the bunkering and emergency procedures.

6.20 Joint Bunkering Plan

The LBS and the Ammonia Bunker Receiving Vessel (LBR) shall jointly prepare and endorse a Joint Bunkering Plan prior to commencement of bunkering. The Plan shall define the agreed operational procedures, responsibilities, communication protocols, emergency response arrangements, and safety

measures applicable to the selected mode of delivery (ship-to-ship, truck-to-ship, or shore-to-ship), including connection, transfer, and disconnection procedures.

6.21. Operational Safety Measures

During Ammonia bunkering, the LBS and LBR shall continuously monitor transfer operations to ensure safe operating pressures, transfer rates, tank levels, and system integrity. Appropriate measures shall be implemented to prevent overfilling, leakage, spills, vapour release, fire, and explosion hazards. The Joint Bunkering Plan shall include procedures for vapour management (where applicable), emergency shutdown (ESD), spill containment, and immediate response to abnormal operating conditions.

6.22 Truck-to-Ship Bunkering

For truck-to-ship bunkering, the LBS shall submit a Traffic Management Plan indicating the designated route for Ammonia tank trucks, parking and staging arrangements, vehicle movement controls, emergency access routes, and safety measures for truck manoeuvring within the port or terminal.

6.23 Shore-to-Ship Bunkering

For shore-to-ship bunkering, the Terminal Operator shall confirm that the Ammonia storage tanks, transfer pipelines, loading arms or hoses, emergency shutdown systems, fire protection systems, and associated safety equipment have been inspected, tested, and are fully operational prior to commencement of bunkering.

6.24 Operational Requirements

(a) Safety Zone:

A safety zone shall be established around the Ammonia bunkering operation to control ignition sources and restrict unauthorized access. The extent of the safety zone shall be determined based on the approved Quantitative Risk Assessment (QRA) and agreed upon by the LBS, the Ammonia Bunker Receiving Vessel (LBR), and the concerned Port Authority. The size and configuration of the safety zone shall be appropriate to the mode of delivery (ship-to-ship, truck-to-ship, or shore-to-ship) and the identified hazardous areas. If any unauthorized vessel, vehicle, or person enters the safety zone, the bunkering operation shall be suspended until the safety of the operation is restored.

(b) Toxic Zone:

The Toxic Zone shall be established based on ammonia dispersion modelling and risk assessment. Access shall be restricted to authorised and trained personnel wearing appropriate PPE. Warning signs, barriers, gas detection and alarm systems shall be provided, as applicable. Wind conditions shall be monitored, and emergency procedures for ammonia leakage, evacuation and emergency shutdown shall be in place. Bunkering shall be suspended in any unsafe condition and resumed only after the hazard has been rectified and safety confirmed.

(c) Monitoring Zone:

The Monitoring Zone shall be established around the bunkering operation based on risk assessment and ammonia dispersion modelling. Ammonia concentrations shall be monitored using suitable fixed or portable gas detection equipment to detect any gas migration beyond the designated Toxic Zone. Monitoring shall

continue throughout bunkering, with alarm levels established in accordance with applicable safety standards. Any abnormal ammonia concentration or gas detection alarm shall be promptly assessed, and appropriate precautionary measures, including suspension of bunkering and evacuation, shall be implemented where necessary. Gas detection equipment shall be regularly tested and calibrated, and monitoring records shall be maintained.

(d) Security Zone:

The LBS and the LBR shall establish and maintain an appropriate security zone around the bunkering operation in accordance with the ISPS Code, Port Authority requirements, and the approved security arrangements. The security zone shall be monitored throughout the operation to prevent unauthorized access and activities that could compromise safety or security. The security zone shall normally extend beyond the safety zone and shall be communicated to all relevant stakeholders, including adjacent terminals, vessels, and the Port Authority, prior to the commencement of bunkering.

