Best Practices

Methanol Bunkering

July 2025

IRCLASS
Indian Register of Shipping

Methanol Bunkering
July 2025

Contents

Introduction

With the advent of methanol as an alternative to conventional fuels, the number of methanol fuelled vessels in service has risen. As on date more than 100 such vessels which are fuelled with methanol are operating on voyages. Methanol is a low flashpoint and toxic fuel. This presents challenges and hazards not only limited to ship design, construction and operation but also with regard to operations such as bunkering. Methanol can be bunkered using ship-to-ship (STS), pipe-to-ship (PTS), or truck-to-ship (TTS) methods.

Classification Society Rules are focused on the design, construction, testing and surveys of ships and equipment. Therefore, it may be well acknowledged that bunkering operations of Methanol ashore, do not strictly come under the ambit of Classification matters, other than to ships involved in the bunkering operations.

Bunkering operations with Methanol have been performed and there is literature (though not very extensive) which addresses the safety aspects to be considered for bunkering operations. This document provides practical insights on performing bunkering operations of methanol while maintaining an acceptable level of safety.

Additionally, compliance may be required with applicable statutory and legal requirements of the local area within which the methanol bunkering operations are envisaged to be performed. Stakeholders are therefore advised to consult local authorities prior planning such operations.

It may be noted that these best practices may not be exhaustive and are to be updated periodically as necessary taking into account experience gained.

Section 1

Application

1.1 Scope

1.1.1 This document provides best practices for the responsibilities, procedures and equipment required for Methanol bunkering operations and recommendations for bunkering risk assessment (Section 6 and Annex A), equipment and operations.

1.1.2 This document does not consider commercial aspects of the bunker transfer measurement of quantity or quality of Methanol.

1.1.3 These best practices are applicable for methanol bunkering operations for different bunkering methods, different ship types and different locations.

1.1.4 Mobile facilities such as road tankers, rail tank cars and portable tanks, piping, hoses, pumps and valves should be fabricated and conform to meet applicable standard recognized by national and/or regional standard bodies, for handling methanol.

1.1.5 All components of the methanol transfer system should be constructed to at least comply with the requirements as specified in the IBC Code Chapter 5.

1.1.6 Checklists for the various phases of the Bunkering Operations are provided in Annex B. Reference is also made to other checklists developed by the industry (for e.g. checklists by IAPH).

1.2 Purpose

1.2.1 The purpose of these best practices is mainly to define and cover the risks associated with bunkering of methanol and to propose a methodology to deal with those additional risks.

1.2.2 This document is intended to complement the requirements of existing applicable guidelines and regulations, such as port and terminal checklists, operator's procedures, industry guidelines and local regulations. The document aims to cover the following items:

.1 Responsibilities of different parties involved in the Methanol transfer,
.2 The Methanol bunkering process,
.3 Simultaneous Operations
.4 Safety distances
.5 Hazard identification (HAZID)
.6 Quantitative Risk Analysis

1.3 Properties of Methanol

1.3.1 The key properties of Methanol are summarized as shown below:

Item	Value (typical)
Chemical Formula	CH_3OH
Boiling Point at atmospheric pressure	-64.7°C
Flashpoint	11°C
Density (at boiling point at atmospheric pressure)	792 kg/m^3
Lower Heating Value	19.9 MJ/kg
Autoignition Temperature (Methane)	456°C
Cetane Number	~3
Octane Number	125 - 135

1.3.2 Methanol has a toxic effect on humans. It is hazardous in case of skin contact, can cause damage to the eyes and possible damage to internal vital organs. Methanol is corrosive in nature especially when contaminated with water.

1.4 Methanol Bunkering Process

1.4.1 Methanol bunkering is the process of transferring Methanol fuel to a ship from a bunkering facility.

1.4.2 The sequence of activities for a bunkering operation carried out for the first time is indicated in Fig. 1.4.2. The references also indicate the applicable sections of this document.

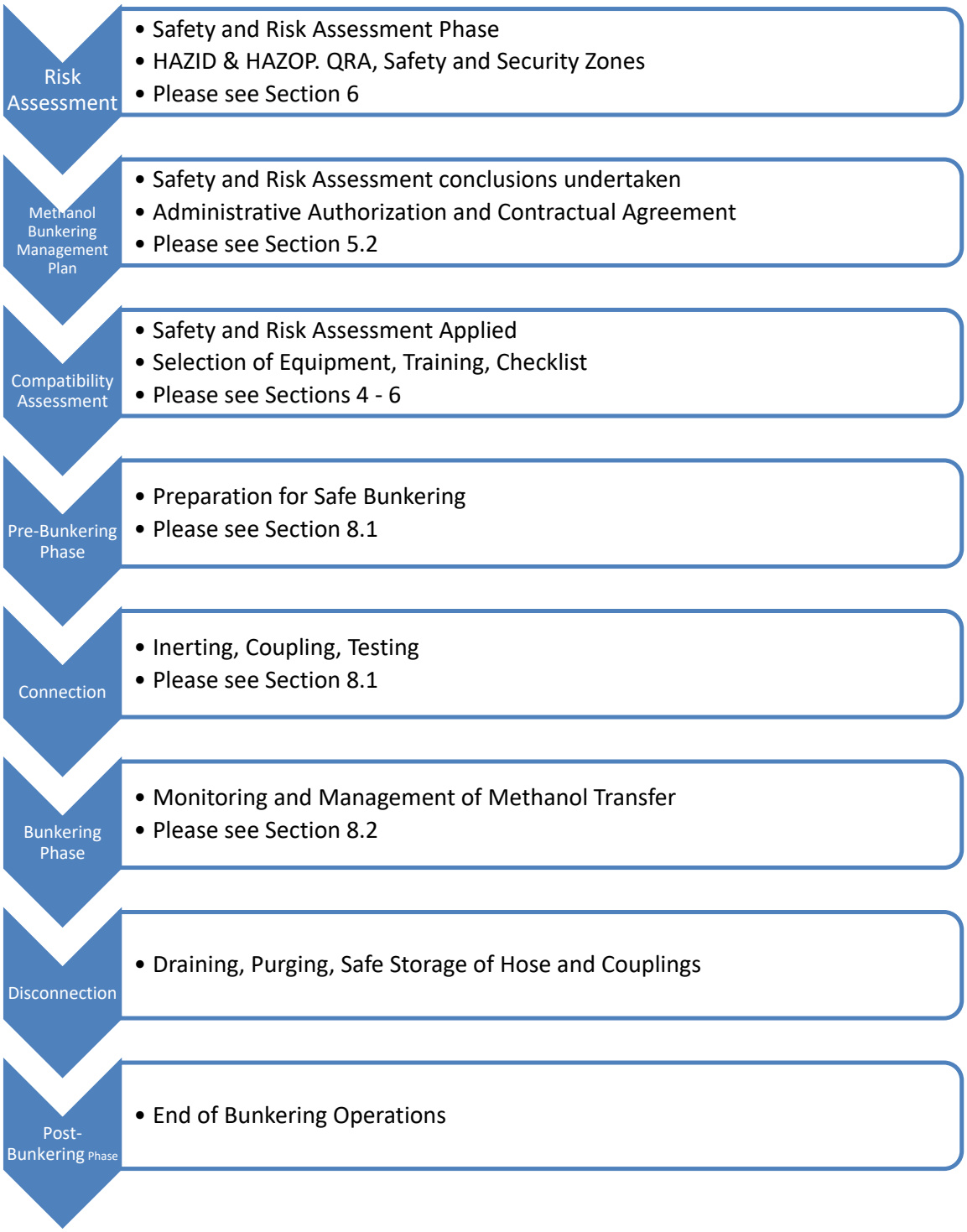

Fig. 1.4.2: Activities involved in Bunkering Operation

Section 2

Definitions and Standards

2.1 Terms and Definitions

2.1.1 Bunkering Facility Organization (BFO)

This is the organization in charge of the operation of the bunkering facility.

2.1.2 Breakaway Coupling (BRC) and Emergency Release Coupling (ERC)

A BRC or ERC is a safety coupling located in the Methanol transfer system (at one end of the transfer system, either the receiving ship end or the bunkering facility end, or in the middle of the transfer system), which separates at a predetermined section at a determined break-load or relative separation distance, each separated section containing a self-closing shut-off valve, which seals automatically.

BRC activation is by breaking of shear pins/studs, requiring higher force. BRC has limited control over disconnection and is generally used in hose-to-hose connections for protecting against accidental pull-aways. Whereas, ERC activation is by collar release mechanism by cable, hydraulics etc., requiring potentially less force with controlled release for tow-away protection on loading arms. In essence, both types of couplings offer safety and spill prevention.

2.1.3 Bunkering facility

A bunkering facility is normally composed of Methanol storage and a Methanol transfer installation. A bunkering facility may be (a stationary shore-based installation or a mobile facility, i.e. a Methanol bunker ship or barge or a tank truck). A bunkering facility may be designed with a vapour return line and associated equipment to manage the returned vapour.

2.1.4 Dry disconnect

This applies when the transfer system between two vessels or a vessel and a port facility is disconnected as part of normal operations. The objective is that no Methanol or Methanol Vapour should be released into the atmosphere. If this objective cannot be achieved, the amount released can be reduced to negligible amounts consistent with safety. Dry disconnect can be achieved by:

- Draining and inerting process before the disconnection; or
- Use of dry connect / disconnect coupling.

2.1.5 Emergency Shut-Down (ESD)

These are systems installed as part of the Methanol transfer system that are designed to stop the flow of Methanol and/ or prevent damage to the transfer system in an emergency. The ESD may consist of two stages. These are:

- ESD - stage 1, is a system that shuts the Methanol transfer process down in a controlled manner when it receives inputs from one or more of the following: transfer personnel, high- or low-level Methanol tank pressure alarms, cables or other means designed to detect excessive movement between transfer vessels or vessel and a Methanol bunkering facility, or other alarms.

- ESD - stage 2, is a system that activates decoupling of the transfer system between the transfer vessel or between a vessel and a Methanol bunkering facility. The decoupling mechanism contains quick acting valves designed to contain the contents of the Methanol transfer line (dry break) during decoupling.

2.1.6 Emergency Release Coupling (ERC)

The ERC is normally linked to the ESD system where this may be referred to as ESD2 as per SIGTTO publication *"ESD arrangements & linked ship/shore systems for liquefied gas carriers"*. An emergency release coupling is activated:

- by excessive forces applied to the predetermined section, or
- by manual or automated control, in case of emergency.

2.1.7 Emergency Release System (ERS)

A system that provides a positive means of quick release of the transfer system and safe isolation of receiving vessels from the supply source. This system includes the BRC or ERC.

2.1.8 Flash Gas

Methanol vapour that is instantly generated during fuel transfer.

2.1.9 HAZOP

A structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment or prevent efficient operation. A HAZOP is a qualitative technique based on guidewords and is carried out by a multi-disciplinary team of experts during a set of meetings.

2.1.10 HAZID

There are several recognized methods for the formal identification of hazards. For example: a brainstorming exercise using checklists where the potential hazards in an operation are identified and gathered in a risk register. These hazards will then be assessed and managed as required.

2.1.11 Hazardous zones

Bunkering-related hazardous zone means any hazardous area zone 1 or zone 2 defined for the following:

- Bunker Receiving Ship
- Bunkering Ship
- Bunkering Shore facility or truck

2.1.12 IBC Code

International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk.

2.1.13 IGF Code

International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels. IGF Code refers to Resolution MSC.391(95) as amended.

2.1.14 Methanol Bunkering

The process of transferring Methanol to be used as fuel on board the receiving ship.

2.1.15 Methanol transfer system

A system consisting of all equipment contained between the manifold used to deliver Methanol bunker (and to handle Methanol vapour return) and the manifold receiving the Methanol (and delivering Methanol vapour return) including but not limited to the following:

- Loading arms and supporting structures,
- Methanol articulated rigid piping,
- Hoses, swivels, valves, couplings
- Emergency Release Coupling (ERC),
- Insulating flanges,
- Quick connect / disconnect couplings (QC/DC),
- Handling system and its control / monitoring system,
- Communication system,
- ESD Ship/Shore Link or Ship/Ship Link used to connect the supplying and receiving ESD systems.

It can also include the pumps, compressors or blowers intended for the Vapour Management system where provided, depending on the design of the transfer system.