(e) Hazardous Area:

The Hazardous Area shall be classified in accordance with applicable standards and the approved risk assessment. Equipment and electrical installations shall be suitably certified for the designated zone. Ignition sources shall be controlled, and hot work shall be prohibited unless authorised under a permit-to-work system. Access shall be restricted to authorised personnel, with appropriate warning signs displayed. Gas detection, ventilation and emergency shutdown arrangements shall be provided, as applicable, and the area shall be regularly inspected for compliance with safety requirements.

(f) Vessel Traffic Services (VTS):

Where Vessel Traffic Services (VTS) are in operation, the bunker supply vessel shall participate in the local VTS and maintain continuous watch on the designated VHF channels throughout the bunkering operation, in accordance with the requirements of the Port Authority.

(g) Traffic Management (Truck-to-Ship):

For truck-to-ship bunkering, the LBS shall implement an approved Traffic Management Plan specifying designated routes, vehicle movement controls, speed limits, parking and staging areas, emergency access routes, and any escort requirements, as prescribed by the concerned Port Authority.

(h) Monitoring of Ammonia Transfer

For ship-to-ship and shore-to-ship bunkering, the LBS and the LBR shall continuously monitor the transfer operation, including transfer pressure, flow rate, tank levels, and the integrity of the transfer system. Emergency Shutdown (ESD) arrangements, where provided, shall be operational and tested prior to commencement of bunkering.

(i) Bunkering Operations

The LBS shall conduct bunkering operations in accordance with the approved Ammonia Bunkering Management Plan and the Joint Bunkering Plan. A pre-bunkering safety checklist shall be completed within 4 hours prior to commencement of bunkering and made available for inspection.

(j) Pre-Transfer Agreement

The following shall be agreed upon and recorded by the LBS and the LBR prior to commencement of bunkering:

a) Quantity and specification of Ammonia to be transferred.

b) Maximum transfer pressure.

c) Maximum transfer rate.

(k) Simultaneous Operations (SIMOPS)

Simultaneous operations shall only be permitted where supported by a documented risk assessment, approved by the Port Authority, and specified in the Joint Bunkering Plan. Operations that may introduce ignition sources or otherwise compromise the safety of Ammonia bunkering shall not be undertaken during the transfer.

(l) Simultaneous Bunkering

Simultaneous bunkering of conventional fuels or other hazardous substances with Ammonia shall not be permitted unless specifically authorized by the Port Authority based on a documented risk assessment and appropriate risk control measures.

(m) Familiarization

Prior to commencement of bunkering, the LBR shall be familiar with the operating procedures, communication protocols, emergency shutdown arrangements, and emergency response procedures established by the LBS.

(n) Electrical Equipment

Electrical equipment and lighting located within the designated hazardous area shall be suitable for hazardous locations and shall comply with the applicable explosion-protection requirements. Non-certified electrical equipment shall not be energized within the hazardous area during bunkering.

(o) Spark-Producing Equipment

Equipment or activities capable of generating sparks, excessive heat, or ignition sources, including hot work, shall not be permitted within the designated safety zone during Ammonia bunkering unless specifically authorized under an approved Permit-to-Work system.

(p) Personnel Awareness

Appropriate warning notices shall be displayed and all personnel, including crew, terminal personnel, contractors, and visitors, shall be informed that Ammonia bunkering is in progress. Access to the designated safety zone shall be restricted to authorized personnel only.

(q) Emergency Communication

Where an emergency affecting the LBS facilities arises, the LBS shall immediately notify the LBR, the Port Authority, and other relevant emergency response agencies through the agreed communication channels.

(r) Emergency Response

In the event of an emergency requiring suspension or termination of bunkering, the Master of the vessel, Harbour Master, or other competent authority shall determine the appropriate operational response, including movement or evacuation of the vessel, where necessary.