2.1.16 MARVS

Maximum Allowable Relief Valve Setting

2.1.17 Person in Charge (PIC)

The Person in Charge (PIC) is a person who is responsible for the overall management of the bunkering operation. The PIC may also be referred to as Person in Overall Advisory Control (POAC). Also refer Section 4.2.5

2.1.18 Qualitative Risk Assessment

A risk assessment method using relative measure of risk value based on ranking or separation into descriptive categories in a qualitative way.

2.1.19 Quantitative Risk Assessment (QRA)

This is a formalized statistical risk assessment method for calculating a numerical risk level for comparison with defined regulatory risk criteria.

2.1.20 Receiving Ship (RS)

Receiving ship is the ship that receives fuel.

2.1.21 Receiving Ship Operator (RSO)

The receiving ship operator (RSO) is the company responsible for the operation of the receiving ship, in particular during the bunkering operations.

2.1.22 Risk

A combination of the likelihood of an event and the consequences if the event occurs.

2.1.23 Risk matrix

A risk matrix is a tool for displaying combinations of likelihood and consequence, used as the basis for ranking of hazards with a view to their prioritization.

2.1.24 Safety zone

The safety zone is a zone around the bunkering facility, the bunkering station of the receiving ship and the Methanol transfer system. The purpose of the zone is to set an area that is put in place during Methanol bunkering and within which only essential authorized and qualified personnel are allowed and potential ignition sources are controlled. Toxicity levels should also be kept below the permissible exposure limits for humans unless appropriate measures are deployed for protection of personnel against exposure to methanol and methanol vapours.

2.1.25 Security zone

The Security Zone is the area around the bunkering facility and receiving ship where ship traffic and other activities are monitored (and controlled) to prevent entry and provide a 'stand-off' distance during the bunkering operation; this will be larger than the safety zone. The security zone may also be referred to as the "exclusion zone". The security zone is site dependent and is often determined by the Port Authorities.

2.1.26 Simultaneous Operations (SIMOPS)

Carrying out Methanol bunkering operations concurrently with any other transfers between ship and shore (or between ships if ship-to-ship bunkering method is used). This includes loading or unloading cargo operations, dangerous goods loading or unloading and any kind of other goods loading or unloading (i.e. stores and provisions), passenger embarkation/disembarkation, chemical and other low flash product handling, bunkering of fuels other than Methanol, and any other activity that can impact or distract from bunkering operations (e.g. cargo movements on board, maintenance, repairs, servicing of equipment etc.). Special attention should be paid to any of the above activities occurring within the bunkering safety zone as well as any on-board testing that may impact on the bunker operation.

2.2 Standards

2.2.1 Methanol Fuel

1. IRS Guidelines on Methanol Fueled Vessels (as amended)
2. ISO 6583: 2024 – Methanol as Fuel for Marine Applications
3. MSC.1/Circ.1621 (as may be amended) - Interim guidelines for the Safety of Ships using methyl/ethyl alcohol as fuel
4. IBC Code
5. IGF Code
6. STCW Code
7. CEN CWA 17540 - Ships and marine technology – Specification for bunkering of methanol fuelled vessels
8. API RP 2003 – Protection against Ignitions arising out of Static, Lightning and Stray Currents
9. IS 7444 – Code for Safety of Methanol
10. IEC 60079 series of standards

2.2.2 Risk analysis

1. ISO 31000 – Risk Management - Principles and Guideline
2. ISO 31010 - Risk Management - Guidelines on principles and implementation of risk management

2.2.3 Other Technical Documents

1. SGMF - FP22-01_Methanol – Safety and Operational Guidelines – Bunkering ISBN**:** 978-1-7395354-6-9
2. Methanol Institute – Introduction to Methanol Bunkering Technical Reference
3. Methanol Institute – Methanol Safe Handling Manual
4. Methanol Institute – Methanol Safe Handling Technical Bulletin – Precautions for Loading, Unloading, Transporting & Storing Methanol
5. Methanol Institute – Methanol Safe Handling and Safe Berthing Technical Bulletin
6. EMSA (2024): Guidance for Safe Bunkering of Biofuels – Guidance document and checklists: Pre-bunkering, Connection, Transfer, Disconnection, SIMOPS.

Section 3

Bunkering Methods

3.1 Typical Ship Bunkering arrangements

3.1.1 Three methods of bunker supply are detailed in the following sub-sections.

3.1.2 The bunkering duration will depend mainly on the transfer rate from the bunkering facility. Other parameters influencing the bunkering duration include testing procedures, flash gas handling, purging and draining method and pre- and post-bunkering procedures.

3.2 Ship to Ship Methanol Bunkering

3.2.1 Methanol bunker ships are a common solution for a significant volume of Methanol to be transferred.

3.3 Truck to Ship Methanol Bunkering

3.3.1 Methanol bunkering operations can be carried out from standardized trucks (typically about 40 cubic meter capacity). Multiple trucks may be required to bunker a single ship, depending on the required bunker volume.

3.4 Terminal to Ship Methanol Bunkering

3.4.1 Methanol bunkering can take place from the Terminal or Onshore Methanol Storage facility through a flexible hose or loading arm for final connection with the ship. The tanks for the storage of the Methanol should generally be as close as possible to the bunkering terminal.

3.4.2 This type of facility should be adequately manned such that personnel are able to manually activate the ESD and stop the bunker transfer in case of an emergency.

Section 4

Responsibilities during Methanol Bunkering

4.1 Responsibilities during Planning Stage

The involvement of stakeholders such as Port, National and/or other Jurisdictional authorities, Methanol supplier and receiving ship in the planning of a bunkering operation are detailed below:

4.1.1 Port, National Authority and Flag Administration responsibilities

Decisions and requirements for Methanol bunkering should be based on a risk analysis carried out in advance of each bunkering operation. The Port authority and/or national or other jurisdictional authority should consider the following as a minimum:

- Overall responsibility for the good governance and framework for Methanol bunker operations in the port
- Applicability of an accreditation scheme for Methanol bunker operators in the ports under their authority,
- Acceptability of the location of bunkering facilities, (bunkering may be limited to specific locations within the port/anchorage),
- Approval of the risk acceptance criteria,
- Restrictions on bunkering operations such as simultaneous operations,
- Shore side contingency plans, emergency response systems,
- General procedures for traffic control and restrictions,
- Environmental Impact Assessment/ compliance with environmental regulations (e.g. accidental release/ spill of methanol in water)
- Whether additional requirements should be applied.

4.1.2 Receiving ship operator (RSO) and bunkering facility organization (BFO) responsibilities

Before setting up a ship bunkering operation, the receiving ship operator (RSO) and bunkering facility organization (BFO) should perform the actions listed below:

Sr. no	Activity	Performed by		Remarks
		BFO	RSO	
1	Review the applicable International, National and Local Regulations, Port bylaws, industry guidelines, standards, checklists, and Classification Societies Rules and Guidelines.	✓	✓	Prior to the operation.
2	Identify all documents, information, analysis, procedures, licenses, accreditations, etc. required by Authorities.	✓	✓	Prior to the operation.
3	Check that the bunkering equipment is certified by the relevant Classification Society (on-board equipment) or by relevant Authorities (on-shore equipment).	✓		Prior to the operation.
4	Check that the receiving ship and the bunkering facility are compatible.	✓	✓	This action should be carried out jointly by RSO and BFO.
5	Develop a specific Methanol bunkering procedure for the concerned ship and bunkering facility based on preselected Methanol bunkering guideline.	✓	✓	The Methanol bunkering procedure should take into account any instructions and check-lists issued by the Port. This procedure should be developed jointly by RSO and BFO

6	Perform the bunkering risk assessment (as part of an initial in-depth study).	✓	✓	Normally required by the Port Authorities and Flag authorities. Bunkering risk assessment study should involve RSO and BFO
7	Develop an emergency response plan and bunkering safety instructions.	✓	✓	This action should be carried out jointly by RSO and BFO with local authorities, fire brigade and hospital premises involvement
8	Ensure that all personnel involved in the bunkering operation are adequately trained.	✓	✓	
9	Develop bunkering plans and procedures reflecting the status of the facility	✓		
10	Prepare, compile and share the Methanol bunkering management plan with stakeholders		✓	

4.2 Responsibilities during Bunkering Stage

4.2.1 Port Authorities General Responsibilities

Port Authority regulations and procedures may impose requirements or criteria for:

- Accreditation of the BFO,
- Qualification of the PIC,
- Mooring of the receiving ship and bunker facility, industry standards may be referenced (e.g. OCIMF Effective Mooring 4th Edition 2019),
- Immobilisation / braking of the tank truck,
- Establishment of a Safety zone / Security zone in way of the bunkering area,
- Simultaneous operations,
- Spatial planning and approval of bunker locations,
- Enforcement,
- Use of checklists,
- Environmental protection (Releases of Methanol, Methanol Vapour, purging),
- Approval of safety and emergency response plans,
- Bunkering risk assessment, and
- Conditions in which Methanol bunkering operations are allowed: weather conditions, sea state, wind speed and visibility.

4.2.2 Methanol Bunkering Facilities Organization (BFO) responsibilities

The Methanol Bunkering Facilities Organization should be responsible for the operation of the Methanol bunkering installations including:

- Planning of the specific operation (liaising with the RSO),
- Operation of the facility in line with plans and procedures; and
- Maintenance of the bunkering equipment.

4.2.3 Receiving ship operator (RSO)

Receiving ship operator has responsibilities for bunkering operation including:

- Informing the BFO and the Port Authority in advance for necessary preparation of the bunkering operation; and
- Attending the pre-bunkering meeting to ensure compliance with local requirements for equipment, quantity and flow rate of Methanol to be bunkered, and coordination of crew and safety communication systems and procedures

4.2.4 Master

The master of the receiving ship retains overall control for the safe operation of the ship throughout the bunkering operation. If the bunkering operation deviates from the planned and agreed process the master retains the right to terminate the process.

The master has overall responsibility for the following aspects of the bunkering operation. However, these tasks may be delegated to the PIC or other responsible crew member but the overall responsibility should be retained by the master:

- Approving the quantity of Methanol to be bunkered
- Approving the temperature and delivery pressure of Methanol that is available from the bunkering facility operator. (Aspects of this may have been agreed prior to the bunkering operation as part of the Methanol supply contract)
- Ensuring that the approved safe bunkering process is followed including compliance with any environmental protection requirements required by international, national or local port regulations
- Agreeing in writing the transfer procedure, including cooling down and if necessary, gassing up; the maximum transfer rate at all stages and volume to be transferred
- Completing and signing the bunkering checklist

4.2.5 Person in Charge (PIC)

A Person in Charge of the bunkering operation (PIC) should be agreed by the receiving ship and the bunkering facility. It is noted that in case of ship-to-ship transfer the role of PIC should be undertaken by either the Master or Chief Engineer of the receiving ship, or the Master of the bunker ship or a person designated by the Master. For other bunker transfer methods, a person of equivalent authority should be selected. In the case of distinct Master and PIC, the division of responsibilities between the two parties should be agreed before commencing bunkering operations.

The PIC should have an appropriate level of competence and be accepted to operate in the bunkering location. This may require authorisation or certification to act as PIC for bunkering operations, issued by the Port Authority or other Authority with jurisdiction over the bunkering location. The PIC should have adequate education, training and authorisation to ensure safe bunkering operations.

The PIC should be responsible for the bunkering operation and for the personnel involved, in all aspects of the bunkering operation, in particular safety, until completion.

The PIC should ensure that:

- Relevant approved procedures are properly applied; and
- Safety standards are complied with, in particular within the hazardous zone and safety zone.

To achieve this, the PIC should be responsible for:

- Ensuring that company specific operating procedures are followed, and that the operation is conducted in compliance with all applicable port regulatory requirements;
- Ensuring that all required reports are made to the appropriate Authorities;
- Conducting a pre-operation safety meeting with the responsible officers of both the bunkering facility and the receiving ship;
- Ensuring that all bunkering documentation is completed (checklists, bunker delivery note, any other document (s) (for e.g. proof of sustainability certificate (as per a recognised International Certification Scheme)) as may be required by the relevant statutory authorities/ flag Administration)
- Agreeing the mooring arrangement and where applicable nominated Mooring Master during the operation
- Ensuring all safeguards and risk prevention measures are in place prior to initiating the fuel flow;
- Being familiar with the results of the location risk assessment and ensuring that all specific risk mitigation means are in place and operating (water curtain, fire protection, etc.);
- The activation of Emergency Procedures related to the bunkering system operation;
- Ensuring operation will remain within the accepted environmental window for the duration of bunkering;
- Ensuring safe procedures are followed and the connection of liquid and vapour transfer hoses and associated ERS is successfully completed;
- Ensuring the safe procedures are followed and purging and leak testing of the bunkering system prior to transfer is successfully completed;
- Monitoring fuel transfer and discharge rates including vapour management;
- Monitoring climatic conditions including lightning strikes throughout operation
- Monitoring mooring arrangement integrity (in communication with mooring master);
- Monitoring communications throughout the operation;
- Ensuring the safe procedures are followed for drainage and purging of the bunkering system prior to disconnection;
- Supervising disconnection of liquid and vapour hoses/ pipes;
- Supervising unmooring and separation of ships or in the case of truck bunkering, departure of the truck; and
- Supervising deployment/ return of fenders and/ or additional support utility to the bunker ship.

4.3 Crew and Personnel Training

4.3.1 General Methanol bunkering operational training

The RSO is responsible for ensuring that the personnel on board the receiving ship involved in the bunkering operation should be suitably trained and certified by a recognised organisation, to fulfil requirements according to STCW.7/Circ.23 “Interim guidance on training for seafarers on board ships using gases or other low flashpoint fuels and STCW.7/Add.1”.

Reference is also made to relevant sections of the STCW Code as amended.

The BFO is responsible for ensuring that all bunkering facility personnel involved with the bunkering operations are suitably trained and certified as required by the regulations governing the bunkering method.

- For ship-to-ship bunkering these are the requirements of STCW Regulation V/1-1 – “Mandatory minimum requirements for the training and qualifications of masters, officers and ratings on oil and chemical tankers” and equivalent requirements as provided by the governing authority for the inland waterway where the vessel is operating.

- For truck-to-ship or shore-based terminal-to-ship bunkering these are the requirements of the local authorities governing activities within the port area. The personnel to be trained include

but are not limited to personnel involved in Methanol bunkering, personnel from authorities and emergency response services.

The person in charge (PIC) should be trained in all aspects involving Methanol. For the introduction of Methanol bunkering operations within Port, sufficient training courses should be introduced in order to provide adequate competency to the role of PIC. This is especially the case with the development of novel bunkering systems or methods. The responsibility for verifying that the PIC is adequately trained falls on the RSO and BFO, the responsibility for certifying the PIC may be taken by the port authority.

4.3.2 Specific Methanol bunkering safety training

Each bunkering method introduces different hazards. Specific training should be developed, based on the different possible failure scenarios and external events identified during the risk assessment study. Specific safety instructions as defined in 4.1.3.1 should be prepared based on the conclusions and outputs of the Methanol Bunkering Risk Assessment.

The Methanol Bunkering safety training should cover at least:

- Sudden change of ambient / sea conditions
- Lightning Strikes
- Loss of power (receiving ship or bunkering facility),
- Loss of monitoring / control / safety systems (ESD),
- Loss of communication,
- Abnormal operating parameters, and
- Rapid situation assessment technique with focus of restabilising unstable situations.

Section 5

Technical Requirements for Methanol Bunkering Systems

5.1 General

The Methanol transfer system should be designed and the bunkering procedure carried out so as to avoid the release of Methanol or its vapours. The transfer system should be designed such that leakage from the system cannot cause danger to personnel, the receiving ship, the bunkering facility or the environment when the system is well maintained and properly used. Where any spillage of Methanol can occur provisions should be taken to protect personnel, ship's structure and equipment. The consequences of other methanol fuel-related hazards (such as flammability and toxicity) should be limited to a minimum through the arrangement of the transfer system and the corresponding equipment.

Specific means should be provided to purge the lines efficiently without the release of Methanol vapour with all purged gases either retained by the receiving ship or returned to the bunkering facility.

Accidental leakage from the Methanol liquid and/or vapour transfer systems including the connections with the receiving ship bunkering manifold and with the bunkering facility should be detected by appropriate means.

5.2 Methanol Bunker Management Plan (MBMP)

A MBMP should be developed to allow for easy availability of all relevant documentation for communication between the receiving vessel and the BFO and, if applicable, the terminal and/ or third parties. The MBMP should be prepared for the parties involved to agree technically and commercially on methodology, flow rate, temperature, pressure of the delivery of Methanol and receiving tank. This plan should contain all the information, procedures, checklist(s) and certificates essential for an effective and safe Methanol Bunkering operation. The MBMP should be referenced as part of the Quality Management System of the Receiving Ship Operator (RSO).

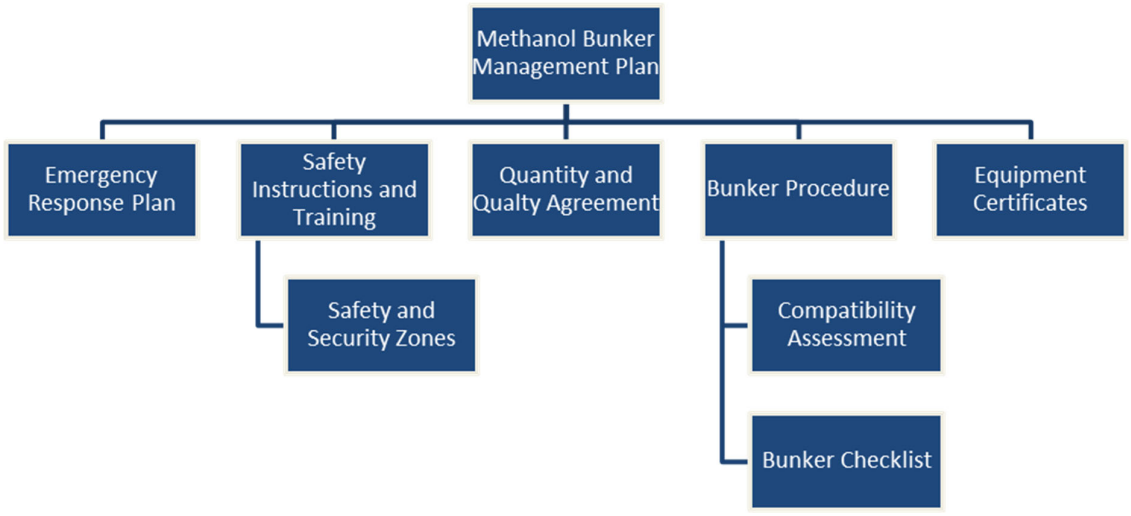

Fig 5.2: Methanol Bunker Management Plan

The MBMP should be stored and maintained by both RSO and BFO. For onboard bunkering this should include the following aspects:

- Description of Methanol, its handling hazards as a liquid and vapour, including toxicity and low flashpoint, necessary safety equipment, personal protection equipment (PPE) and description of first aid measures
- Material Safety Data Sheets for Methanol
- Description of the dangers of asphyxiation from inert gas on the ship
- Bunkering safety instructions and emergency response plan
- Description of the bunker facility Methanol tank measurement and instrumentation system for level, pressure, and temperature control
- Definition of the operating envelope for which safe Methanol bunkering operations can be undertaken in reference to temperature, pressure, maximum flow, weather and mooring restrictions etc.
- Description of all risk mitigation measures to comply with during Methanol bunkering
- Description of the hazardous areas, safety zone, and security zone and a description of the requirements in the zones to be complied with by the receiving vessel, the bunkering facilities, and if applicable the terminal and third parties
- Descriptions and diagrams of the bunker facility Methanol bunkering system, including, but not limited to, the following as applicable:
    - Recirculating and vapour return line system
    - Procedure for controlling the pressure of the receiving tank before and during bunkering
    - Methanol fuel tank pressure relief valve
    - Ventilation and inlet/outlet location
    - Inerting system and components
    - Vapour Recovery Unit
    - Gas detection system including locations of detectors and alarms
    - List of alarms or safety indication systems linked to the gas fuel installation
    - Methanol transfer line and connectors
    - Emergency Shutdown System
    - Communication systems and controls protocol
- Roles and Responsibilities of the persons involved in the Methanol Bunkering Operation

In addition to the above list of description and schematic drawings, the Methanol BMP should include:

- Documents/reports on periodic inspections of the BFO Methanol installation (components), and safety equipment.
- A checklist to verify that the ship's crew have received proper training for bunkering Methanol.
- Bunkering safety instructions and safety management plan (see below).

5.2.1 Bunkering Safety Instructions

RSO and BFO specific safety instructions should be prepared by both parties based on the conclusions and outputs of the Methanol Bunkering Operations Risk Assessment (see Section 6).

The Methanol Bunkering safety instructions should cover at least the following:

- Sudden change of ambient / sea conditions,
- Breaching of safety and security zones,
- Loss of power (receiving ship or bunkering facility),
- Loss of monitoring / control / safety systems (ESD),
- Loss of communication
- Abnormal operating parameters, and
- Impact due to Lightning strikes

In addition, the safety instructions for Methanol bunkering may contain technical, RSO and BFO company-internal and operational regulations. The safety instructions should identify conditions under which bunkering will be stopped and in each case the actions required/ conditions to be reinstated before the bunkering operation can be restarted.

5.2.2 Emergency Response Plan

An Emergency Response Plan should be prepared to address hazards, and firefighting techniques for controlling, mitigating and elimination of a gas cloud fire, jet fire and/or a Methanol pool fire.

The Emergency Response Plan should cover all emergency situations identified in the Methanol Bunkering Operations Risk Assessment and may designate responsibilities for local authorities, hospitals, local fire brigades, PIC, Master and selected personnel from the bunkering facility. As a minimum, the following situations should be covered where appropriate:

- Methanol leakage and spill on the receiving ship, on the bunkering facility or in the water body (sea, river, inland waterway) from the Methanol transfer system
- Gas detection
- Fire in the bunkering area
- Lightning Strike
- Unexpected movement of the vessel due to failure or loosening of mooring lines
- Unexpected moving of the truck tanker
- Unexpected venting on the receiving ship or on the bunkering facility
- Loss of power

5.3 Loading Arms and Hoses Arrangements

5.3.1 Transfer installation

Arrangements should be made for:

- Purging and inerting the bunkering lines (or between designated ESD valves for systems with long Methanol transfer lines) prior to the Methanol transfer,

- Draining, purging and inerting the transfer system after completion of the Methanol transfer.

Methanol and vapour transfer systems (loading arm and/or flexible hose) should be fit for Methanol bunkering operations. The hoses and loading arms should be specially designed and constructed for the transfer products (Methanol) and purging inert gas (Nitrogen).

Pressure relief devices should be provided so that the hose or loading arm is not over-pressurised (for example if the ERS is activated). Means should be provided to safely drain and collect the methanol trapped between isolating valves.

Hoses, loading arms and parts of the ship manifold should be designed for loads which may be experienced during operation such as self-weight (including fully loaded), loads due to relative motion between receiving ship and bunker supplier, and loads due to any lifting equipment used to handle the hose. The loading arms and parts of the ships manifold may also need to be designed to support the weight of an emergency release coupling.

Care should be taken when choosing the transfer system particularly with regards to:

- Potential movements between the receiving ship and the bunkering facility,
- Operating envelope of transfer system,
- Minimum bending radius allowed for hoses
- ESD system functionality
- Means of purging and draining the transfer lines,
- Material selection and structural support
- Type of connectors

- Electrical insulation
- Continuity of earthing system
- System design to address potential surge pressures developed during an ESD
- Methanol Vapour handling system, and
- Arrangements for pressure relief

5.3.2 Hoses

Hoses should comply with appropriate recognized standards and Section 8 of MSC.1/Circ.1621. Hoses must be constructed from materials compatible with methanol. These are specialized hoses, designed to handle the specific properties of methanol, including its corrosiveness and flammability.

Transfer hose manufacturer's instructions, regarding testing and number of temperature and pressure operating cycles before removal from service, should be strictly followed.

Depending on which party owns the bunkering hose, a document should be included in the MBMP and a copy kept by the receiving ship containing the following information, as applicable:

- Hose identification number
- Manufacturer's name
- Date of Manufacture
- Date of initial entry into service
- Diameter
- Minimum Bend Radius
- Working Temperature range
- Maximum Allowable Working Pressure
- Factory Test Pressure
- Materials of Construction
- Electrostatic properties and conductivity
- Initial test certificate and all subsequent test reports and certificates

Hoses should be handled with care. They should not be dragged over abrasive surfaces or sharp edges/corners.

Hoses should be subjected to hydrostatic testing once in six months, if any defects appear during this inspection, the hose should be replaced. Periodic visual inspection of the hoses both internally and externally is required; in fact, prior to and after every operation to ensure the fitness of the hoses for the current and future operations. In addition, the manufacturer of these hoses may lay down requirements relating to service life, inspection and maintenance. The manufacturer's instructions should be followed.