(s) Pre-Bunkering Verification

Prior to each Ammonia bunkering operation, the following shall be verified and recorded:

i) Communication systems and Emergency Shutdown (ESD) arrangements, where applicable.

ii) Operational readiness of transfer valves, pumps, hoses/loading arms, and associated equipment.

iii) Availability of emergency response services, including fire-fighting and medical assistance.

iv) Visual inspection of transfer manifolds, hoses/loading arms, couplings, valves, piping, spill containment arrangements, and associated equipment.

v) Availability and readiness of spill response equipment, fire-fighting systems, appropriate extinguishing media (including alcohol-resistant foam), emergency eyewash and safety shower facilities, drip trays, and suitable absorbent materials.

(t) Technical Requirements

All bunkering systems, transfer equipment, instrumentation, safety devices, and associated installations shall be designed, operated, inspected, tested, and maintained in accordance with the manufacturer's recommendations, applicable Classification Society Rules, relevant IMO instruments, recognized international standards, and the requirements of DGMA, PESO, and the concerned Port Authority.

(u) Notifications

The LBS shall comply with the following notification requirements:

i) **Pre-Notification:** Notify the concerned Port Authority at least 24 hours prior to the planned bunkering operation, providing details of the location, time, delivery mode, quantity of Ammonia, and emergency contact information.

ii) **Operational Notifications:** Notify the Port Authority of the commencement, suspension (if any), and completion of the bunkering operation through the prescribed communication channel.

iii) **Incident Reporting:** Immediately report any accident, spill, fire, equipment failure, pollution incident, injury, or other abnormal occurrence to the Port Authority and other competent authorities in accordance with applicable statutory reporting requirements.

7. Bunker Delivery Note (BDN)

The Licensed Ammonia Bunker Supplier (LBS) shall issue a Bunker Delivery Note (BDN) for every consignment of Ammonia supplied to a receiving vessel. The BDN shall comply with applicable statutory requirements and include the supplier's and receiving vessel's details, date and place of delivery, quantity, and specification of Ammonia supplied. A copy of each BDN shall be retained by the LBS for a minimum period of three (3) years and made available for inspection upon request.

8. Requirements for Crew Members and Personnel

a) Ship-to-Ship: Personnel of the LBS and LBR engaged in Ammonia bunkering shall be trained and competent in accordance with the STCW Convention and Code**,** MSC.1/Circ.1687, the vessel's Safety Management System (SMS), and other applicable statutory requirements.

b) Truck-to-Ship: Drivers transporting Ammonia shall possess valid licences and training in accordance with PESO, the Central Motor Vehicles Rules, 1989, and other applicable regulations for the transportation and handling of hazardous chemicals.

c) Shore-to-Ship: Terminal personnel shall be trained and competent in the operation of Ammonia storage and transfer systems, emergency shutdown procedures, fire protection, spill response, and emergency management, in accordance with applicable PESO, and Port Authority requirements.

d) Training and Drills: The LBS shall ensure periodic training, competency assessment, and emergency drills for all personnel involved in Ammonia bunkering and maintain the corresponding records for inspection.

9. Enforcement

The Directorate General of Maritime Administration (DGMA) shall enforce the provisions of this Circular in coordination with the concerned Port Authority**,** PESO,and other competent authorities. Any Licensed Ammonia Bunker Supplier (LBS), vessel, trucking company, or terminal operator found to be in non-compliance shall be liable to appropriate regulatory action under the applicable laws.

Approval of Ammonia bunkering operations shall be based on a documented risk assessment. The Port Authority, DGMA, and PESO shall, as applicable, consider:

a) Approval of the risk acceptance criteria and QRA.

b) Governance of Ammonia bunkering operations within the port.

c) Accreditation/approval of Licensed Ammonia Bunker Suppliers (LBS).

d) Suitability of approved bunkering locations.

e) Restrictions on simultaneous operations (SIMOPS).

f) Shore-side emergency response and contingency arrangements.

g) Traffic management and navigational safety measures.

h) Any additional safety, environmental, or operational requirements deemed necessary by the competent authority.

9. Amendments

This Circular shall be subject to periodic review and revision by the Directorate General of Maritime Administration (DGMA), as necessary, to incorporate technological advancements, amendments to applicable international conventions, national laws and regulations, and evolving industry best practices relating to AmmoniaA bunkering operations.