5.3.3 Lifting and supporting devices

The lifting devices, where fitted, should be of suitable capacity to handle the Methanol transfer hoses and associated equipment.

Hoses should be suitably supported in such a way that the allowable bending radius is satisfied. They should normally not lie directly on the ground and should be arranged with enough slack to allow for all possible movements between the receiving ship and the bunkering facility.

Lifting and supporting devices should be suitably electrically insulated and should not impair the operation of any emergency release coupling or other safety devices.

5.4 Couplings and Flanges

5.4.1 General

The use of dry disconnect couplings is recommended for day-to-day bunkering operations using small hose diameters that will require several connections and disconnections.

5.4.2 Standard

Couplings used for Methanol Bunkering operation should be designed according to the requirements provided in recognized standards which should be agreed with IRS.

5.4.3 Isolation flange

The bunker transfer system should contain an isolation flange of a non-electrically conductive material to prevent stray currents between the bunkering facility and the receiving ship. The isolation flange is generally fitted at the receiving ship end of the transfer system.

5.4.4 Spool piece

When spool pieces are used to connect to different sizes and geometries of connectors, they should be installed and leak tested as part of the preparation for bunkering. The leak testing is needed to ensure that the arrangement including spool piece is fully inerted and gas tight before transfer.

5.5 Leakage and Fire Safety

The following safety devices should be provided, as a minimum, in an enclosed or semi enclosed bunker station (on the receiving ship) or discharging station (of the bunker facility):

- Liquid detector(s), in suitable location(s) to immediately detect Methanol leakage.
- Gas detectors including Portable gas detectors to detect leakage of Methanol Vapours
- CCTVs to observe the bunkering operation from the bridge or operation control room. The CCTV should provide images of the bunker connection and also if possible the bunker hose such that movement of transfer system during bunkering are visible. CCTV is particularly recommended for bunker stations. Where CCTV is not provided, a permanent watch should be maintained from a safe location.
- Portable Thermal Imaging Cameras to detect flames due to methanol fire

Gas detectors should be connected to the ESD system for monitoring leakage on the receiving ship.

Consideration may be given to the use of thermal imaging cameras or other suitable technology (such as for leakage detection, especially in semi-enclosed bunkering stations.

A gas dispersion analysis will aid in identifying the critical locations and the extent of the LEL range where gas detectors should be fitted to enable early detection of any leakage.

Fire-fighting equipment should be provided and be ready for use within the bunkering operation area. This should include at least two hoses and two portable alcohol resistant foam extinguishers of at least 9 litres capacity.

For truck to ship bunkering, emergency eye wash stations and showers should be provided in the bunkering operation area.

5.6 ESD Systems

The bunkering facility and receiving ship should be fitted with a linked ESD system such that any activation of the ESD systems should be implemented simultaneously on both bunkering facility and receiving ship. Any pumps and vapour return compressors should be designed with consideration to surge pressure in the event of ESD activation.

The bunkering line should be designed and arranged to withstand the surge pressure that may result from the activation of the emergency release coupling and quick closing of ESD valves.

On ESD activation, manifold valves on the receiving ship and bunkering facility and any pump or compressor associated with the bunkering operation should be shut down except where this would result in a more hazardous situation (see Table 5.5).

An ESD activation should not lead to Methanol being trapped in a pipe between closed valves. An automatic system should be provided that is designed to extract the Methanol to a safe location without release to the environment.

If not demonstrated to be required at a higher value due to pressure surge considerations, a suitably selected closing time should be selected, depending on the pipe size and bunkering rate from the trigger of the alarm to full closure of the ESD valves, in accordance with the IGF Code.

The emergency shutdown system ESD should be suitable for the capacity of the installation. The minimum alarms and safety actions required for the transfer system are given in Table 5.5 below:

Table 5.5: Alarms and Safety actions recommended for the transfer system

Parameter/Alarm Trigger	Alarm	Action[1]
Low Pressure in the supply tank	✓	✓
Sudden Pressure Drop at the Transfer Pump	✓	✓
High Level in Receiving Tank	✓	✓
High Pressure in Receiving Tank	✓	✓
Methanol leakage in Bunkering Station	✓	✓
Methanol Vapour detection (as applicable	20% of LEL	Alert at 20% LEL. ESD activation at 40% LEL.
Manual activation of shutdown from either the receiving ship or the bunker facility (ESD1)	✓	✓
Safe Working Envelope of the Loading Arm exceeded	✓	✓
Fire Detection (on either the ship or bunkering facility)	✓	✓
Electrical Power Failure (For the methanol transfer system)	✓	✓

Notes:
1: Alert should be made at both the delivery and receiving ends of the transfer system to clearly identify the reasons for the ESD activation.

2: Where the parameter that triggers the ESD is such that closure of vapour connection valves and shut down of vapour return compressors would increase the potential hazard (for example a receiving tank high level alarm) these are to remain open/active where appropriate.

Alarms should be both audio and visual.

The manual activation position for the ESD system should be outside the bunker station and should have a clear view of the manifold area (the ‘clear view’ may be provided via CCTV).

Methanol bunker transfer should not be resumed until the transfer system and associated safety systems (fire detection, etc.) are returned to normal operation condition.

All electrical components of the emergency release coupling actuator and of the ESD systems that are considered as provided by the ship side should be type approved/ certified by IRS or the ship’s Classification Society. When the ESD hardware and components are part of the onshore facility they should be designed and tested according to the industry standards.

5.7 Emergency Release Coupling

5.7.1 General

Transfer hoses may be fitted with a Breakaway Release Coupling. The BRC should be subjected to a type test to confirm the values of axial and shear forces at which it automatically separates.

Transfer arms should be fitted with an Emergency Release Coupling designed to minimize the release of Methanol on emergency disconnection.

The ERC may be designed for:

- Manual or automatic activation, and
- Activation as a result of excessive forces i.e. automatic disconnection in case the safe working envelope of the transfer system is exceeded.

For a BRC and an ERC, the tightness of the self-closing shut-off valves after separation should be checked.

The ERC should be designed and installed so that, in the worst allowable conditions for current, waves and wind declared in the bunkering conditions, it will not be subjected to excessive axial and shear forces likely to result in the loss of tightness or opening of the coupling. When the Safe working envelope of the transfer system is exceeded, the ERC system should be triggered.

Means should be provided in order to avoid a pressure surge in the bunker hose after release of the ERC when the connecting end of the hose is fitted with a dry disconnect coupling type.

Full operating instructions, testing and inspection schedules, necessary records and any limitations of all emergency release systems should be detailed in the ship's operating manuals.

5.7.2 ERC Activation

Where manual activation type ERC is fitted, the means of remotely operating the ERC should be positioned in a suitability protected area both on bunkering facility and receiving ship allowing visual monitoring of the bunkering system operation. A physical ESD link should bond the two parties. This does not apply to a dry breakaway coupling as this is a passive component which cannot be remotely activated.

5.7.3 Hose Handling after ERC Release

An integrated hose/ support handling system should be in place, capable of handling and controlling the bunker transfer hoses after release of the ERC. In addition, it should be capable of absorbing all shock loadings imposed by the release of ERC during maximum capacity transfer conditions.

The system should ensure that, as far as practicable, upon release the hoses, couplings and supports do not contact the metal structure of the ship and bunkering facility, thereby reducing the risk of sparking at the contact point, injury to personnel or mechanical damage.

5.8 Communication Systems

A communication system with back-up should be provided between the bunkering facility and the receiving ship.

The components of the communication system located in hazardous and safety zones should be type approved according to IEC 60079.

5.9 Bunkering Transfer Rate

The Methanol transfer rate from the BFO should be adjusted, taking into consideration:

- Initial flow rate
- Maximum allowable flow rate of the bunker station manifold
- Flow rate for topping up operations for the fuel tank
- Management of the flash gas generated during bunkering
- Temperature of the Methanol supplied from the bunkering facility
- Temperature of the Methanol remaining in the receiving ship tank, and
- Pressure in both bunkering facility tank and receiving ship tank

Adequate provisions should be made for the management of the Methanol vapours generated during the bunkering operation, without release to the atmosphere.

In the initial phase, the maximum velocity of the methanol in the should not exceed 1 m/s. The maximum Methanol velocity in the piping system may be ramped up after the initial phase but however should not exceed 7 m/sec under the rated equipment capacity to avoid the generation of static electricity, additional heat, and consecutive boil off gas due to nonlinear flow.

5.10 Vapour Return Line

Vapour return line(s) may be used to control the pressure in the receiving tank or to reduce the time required for bunkering (refer to Section 8.2.4.6). The important factors that will affect the amount of flash gas generation in a typical bunkering operation are as follows:

- Difference in the conditions prevailing between the bunkering facility tanks and the receiving tanks (particularly the temperature of the receiving tank)
- Transfer rates (ramp up, full flow, ramp down/ topping up)
- Heat gain in pipeline between bunkering facility tank and receiving ship tank
- Pumping energy

5.11 Lighting

Lighting should illuminate the bunker station area, and, if installed in a hazardous area, should be compliant with applicable hazardous area equipment requirements. It is recommended that the following areas are adequately illuminated:

- Methanol bunker hose(s),
- Connection and couplings on both receiving ship and bunkering facility
- ESD system call points
- Communication systems
- Fire-fighting equipment
- Passageways / gangways intended to be used by the personnel in charge of the bunkering operation, and
- Vent mast(s)

Section 6

Risk Assessment of Methanol Bunkering Operations

6.1 General

A risk assessment of the bunkering operations should be undertaken.

The objectives of this risk assessment are to:

- demonstrate that risks to people and the environment have been identified and eliminated where possible, and if not, mitigated as necessary, and
- provide insight and information to help set the required safety zone and security zone around the bunkering operation

In order to meet these objectives, the bunkering operations risk assessment should cover the following operations as a minimum:

- Preparations prior to and on ship's arrival, approach and mooring
- Preparation, testing and connection of equipment
- Methanol transfer and Methanol vapour management
- Completion of bunker transfer and disconnection of equipment
- Simultaneous operations (SIMOPS)

6.2 Risk Assessment Approach

6.2.1 Qualitative Risk Assessment

A Qualitative Risk Assessment (QualRA) should be undertaken prior to introduction of a new bunkering operation procedure that follows the guidance in this document.

Provided the bunkering operation is one of the three standard bunkering scenarios below, and guidance in this document is followed, i.e. there are no deviations from the functional requirements, then the qualitative approach is considered sufficient to meet the objectives of the bunkering operations risk assessment.

Standard bunkering is characterised by three bunkering scenarios:

- Shore-to-ship (that is, Methanol transfer from an onshore facility to a Methanol fuelled ship)
- Truck-to-ship (that is, Methanol transfer from a road truck to a Methanol fuelled ship)
- Ship-to-ship (that is, Methanol transfer from a ship, such as a bunker barge, to a Methanol fuelled ship)

6.2.2 Quantitative Risk Assessment

As a supplement to the Qualitative Risk Analysis, a Quantitative Risk Assessment (QRA) should be required where:

- bunkering is not of a standard type
- design, arrangements and operations differ from the guidance given in this document; and
- bunkering is undertaken alongside other transfer operations (SIMOPS),

A QRA is also appropriate where further insight is required to: judge the overall level of risk (since this is not typically provided by a Qualitative Risk Analysis); appraise design options and mitigation alternatives; and/or to support a reduced safety zone and/or security zone.

The requirement for a QRA (in addition to a Qualitative Risk Analysis) is normally determined by the Administration or Port Authority based on the conclusions and outcomes of the Qualitative Risk Analysis and accepted by the concerned parties.

The Quantitative Risk Analysis should also, in addition to gas dispersion analyses consider – thermal radiation and explosion shock wave.

6.2.3 Scope of Risk Assessment

As a minimum the risk assessment should detail:

- How the bunkering operation could potentially cause harm. That is, systematic identification of potential accidents/incidents that could result in fatality or injury or damage to the environment
- The severity of harm. That is, the worst-case consequences of the accidents/incidents identified above in terms of single, multiple fatalities, severe injuries etc. and environmental damage caused
- The likelihood of harm. That is, the probability or frequency with which the worst-case consequences might occur;
- Risk – which is a combination of likelihood and severity
- How the functional requirements are met.

In addition, the risk assessment should help identify the scenarios to be used to determine the safety zone; and as a minimum, consider SIMOPS within the safety zone.

Qualitative Risk Analysis and QRA approaches should be selected using recognized standards or established best practices. These approaches or similarly established approaches should be used provided they cover the items above.

The risk assessment should be carried out by a team of suitably qualified and experienced experts with collective knowledge of, and expertise of risk assessment application; engineering design; emergency response, and bunkering operations.

6.2.4 Risk Acceptance Criteria

Risk Acceptance Criteria for Qualitative Risk Analysis and Quantitative Risk Analysis should be defined and submitted to IRS. These should also be agreed with the Administration and/or Local Authority. Recognized Standards may be referred to develop the Risk Acceptance Criteria.

6.3 Risk Assessment for SIMOPS

Where it is proposed to carry out bunkering operations concurrently with other operations that may impact or be impacted by the bunkering then further risk assessment should be carried out to demonstrate that the required level of safety can be maintained. The other operations may include but may not be limited to:

- Cargo handling
- Ballasting operations
- Passenger embarking / disembarking
- Dangerous goods loading / unloading and any kind of other goods loading or unloading (i.e. stores and provisions)

- Chemical products handling
- Other low-flash point products handling
- Bunkering of fuels other than Methanol

Simultaneous operations should be investigated for any of the above activities occurring within the safety zone calculated as described in Section 7.

Any simultaneous shipboard technical operations such as testing of systems that might affect the stability of the receiving ship, for example, changes to the mooring situation, testing of power generations systems or fire-fighting systems, should not be be carried out during Methanol bunkering operations.

Section 7

Safety and Security Zones

7.1 General

A safety zone and a security zone should be established around the bunkering operation by evaluating the hazardous area zones as elaborated in Section 7.2. These zones are in addition to the established practice of setting hazardous area classification zones that will be required around areas with potential for explosive atmospheres such as the bunkering connections

Both the safety and security zones should be enforced and monitored at all times during bunkering, at all other times these zones may not be enforced.

The purpose of the safety zone is to set an area within which only essential personnel are allowed and potential ignition sources are controlled. The zone is also to ensure personnel are not exposed to toxicity levels above permissible limits. Essential personnel are those required to monitor and control the bunkering operation. Similarly, the purpose of the security zone is to set an area within which ship/port traffic is monitored and controlled.

Together, the safety and security zones help further minimise the likelihood of a fuel release, its possible ignition and toxicity and help protect individuals and property via physical separation.

7.2 Hazardous Area Classification

Bunkering-related hazardous areas means any hazardous area zone 1 and zone 2 defined for:

- The receiving ship in accordance with MSC.1/Circ.1621, Section 12
- The bunkering ship in accordance with IEC 60079-10-1

Hazardous areas should be determined using recognized standards or quantitative techniques (when prescriptive safety distances are not available).

In the hazardous area, only electrical equipment certified in accordance with IEC 60079 is permitted. Other electrical equipment should be de-energised prior to the bunkering operations. Attention is drawn to the following equipment, which is not intrinsically safe and should therefore be disabled, except if otherwise justified:

- Radar equipment, which may emit high power densities
- Other electrical equipment of the ship, such as radio equipment and satellite communication equipment, when they may cause arcing.

7.3 Safety Zones

In the safety zone, the following restrictions normally apply during the bunkering operations, except if otherwise justified by the safety analysis or agreed by the Local Port Authorities or National Administration:

- Smoking is not permitted.
- Naked lights, flashlights, mobile phones, laptops, tablets, cameras (except thermal imaging cameras of a certified type) and other non-certified portable electrical equipment are strictly prohibited.
- Cranes and other lifting appliances not essential to the bunkering operation should not be operated.

- No vehicle (except the tank truck) should be present in the safety zone
- No ship or craft should normally enter the safety zone, except if duly authorised by the Port Authorities.
- Other possible sources of ignition should be identified and eliminated
- Access to the safety zone is restricted to the authorised staff, provided they are equipped with personal protective equipment (PPE) provided as below taking into account the possibility of exposure to either methanol or it's vapours or both of these:
    - Fire Retardant Clothing
    - Coverall suitable for handling methanol (to be used when connecting and disconnecting hoses or loading arms)
    - Gloves suitable for handling of methanol (to be used when connecting and disconnecting hoses or loading arms or sampling (if required by the flag administration or national authority))(butyl or nitryl material)
    - Safety Shoes
    - Hardhat
    - Safety Glasses
        - Safety goggles or
        - Face Shields
    - Respiratory Protection
    - Methanol exposure monitor
    - Self-contained breathing apparatus

7.3.1 Determination of the safety zone distance

There are two different approaches which are outlined in the following paragraphs**.** Notwithstanding 7.3.1.1 and 7.3.1.2, the safety zone should not be considered less than 16m.

7.3.1.1 Deterministic approach

The safety zone should be set based upon the flammable extent of a maximum credible release scenario. This approach to setting the safety zone is referred to as the 'deterministic approach'. Specific requirements for the determination of the safety zone may be set by national and local authorities.

The flammable extent is the distance at which the lower flammable limit (LFL) is reached as the vapour/gas (from the released fuel) disperses in the atmosphere. For Methanol, the LFL is approximately 6% in air.

As a minimum, the following information should be taken into account in the maximum credible release scenario:

- The physical properties of the released methanol
- Weather conditions at the bunkering location; wind speed, humidity, air temperature and the temperature of the surface upon which the fuel leaks. The chosen conditions should reflect the worst-case conditions that result in the greatest distance to LFL
- Roughness of the surface over which the vapour/gas disperses, (i.e. land or water).
- Structures and physical features that that could significantly increase or decrease dispersion distances.
- Release rate, release orientation, available inventory and rate of vapour generation.

In addition, release height is to be considered as this can significantly affect the extent of the calculated safety zone. The vertical extent of the safety zone may require special consideration, especially in cases where persons can be at elevated positions, such as located in cabins many metres above the bunker station.

Large objects, such as buildings and ships, and topography, such as cliffs and sloping ground, can constrain or direct dispersion. This should be recognised in setting the safety zone. Failure to do this can result in inappropriate safety zones that include areas that would not be affected by any release of natural gas or exclude areas that would be affected if there was a release. Advanced modelling techniques, such as computational fluid dynamics (CFD) should be utilized to justify the zone's shape and extent.

Regardless of the technique(s) used in setting the safety zone it should be applied by a suitably qualified and experienced individual.

The following credible release scenarios should be considered as minimum:

- A release of the 'trapped inventory' between emergency shutdown valves in the liquid bunkering line (i.e. bunker hose), and
- 'continuous release' from an instrument connection where emergency valves do not close to isolate the release and delivery pressure is maintained

Other credible release scenarios should be identified during the risk assessment. The effects of toxicity should also be considered when determining the size and extent of the safety zone.

7.3.1.2 Quantitative Risk Analysis

QRA based approach may also be utilized whereby consideration is given within a predefined scenario to a representative set of potential releases and the likelihood with which they occur.

Notwithstanding, the outcome of the QRA, the Safety Zone should at least extend beyond the hazardous areas and/or the minimum distance defined by the authorities from any part of the bunkering installation.

A key feature of QRA is that it accounts for both the consequence and likelihood of releases and can consider the location of people, the probability of ignition, and the effectiveness of mitigation measures and other emergency actions. As such, it can provide increased understanding of those releases that contribute most to the risk, and this can be useful in identifying and testing the suitability of mitigation measures and optimizing zone extent. If this approach is selected, then it is important that appropriate risk criteria are used.

7.4 Security Zones

A security zone should be set based upon ship/ port operations. In setting the zone, consideration should be given to activities and installations that could endanger the bunkering operation or exacerbate an emergency situation. For example, consideration of the following is required when setting the security zone:

- Other ship/ship movements
- Surrounding road traffic, industrial plants, factories and public facilities
- Crane and other loading/unloading operations
- Construction and maintenance works
- Utilities and telecommunication activities and infrastructure

It is likely that most or all of the above factors are considered in the risk assessment described in this document. Therefore, to help inform setting of the zone, reference should be made to this risk assessment.

Section 8

Requirements for Methanol Bunkering Operations

8.1 Pre-Bunkering Phase

8.1.1 General

The pre-bunkering phase starts from the first communication between receiving ship and bunkering facility for ordering a bunker of Methanol and ends with the physical connection of the bunker line to the bunker station.

8.1.2 Goal

The goal of the pre-bunkering phase is the preparation and the completion of a safe connection between the transfer systems of the bunkering facility and the receiving ship.

8.1.3 Functional Requirements

The following functional requirements should be considered during the pre-bunkering phase:

- The risk assessment has been conducted on both the BFO and RSO sides and the findings have been implemented
- A Methanol Bunker Management Plan has been established and is applicable to the ship.
- A compatibility check demonstrates that the safety and bunkering systems of the bunkering facility and the ship to be bunkered match
- The relevant authorities have been informed regarding the Methanol bunkering operation.
- The permission for the transfer operation is available from the relevant authority
- The boundary conditions such as transfer rate, vapour handling and loading limit have been agreed between the supplier and the ship to be bunkered
- The fuel tank(s) to be bunkered are in a state of readiness for bunkering
- Initial checks of the bunkering and safety system are conducted to ensure a safe transfer of Methanol during the bunkering phase.

8.1.4 General Requirements

8.1.4.1 Personnel on Duty

During the transfer operation, personnel in the safety zone (please also refer 4.1.2) should be limited to essential staff only. All staff engaged in duties or working in the vicinity of the operations should wear appropriate personal protective equipment (PPE) and an individual portable gas detector and thermal imaging camera as required by the Methanol Bunker Management Plan.

8.1.4.2 Compatibility Assessment

A compatibility assessment of the bunkering facility and receiving ship should be undertaken prior to confirming the bunkering operation to identify any aspects that require particular management.

The compatibility assessment should be undertaken with the assistance of an appropriate Checklist to be completed and agreed by Master(s) and PIC prior to engaging in the bunkering operation.

As a minimum, compatibility of the following equipment and installation should be checked prior to engaging further in any Methanol bunkering operation:

- Communication system (hardware, software if any and language) between the PIC, ship's crew and BFO personnel
- ESD system
- Bunker connection
- Emergency release system (ERS) or coupling (ERC)
- Methanol Vapour return line when appropriate
- Nitrogen lines availability and connection
- Mooring equipment
- Bunker Station location
- Transfer system sizing and loading on manifold
- Location of ERS
- Closure speed of valves
- HAZOP results as applicable

8.1.5 Preparation for Bunker Transfer

8.1.5.1 Environmental Conditions

The environmental conditions (weather (especially lightening), sea state, temperature, and visibility limitation such as fog or mist) should be acceptable in terms of safety for all the parties involved.

8.1.5.2 Mooring

8.1.5.2.1 Mooring Condition of Receiving Ship

The ship should be securely moored to the bunker supplier to prevent excessive relative movement during the bunkering operation. The effect of swell due to ships passing in the waterway, channel or port area should also be considered.

8.1.5.2.2 Mooring condition of bunker ship

For ship-to-ship bunkering the bunker ship should be securely moored according to the result of the compatibility check, so that excessive movements and overstressing of the bunkering connections can be avoided. Refer to 8.1.7.3 below. For the mooring of the bunker ship the limiting conditions should be considered such as weather, tide, strong wind, waves and current.

8.1.5.2.3 Parking condition of Methanol Truck(s)

The Methanol trucks should be securely parked, to prevent unintended movements.

All ignition sources linked to the truck should be managed in accordance with the bunkering management plan/procedure taking into account Hazardous areas and Safety Zones. Any situation whereby this requirement cannot be met, special consideration must be provided (i.e. non-standard) to ensure the risk of ignition is managed to ALARP.

In any case, the truck(s) engine(s) should not be running during connection and disconnection of the transfer system.

The Methanol truck(s) should be electrically earthed.

If multiple trucks are utilized in the bunkering operation, then they must be suitably located so that an incident with one truck does not affect the safety of the other trucks and the ship.

8.1.5.3 Communication

Communication should be satisfactorily established between the bunkering facility and the receiving ship prior to any transfer operation. If they are to be used, visible signals should be agreed by and clear to all the personnel involved in the Methanol bunkering operation.

In case of communication failure, bunkering operations should be stopped and not resumed until communication is re-established.

8.1.5.4 Agreement of Transfer Conditions

The following should be agreed before commencing the bunker transfer:

- Transfer time, temperature and pressure of the delivered Methanol, pressure inside the receiving ship tank, delivery line measurement, vapour return line measurement (if any) should be agreed and checked prior to engaging in any Methanol Bunkering Operation.
- The Methanol temperature ranges that the receiving ship can handle should be stated by the receiving ship.
- Liquid levels, temperature and pressure for the Methanol bunker tanks of the receiving ship should be checked and noted on the bunkering checklist.
- The maximum loading level and transfer rate. This includes the pressure capacity of pumps and relieving devices in the connected transfer system.

The agreed transfer conditions should be included in the Methanol Bunker Management Plan.

8.1.5.5 Individual Safety Equipment in Place

All personnel involved in the Methanol bunkering operation should properly wear adequate Personal Protective Equipment (PPE) (please also see section 7.3). It should be ensured that all the PPEs have been checked for compliance and are ready and suitable for use. Eye Wash and Showers should also be in a state of readiness in the vicinity for ready use

8.1.5.6 Spill Protection

A drip tray of suitable size and suitable material compatible with Methanol may be fitted below the pipe coupling to collect the Methanol spill and convey it to a safe location.

It is recommended that spill protection is also provided for the BFO equipment, this may be governed by local regulations for truck-to-ship bunkering and shore-based facilities.

8.1.5.7 Safety Zone requirements and mark out

- The boundaries of the safety zone associated with bunker station and BFO connection should be clearly marked out
- Any non-Ex equipment installed in hazardous areas and/or in safety zone, such as the bunker station, should be electrically isolated before the bunkering operation commences and throughout the bunkering process until such time as the area is free of any gas leak hazard. Any such arrangement where there is non-Ex rated equipment installed in a hazardous zone should be subject to special consideration by IRS.
- Radio communications equipment not needed during bunkering and cell phones should be switched off as appropriate

8.1.5.8 Readiness of Fuel Tank to Receive Methanol Bunker

The fuel tank should be in a state of readiness to receive Methanol Bunker in accordance with the Fuel Handling Manual (as required by MSC.1/Circ.1621). The following aspects are recommended to be nonetheless confirmed to the extent practicable:

- Tank should be free from contaminants (this is especially relevant if the ship is returning from drydock or repairs where fuel tank entry had carried out)
- Tanks should be gas free and inerted
    - Inerting should have been carried out using nitrogen such that the oxygen content in the atmosphere within the tank is below 2%
    - Oxygen content is measured using a calibrated instrument
- Tank should be free of water
- Tank vapour return lines should be operational
- Level of liquid methanol in the tank is confirmed
- Temperature monitoring system for the tank is operational

8.1.5.9 Electric Isolation

A single isolation flange should be provided, in each arm or hose of the transfer system, between the receiving ship manifold and the bunker pipeline. The installation should not permit shorting out of this insulation for example by, leaving the flange resting in stainless steel drip tray. This flange prevents galvanic current flow between the receiving ship and the bunkering facility. Steel to steel contact between receiving ship and bunkering facility e.g. via mooring lines, ladders, gangways, chains for fender support etc. should be avoided through the use of insulation. Bunker hoses/ pipes should be supported and isolated to prevent electrical contact with the receiving ship.

When bunkering from trucks, the truck should be grounded to an earthing point at the quay to prevent static electricity build up. Where approval has been given for the bunkering truck to be parked on the deck of the ship then the truck should be grounded to the receiving ship.

Ship-shore bonding cables/ straps should not be used unless required by national or local regulations.

If national or local regulations require a bonding cable/ strap to be used, the circuit continuity should be made via a ‘certified safe’ switch (e.g. one housed inside a flame proof enclosure) and the connection on board the receiving ship should be in a location remote safe area from the hazardous area. The switch should not be closed until the bonding cable/ strap has been connected, and it should be opened prior to disconnection of the bonding strap.

8.1.5.10 ERS

Simulated testing of all types of coupling having the function of ERC within the ERS should be performed according to a recognised standard. Testing records should be retained with the bunkering operator or organisation responsible for such equipment ready for immediate inspection by authorities. Any transfer /support system should be proved operational (if necessary, by inspection of marine loading arm or supported hose) and be confirmed as part of the pre-transfer checklist.

Testing of the system prior to each bunkering operation should prove all components are satisfactory, with the exception of actually releasing the ERC. The system used to link the ERS system with the ships’ ESD1 trip circuit should be tested and proved operational.

8.1.5.11 Emergency Release Coupling

The disconnection can be triggered manually or automatically. In either case, activation of the ERS system should trigger activation of the ESD (ESD1) before release of the ERC (ESD2).

Where applicable, step-by-step operating instructions should be permanently affixed to the ERC equipment and all personnel involved in its operations should be trained and made familiar with its correct use. Additionally, clear procedures should be in place identifying the process for authorization to remotely activate the ERC.

In the event of ESD2 activation, i.e. ERC sudden release triggered due to emergency event or overstress on the transfer line induced by ship movement, the backlashing hoses can damage hull structure and injure personnel in the absence of an appropriate supporting arrangement. This supporting arrangement, if fitted, should not prevent the correct operation of the ERC, any relative motion between the receiving ship and the bunkering facility should act directly on the ERC to ensure its correct operation if the event of vessel drift or unexpected truck movement.

Routine inspection and testing of the release equipment is required. Responsibility for this testing will depend on agreements between the BFO and RSO.

8.1.5.12 ESD Testing

The bunkering facility and receiving ship should both test their emergency shutdown systems not more than 24 hours before bunkering operations commence. The PIC should then be advised of the successful completion of these tests. These tests should be documented in accordance with the bunkering procedure.

8.1.5.13 Visual inspection of bunker hose or arm before physical connection

Bunker hoses and connecting systems should be visually examined for wear and tear, physical damage and cleanliness. If any defects are found during this inspection, the bunkering operation is cancelled until the transfer hose is replaced.

8.1.5.14 Liquid and gas leakage detection systems activated

The gas detection system as described in Section 5.4 should be activated. Sensors to detect leakage should be installed in the bunker station below the drip tray and their calibration(s) should be checked. Their function should also be tested. Portable Thermal Imaging Cameras to detect methanol fires should also be checked and confirmed to be in a state of readiness.

8.1.5.15 Preparation of the transfer system

The piping at the bunkering facility should be inerted prior to the connection with the ship to be bunkered. If this operation may cause any specific hazards when connecting to the transfer line it should be carried out after the connection has been carried out. Connections to the bunkering facility and the receiving ship should be visually checked and if necessary retightened. During this operation there should be no release of any Methanol liquid or vapour.

8.1.6 Pre-Bunkering Checklist

The MBMP should include a checklist to be used during Methanol bunkering operation by all involved personnel. This checklist should be elaborated once the full agreement on procedures to apply, equipment to be used, quantity and quality of Methanol to bunker, training, etc. is obtained by all involved parties.

8.1.7 Connection of the Transfer System

8.1.7.1 Connecting

Equipment utilised with the transfer system such as couplings and hoses should be approved and tested both before and after installation. For emergency release coupling requirements (ERC), see Section 5.6.

The transfer system should be connected such that all the forces acting during the transfer operation are within the operating range.

8.1.7.2 Condition of Flange and Sealing Surfaces prior to connection

During connecting of the transfer system, humidity at the flange mating surfaces should be avoided and it should be ensured that all mating surfaces are clean. When necessary, compressed air should be used for cleaning the contact surface of flanges and seals before physical connection and clamping of the couplings. Heating of the connections to dry them prior to connecting may also be considered in some circumstances.

8.1.7.3 Minimum Bending Radius of Hose

Hoses should be suitably supported in a manner that the minimum acceptable bending radius according to the qualification standard of the hose is not exceeded. Equipment utilised with the transfer system such as hose rests, saddles, and guidance systems (as applicable) should be approved and tested.

A Methanol transfer hose should normally not lie directly on the deck plate and should be isolated from the deck. As a minimum, suitable protection such as wooden boards should also be provided to avoid damage from friction on the quay.

8.1.7.4 Transfer Line Purging

After connection of the transfer system, it should be purged to ensure that no oxygen or humidity remains in the transfer system. Nitrogen should be used for purging.

Attention is drawn to quantity of the inert gas used for purging / inerting, which may result in high inert gas content in the Methanol tank of the receiving ship, which may affect the proper operation of engines. A typical purging sequence of the transfer line involves the injection of six times the volume of the bunker line. The volume of inert gas required may be minimised by the design of the transfer system (i.e. using shorter lengths of hose).

8.1.7.5 Transfer Line Pressure Testing

During inerting of the transfer system, the leak test according to the bunkering procedure should be carried out. As a minimum, a leak test of the connection points and flanges in the system from the bunkering facility up to the ESD valve on the receiving ship should be performed prior to any transfer operation.

8.2 Bunkering Phase

8.2.1 Definition

The bunkering phase begins after the physical connection between the bunkering facility and the receiving ship's bunker station has been safely completed with the opening of the Methanol transfer valve from the bunker ship, the truck tanker or the onshore bunkering facility.

It is followed by the Methanol bunker transfer and ends at the end of the topping up phase and the closure of the Methanol valve from the bunkering facility.

8.2.2 Goal

Transfer of the required quantity of Methanol without release of Methanol and/or Methanol vapour to the surrounding environment in a safe and efficient operation.

8.2.3 Functional requirements

- A suitable ESD and ERS system should be provided for the transfer system.
- After connection of the transfer system, Methanol transfer should be carried out in accordance with the specification of the transfer system and the receiving tank supplier requirements

- Methanol vapour should not be released to atmosphere during normal transfer operations.
- Bunker lines, transfer system and tank condition should be continuously monitored for the duration of the transfer operation.

8.2.4 General Requirements

8.2.4.1 ERS

The ERS control signals and actuators should be checked and tested and should be ready for use.

The mechanical release mechanism of the ERS system should be proven operational and ready for use before fuel bunkering operation commences.

8.2.4.2 ESD Connection Testing

It should be ensured that a linked ESD system connected, tested and ready for use is available.

The ESD system should be tested following completion of manifold connection and ESD link. The testing should take place between the receiving ship and the bunkering facility prior to commencement of operation to confirm that the systems are compatible and correctly connected. The initiation of the ESD1 signal should be done from either one of the receiving ship or the bunkering facility.

8.2.4.3 Main Bunker Transfer

After proper cooling down of the transfer system and a stable condition of the system the transfer rate can be increased to the agreed amount according to the bunkering procedure. The transfer process should be continuously monitored with regard to the operating limits of the system.

If there are any deviations from the operation limits of the system the transfer of Methanol should be immediately stopped.

8.2.4.4 Monitoring Pressure and Temperature

Receiving tank pressure and temperature should be monitored and controlled during the bunkering process to prevent over pressurisation and subsequent release of Methanol or Methanol Vapour through the tank pressure relief valve and the vent mast.

8.2.4.5 Vapour Management

The vapour management methodology will vary depending on tank type, system type and system condition, but should be agreed on during the compatibility check. For gravity tanks a vapour return line may be used but also other systems like methanol condenser units or pressurised auxiliary systems can also be used to regulate the pressure of the return vapour.

8.2.4.6 Topping up of the Tank

The topping up of the tank should be carefully examined by the PIC and/or the Chief Engineer monitoring the filling up of the Methanol tank(s). The Methanol fuel transfer flow rate should be slowed with an appropriate declining value when the receiving tank Methanol level approaches the agreed loading limit. The loading limit of the tank and the tank pressure should be paid special attention to by the PIC during this step. The opening of the Tank's Pressure Relief Valve (PRV) due to overpressure in tank, for example following overfilling, should be avoided.

8.2.4.7 Selection of Measuring Equipment

The impact on the safety of the transfer system by any equipment used for the measurement of Methanol quantity during the bunkering operation should be considered. The measurement method selected, and the equipment used (flow meters, etc.), should minimise disruption to the flow of Methanol to prevent pressure surge, excess flash gas generation, or pressure losses in the transfer system.

8.3 Bunkering Completion Phase

8.3.1 Definition

The post bunkering phase begins once the bunker transfer (final topping up phase) has been completed and the bunkering facility Methanol delivering valve has been closed. It ends once the receiving ship and bunkering facility have safely separated and all required documentation has been completed.

8.3.2 Goal

This phase should secure a safe separation of the transfer systems of the receiving ship and bunkering facility without release of Methanol or Methanol vapours to the surrounding environment.

8.3.3 Functional Requirements

The following functional requirements should be considered during the Post Bunkering Phase:

- The draining, purging and inerting sequences as described in 8.3.4 below for the different bunkering cases are fulfilled without release of Methanol or Methanol vapour to the atmosphere.
- The securing and safe storage of transfer system equipment is ensured
- The unmooring operation and separation of ship(s) is completed safely.

8.3.4 Draining, Purging and Inerting Sequence

This part of the process is intended to ensure that the transfer system is in a safe condition before separation, the couplings should not be separated unless there is an inert atmosphere on both sides of the coupling.

The details of this process will be design dependent but should include the following steps:

- Shut down of the supply.
- Safe isolation of the supply.
- Draining of any remaining Methanol out of the transfer system.
- Purging of Methanol and Methanol Vapour from the transfer system
- Safe separation of the transfer system coupling(s).
- Safe storage of the transfer system equipment in a manner that the introduction of moisture or oxygen into the system is prohibited.

8.3.4.1 Methanol Bunkering from Truck to Ship

The process of purging and inerting will follow the general outline described above, all purged gasses should be safely disposed off at a safe location.

8.3.4.2 Methanol Bunkering from Ship to Ship

The process of purging and inerting will follow the general outline described above, all purged gasses should be safely disposed off at a safe location.

8.3.4.3 Methanol Bunkering from Terminal

The process of purging and inerting will follow the general outline described above, all purged gasses are generally returned to the shore facility.

8.3.5 Post Bunkering Documentation

Upon completion of bunkering operations, the checklist in the MBMP (as described in the pre-bunkering section above) should be completed to document that the operation has been concluded in accordance with the agreed safe procedure. The vessel PIC should receive and sign a Bunker Delivery Note for the fuel delivered, sample details of a bunker delivery note are shown in Annex C. The bunker delivery note may need to be accompanied by any other document (s) (for e.g. proof of sustainability certificate (as per a recognized International Certification Scheme)) as may be required by the relevant statutory authorities/ flag Administration.

Annex A: Guidance on HAZID and HAZOP for Methanol Bunkering Operations

This annex presents the minimum scope for the HAZID and HAZOP related to Methanol Bunkering

A.1 HAZID

A.1.1 Objective

The principal objectives of the HAZID should be to identify:

- Hazards and how they can be realised (i.e. the accident scenarios)
- The consequences that may result
- Existing measures/safeguards that minimise leaks, ignition and potential consequences, and maximise spill containment; and
- Recommendations to eliminate or minimise risks

A.1.2 Scope

As a minimum the HAZID should include the scope as described in Section 6. It should be complemented with an HAZOP (Hazard and Operability) assessment after all safeguards have been implemented.

A.1.3 HAZID Process

The HAZID process should be carried out in accordance with a recognised technique using experienced subject matter experts. It is recommended that professional guidance is sought to ensure that the process is carried out to an adequate and appropriate level of detail.

The outcomes of the HAZID include hazard rankings and recommendations for additional safeguards and analysis. This may include detailed analysis or studies to establish that the measure in place meet the acceptance criteria agreed by the Administration.

A.1.4 Technique

To facilitate the HAZID process, the bunkering process may be divided into smaller steps each of which are then addressed systematically:

It is recommended that the following list is used to structure the HAZID exercise for Methanol bunkering

- Preparation (compatibility, testing, mooring)
- Connection
- Inerting of relevant pipe sections
- Transfer start
- Transfer at nominal flow
- Transfer stop including topping-up
- Draining & purging
- Inerting
- Disconnection
- Debriefing
- Security

A.1.5 Guidewords

The following guidewords may be used to help the HAZID Process:

Leakage	Vapour management during bunkering	Potential fire & explosion
Rupture	Control failure	Excessive transfer rate
Corrosion	ESD valves control failure	Hydraulic Power Unit failure
Impact	ERC actuator failure	Communication failure
Fire/Explosion	ERC spring failure causing not closing	Black out
Structural integrity	Loss of containment (piping, valves)	Relative motions of vessels
Mechanical failure	Hose damage	SIMOPS
Control/electrical failure	Hose rupture	Unexpected venting
Human error	Major structural damage	Harsh weather
Manufacturing defects	Vapour leak	Lightning Strikes
Material selection	Vapour dispersion	
Flange or connector failure	Vapour in air intake	

A.2 HAZOP

A.2.1 Definition

The HAZOP study is a structured and methodical examination of a planned process or operation in order to identify causes and consequences from a deviation to ensure the ability of equipment to perform in accordance with the design intent. It aims to ensure that appropriate safeguards are in place to help prevent accidents. Guidewords are used in combination with process conditions to systematically consider all credible deviations from normal conditions.

A.2.2 Process

The HAZOP should be realised with a focus on the Methanol bunkering, storage and delivery to the engines. The operational modes for the receiving ship to be considered are:

- Start-up
- Normal Operations
- Normal Shutdown, and
- Emergency Shutdown

A.2.3 Scope

The HAZOP should review the following cases but not be limited to:

- Joining together of the emergency shutdown systems of the Bunkering Facility, Receiving Ship and transfer system
- Emergency procedures in the event of abnormal operations
- Leakage from hoses
- Overpressure of the Methanol Tank
- Emergency unmooring
- Emergency venting of Methanol or Methanol Vapour
- Emergency shut down and quick release protocol
- Requirements for external assistance such as tugs
- Loss of power

The following should be analysed:

- Connection
- Inerting of piping
- Transfer start
- Transfer at nominal flow
- Transfer stop including topping-up
- Draining
- Inerting
- Disconnection
- Fatigue, stress and human errors

It is recommended that emergency disconnection at the receiving ship's manifold should be addressed by the bunkering operations risk assessment in order for any potential impact of the system within the receiving ship's bunker station lay-out to be identified and additional mitigation or support utilities to be incorporated as appropriate.

Both HAZID and HAZOP processes will produce a list of recommendations and an action plan. These action plans will address each recommendation developed and provides a means for tracking the hazards for assessment and implementation.

Annex B: SAMPLE Checklists for Methanol Bunkering

This annex provides sample checklists that may be considered for planning and executing the Methanol Bunkering Operations

B.1 Pre-Bunkering Phase

Item	Particulars	Responsible	Status	Remarks	PTS	TTS	STS
1. Pre-Operation Considerations							
1.1	**Compliance Considerations**	BFO, RS					
1.1.1	International (IMO/ISO)				✓	✓	✓
1.1.2	Regional (e.g. EU)				✓	✓	✓
1.1.3	Port State/Flag State Requirements				✓	✓	✓
1.1.4	Local				✓	✓	✓
1.1.5	Port Specific Requirements				✓		
1.1.6	Terminal				✓	✓	
1.2	**Bunker**						
1.2.1	Bunker Purchase Contract	RS			✓	✓	✓
1.2.2	Bunker Delivery Note[1]				✓	✓	✓

[1] The BDN may need to be accompanied by any other document (s) (for e.g. proof of sustainability certificate (as per a recognized International Certification Scheme)) as may be required by the relevant statutory authorities/ flag Administration.

1.2.3	Certificate of Quality (Bunker Specifications)				✓	✓	✓
1.2.4	Verify mass/volume and density				✓	✓	✓
1.3	**Plan to include discussion**	RS					
1.3.1	Terminal				✓		
1.3.2	Bunker Vessel						✓
1.3.3	STS Bunkering						✓
1.3.4	Truck				✓	✓	
1.3.5	Notification of Bunker Operation is given to relevant authorities	BFO, RS			✓	✓	✓
1.4	**Discuss and document where relevant with Master/Person designated by Master**	BFO, RS					
1.4.1	Compatibility documents enabling checks on hazardous area zones, safety zones, security zones, mooring, fendering and other compatibility aspects				✓	✓	✓
1.4.2	Draft, Trim and List				✓	✓	✓
1.4.3	Vessel information of both Receiving and Bunker Vessel				✓	✓	✓
1.4.4	Calculated Tank Capacities for Bunker				✓	✓	✓
1.4.5	Ensure sufficient Ullage Space in Tank	RS			✓	✓	✓
1.4.6	Operating Limits for Bunkering				✓	✓	✓

1.4.7	Emergency Preparedness and Response Plan				✓	✓	✓
1.5	**Agreement Points – Discuss and Agree upon**						
1.5.1	Means of Communication				✓	✓	✓
1.5.2	Emergency Procedures				✓	✓	✓
1.5.3	Hose connection and disconnection procedures including nitrogen purging				✓	✓	✓
1.5.4	Crew Transfer Procedures (if applicable)						✓
1.5.5	Use of ESD link				✓	✓	✓
1.5.6	Use of Vapour Return				✓	✓	✓
1.5.7	Access between Vessels						✓
1.5.8	Mandatory Check Points during Bunkering				✓	✓	✓
1.5.9	Agreement on Bunkering Schedule in terms of pumping rates, pressures (e.g. initial rate, maximum rate, topping off of tanks etc)				✓	✓	✓
1.5.10	Fuel Quality/Sampling (only if instructed by the flag administration/national authority)				✓	✓	✓
1.6	**Operational Considerations**	BFO, RS					
1.6.1	Ensure valves and actuators are well maintained and in working order/state of readiness	BFO, RS			✓	✓	✓
1.6.2	Ensure availability of suitable PPE				✓	✓	✓

1.6.3	Ensure all relevant equipment are suitable for use				✓	✓	✓
1.6.4	Hoses, Saddles, Drip Trays, Manifold Connections				✓	✓	✓
1.6.5	Connection, Tightness Tests and Purging				✓	✓	✓
1.7	**Approach of Receiving Vessel to Bunker Vessel/Quay/Terminal**				✓	✓	✓
1.8	**Mooring**	BFO, RS					
1.8.1	Mooring Analysis performed				✓	✓	✓
1.8.2	Mooring Equipment is in good condition and ready for use				✓	✓	✓
1.8.3	Fendering adequacy and safe working distances				✓	✓	✓
1.9	**Organization Plan**	BFO, RS					
1.9.1	Duty Officer (Deck)				✓	✓	✓
1.9.2	Person in charge of Bunkering				✓	✓	✓
1.9.3	Persons assisting with the Bunkering				✓	✓	✓
1.9.4	Bunker Manifold manning						✓
1.9.5	Ensuring continuous supervision at the Bunker Station and Manifold				✓	✓	✓
1.9.6	Availability of Emergency Services				✓	✓	✓

1.10	**Adequacy of Lighting**	BFO, RS					
1.10.11	Evaluate need for night operations	BFO, RS					✓
1.10.12	Evaluate feasibility of initiation and completion of operation during daylight						✓
1.10.13	Ensure adequate lighting for night operations						✓
1.11	**Other Considerations**						
1.11.1	Restricted area classifications are compatible. Classification in terms of Hazardous, Safety & Security zones & ex-considerations	BFO, RS					✓
1.11.2	Ensure that means for prevention of static electric discharge is available and functional	BFO, RS			✓	✓	✓
1.11.3	Ensure fuel control, P/V valves/ESD system, Fire fighting systems are functional and appropriate with regards to configuration of bunker stations – closed/semi closed.	BFO, RS			✓	✓	✓
1.11.4	Ensure unused bunker line connections are blanked and fully secured	BFO, RS			✓	✓	✓
1.11.5	Ensure procedures are available for environmental protection in case of spills	BFO, RS			✓	✓	✓
1.11.6	Ensure that an International Shore connection is available on RS	BFO, RS			✓	✓	✓
1.11.7	Ensure closure of external doors, portholes & other devices to prevent gas ingress into non-hazardous spaces during bunkering	BFO, RS			✓	✓	✓
1.11.8	Ensure steering and propulsion can be readily deployed on bunkering vessel and Receiving Vessel- i.e. Vessels can sail	BFO, RS					✓

	under its own power in a safe and non-obstructed direction						
2. Agreement for signing off and record keeping							
2.1	**Agreed Operational Limits**	BFO, RS					
2.1.1	Wind				✓	✓	✓
2.1.2	Wave Height & Periods				✓	✓	✓
2.1.3	Current				✓	✓	✓
2.1.4	Lightning Strikes				✓	✓	✓
2.1.5	Forecast for Thunderstorms				✓	✓	✓
2.1.6	Visibility				✓	✓	✓
2.1.7	Agreed Bunker Specifications (product grade, density, volume, loading temperature, transfer rates and line pressures etc.)				✓	✓	✓
2.2	**Safe Access Confirmation**	BFO, RS					
2.2.1	Ensure Safe Access between RS and BF						✓
2.2.2	Ensure Access is secured and controlled				✓	✓	
2.3	**Ensure adequacy of supervision and watchkeeping for Bunker Operation**	BFO, RS					

2.3.1	Agreed means of communication				✓	✓	✓
2.3.2	Ensure Awareness of ESD, location of emergency stop buttons, ESD link functionality				✓	✓	✓
2.3.3	Ensure persons involved in the Bunkering Operation have had adequate hours of rest and in a state of awareness required during the watch				✓	✓	✓
2.4	**Ensure Operational/ Safety Measures are agreed upon**	BFO, RS					
2.4.1	Ensure that the different zones/boundaries (safety zone, security zone, mooring safe working zone etc.) are well understood				✓	✓	✓
2.4.2	Ensure use of explosion proof equipment inside Hazardous zones				✓	✓	✓
2.4.3	Availability of MSDS				✓	✓	✓
2.4.4	Agreed safety measures within the safety area are in place including the functionality and readiness for use of proper PPE, Portable Gas detectors, Thermal Imaging Cameras etc.				✓	✓	✓
2.4.5	Arrangements are in place to treat injuries, exposure to methanol etc.				✓	✓	✓
2.4.6	Sampling Procedures and Equipment are available (if required by the flag administration or national authority)				✓	✓	✓
2.4.7	Vapour Management including vapour return and/or vapour balancing should be agreed upon				✓	✓	✓
2.4.8	Ensure arrangements for preventing static electrical discharges are operational (hose and coupling)				✓	✓	✓
2.5	**Emergency Preparedness**	BFO, RS					

2.5.1	Emergency procedures and plans, including the emergency contact list, are known to the person in charge and all persons involved in the operation				✓	✓	✓
2.5.2	Emergency shut down and release procedures agreed upon				✓	✓	✓
2.6	**SIMOPS (See B.4)**	BFO, RS			✓	✓	✓
3. Connection							
3.1	**Readiness of Bunkering Tanks and appurtenances**				✓	✓	✓
3.1.1	Master to monitor that operational limits specified in 2.1 are satisfied	RS			✓	✓	✓
3.1.2	Confirm adequate lighting at manifold	RS			✓	✓	✓
3.1.3	Confirm transfer equipment (piping, hose, hose supports, flanges, gaskets, etc.) in order including good condition, appropriateness, lining up, rigging etc.	RS			✓	✓	✓
3.1.4	Confirm tightness testing of relevant bunker equipment: - confirm all bolts are fixed and tightened at bunker manifold (for bolted hose connections) - tightness test for QCDC	BFO, RS			✓	✓	✓
3.1.5	Confirm that the bunker/fuel tanks vents/PV valves are operational	RS			✓	✓	✓
3.1.6	Confirm that bunker/fuel tanks and piping have been inerted	RS			✓	✓	✓
3.1.7	Confirm that bunker manifold drip tray valves are closed, and deck scuppers plugs are fitted	RS			✓	✓	✓
3.1.8	Blank unused bunker manifolds and close unused bunker manifold valves	RS			✓	✓	✓

3.1.9	Confirm that all drain valves, purge valves etc. are closed	RS			✓	✓	✓
3.1.10	Confirm that any overflow tank, if installed, is empty	RS			✓	✓	✓
3.1.11	Confirm that spill containment systems and equipment are available and ready	RS			✓	✓	✓
3.1.12	If vapour return/balancing is applicable, confirm that Methanol Liquid and vapour hoses are correctly connected, and pressure monitoring systems are operational						✓
3.2	**Safety Systems**						
3.2.1	All safety systems associated with bunkering should be tested. This includes the fire and gas detection system and emergency shut-down system, emergency stop buttons, ESD arrangements including automatic valves and ESD link system, and automatic closing of ship bunker valve at high-high level in fuel tank.	BFO, RS			✓	✓	✓
3.2.2	Confirm that all portable electrical equipment incl. Communication equipment used within Hazardous zones are confirmed Ex-certified				✓	✓	✓
3.2.3	Confirm that arrangements for preventing static electrical discharge are operational	BFO, RS			✓	✓	✓
3.2.4	Test all tank alarms (high [95%] and overfill alarms [98%]) (filling limits to comply with the fuel handing manual of the ship	RS			✓	✓	✓
3.2.4	Consider additional high level alarm setting to 90% of nominated loading level	RS			✓	✓	✓
3.2.5	Monitor filling in non-loading tanks or set alarms to warn of change in non-loading tanks	RS			✓	✓	✓
3.2.6	Relief valve setting on tank on the bunker vessel to minimize the risk of unintentional	BFO					✓

	methanol vapor venting and gas release on the receiving vessel.						
3.3	**System Preparation**						
3.3.1	Transfer system tested and ready for use in accordance with Methanol Bunker Management Plan and Fuel Handing Manual	RS			✓	✓	✓
3.3.2	Confirm sufficient nitrogen supply before bunkering for system purging	RS			✓	✓	✓
3.3.3	Confirm that piping systems and bunkering hoses are purged with Nitrogen prior to bunkering	RS			✓	✓	✓
3.3.4	Agreement on bunkering schedule & rates	RS			✓	✓	✓
3.3.5	Confirm that hoses and manifolds are compatible and confirm use of appropriate color coding to prevent accidental cross-connection with other fuels.	RS			✓	✓	✓
3.3.6	Control valves are in the correct initial positions	RS			✓	✓	✓
3.3.7	Vapour return system tested and ready for use	BFO, RS					✓
3.3.8	Keep all doors/openings to non-hazardous spaces closed.	RS			✓	✓	✓
3.3.9	Consider measures to operate ventilation systems to reduce gas ingress into non-hazardous spaces	RS			✓	✓	✓
3.3.10	Prohibit internal transfers between bunker/fuel tanks	RS					✓
3.4	**Agreement Points - To be Recorded & signed off in a Safety Meeting**						
3.4.1	Master to confirm permission for barge to come alongside	RS					✓

3.4.2	Safety data sheets are available and reviewed	BFO, RS			✓	✓	✓
3.4.3	Hazardous properties of the methanol to be transferred identified in the safety data sheet are discussed	BFO, RS			✓	✓	✓
3.4.4	Personnel transfer and lifting to follow ship's procedures for the same including risk assessments as required	RS			✓	✓	✓
3.4.5	Responsible Engineer to confirm bunker/fuel tank soundings or level of methanol fuel in the tank	RS			✓	✓	✓
3.4.6	Bunker watch is established	BFO, RS			✓	✓	✓
3.4.7	Bunker tanks to be loaded (in m^3) with tank number, capacities (before, free volume and final volumes) are to be agreed.	BFO, RS			✓	✓	✓
3.4.8	Bunker flow meters or measurement systems are calibrated and functional	BFO, RS			✓	✓	✓
3.4.9	No-smoking areas are established and enforced	BFO, RS			✓	✓	✓
3.4.10	Naked light restrictions are established and enforced	BFO, RS			✓	✓	✓

B.2 Bunkering Phase

(Note: This checklist should be completed once in every 30 minutes of the bunkering operation)

Item	Particulars	Responsible	Status	Remarks	PTS	TTS	STS
1. Vessel Conditions							
1.1	**Operational Conditions**	BFO, RS					
1.1.1	Wind within operational limits				✓	✓	✓
1.1.2	Wave Height and period within operational limits				✓	✓	✓
1.1.3	Current within Operational limits				✓	✓	✓
1.1.4	Lightning Strikes forecast				✓	✓	✓
1.1.5	Mooring arrangement secure				✓	✓	✓
1.1.6	Fenders in place and functional						✓
1.1.7	Access between Vessels is adequate						✓
1.1.8	Communications functional				✓	✓	✓
1.1.9	For operations in night, the lighting system is adequate and functional				✓	✓	✓
1.1.10	Doors/Openings to non-hazardous spaces are closed and measures are taken to operate ventilation systems to reduce potential gas ingress to these spaces				✓	✓	✓
1.1.11	Steering and propulsion of Bunker/Receiving vessel can be readily deployed so the vessel can sail under its own power in a safe and non-obstructed direction						✓

1.1.12	Reports of traffic or any events in the vicinity which can affect the bunkering operation				✓	✓	✓
1.2	**Safety and Operational Procedures**	BFO, RS					
1.2.1	Ensure that the sanctity of the designated zones (Safety, Security and Mooring) maintained				✓	✓	✓
1.2.2	Ensure that all electrical equipment used within hazardous zones is explosion-proof (Ex-proof) to prevent ignition.				✓	✓	✓
1.2.3	Safety measures are in place within safety area (PPE-EEBD, Portable gas detectors, etc.)				✓	✓	✓
1.2.4	Whether methanol vapours have been detected				✓	✓	✓
1.2.5	Emergency procedures and plans are in place, including emergency contact list, incident management planning, and emergency shut down and release procedures				✓	✓	✓
1.2.6	Firefighting systems are in place and functional				✓	✓	✓
1.3	**Watchkeeping**						
1.3.1	Ensure monitoring of all connections and bunker lines for potential leakages, line pressure, and levels of non-nominated bio methanol tanks				✓	✓	✓
1.3.2	Naked light restrictions are complied with				✓	✓	✓
1.3.3	Smoking restrictions and designated smoking areas are maintained				✓	✓	✓
1.3.4	Save-all, drains and scuppers are plugged				✓	✓	✓

1.3.5	Bunker Sounding Log at half hour intervals				✓	✓	✓
1.3.6	Confirm Bunker Received with Bunker Supplier quantities				✓	✓	✓
1.3.7	Responsible Officer to Inform bunkering facility when bunkered tanks reaches agreed levels (for e.g. 70% or 75%)				✓	✓	✓
1.3.8	Ensure adjusted loading rate during top off of tanks and open additional tanks if relevant	RS			✓	✓	✓
1.3.9	Provide adequate notice to the bunker supplier to allow them to adjust their loading operations accordingly.	RS			✓	✓	✓
1.3.10	Relevant restrictions are in place during SIMOPS	RS			✓	✓	✓
1.3.11	If watch is handed over to replacement personnel then adequate briefing takes place during transfer of the watch	BFO, RS			✓	✓	✓

B.3 Post-Bunkering Phase

Item	Particulars	Responsible	Status	Remarks	PTS	TTS	STS
1. Disconnection							
1.1	System Preparation: Relevant bunker hoses, vapour return lines, fixed pipelines and manifolds are: 1. Purged 2. Inerted 3. Depressurized 4. Liquid Free/Drained Ready for Disconnection	BFO, RS			✓	✓	✓
1.2	All remotely and manually operated valves are closed as required for safe disconnection	BFO, RS			✓	✓	✓
1.3	Inform Officer on Watch (OOW) when bunkering is complete	BFO			✓	✓	✓
1.4	Bunker/Receiving vessel is notified on “ready to disconnect”	BFO, RS					✓
1.5	Disconnect transfer hose				✓	✓	✓
2. Post Disconnection							
2.1	Bunker area on the vessel is cleared and restored to standard condition	BFO, RS			✓	✓	✓
2.2	Manifold blanks are replaced				✓	✓	✓
2.3	Relevant documents are signed and exchanged	BFO, RS			✓	✓	✓
2.4	Sign bunker delivery notes (BDN) after verifying bunker and other requisite documents				✓	✓	✓
2.5	Apply temperature and density corrections to convert: Gross to net volume/ Net volume to weight				✓	✓	✓

2.6	Update logbooks in accordance with vessel procedures				✓	✓	✓
2.7	Competent authorities are notified on the completion of the bunker operation	BFO, RS			✓	✓	✓
2.8	Near misses and incidents are reported to competent authorities	BFO, RS			✓	✓	✓

B.4 SIMOPS

(Note: Only to be used when absolutely essential)

Item	Particulars	Responsible	Status	Remarks	PTS	TTS	STS
1. Operational							
1.1	Ensure no stores or garbage handling during bunker operations & other operations such as oily bilge/sludge, transfer, loading and unloading of stores, etc.	RS					
1.2	Any labour intensive tasks to be done in parallel with bunkering to be risk assessed	RS					
1.3	No cargo operations to be planned when bunkering but if unavoidable a separate risk assessment to be done	RS					
1.4	Avoid scheduling vetting, charterers, Flag State or other inspection or audit	RS					
1.5	Ensure compliance with procedures for internal transfer of bunker/cargo	RS					
1.6	Clear protocols for: information sharing, coordination, and emergency response	BFO, RS					
1.7	Clear communication channels are established between all parties involved	BFO, RS					
1.8	Permit-to-work system is implemented for critical activities during SIMOPS	BFO, RS					
2. SIMOPS Planning							

2.1	Planned SIMOPS are in accordance with the safety procedures and risk mitigation in ship's operational documentation for Receiving Vessel	RS			✓	✓	✓
2.2	Ensure that SIMOPS are compliant with local regulations and restrictions	RS			✓	✓	✓
3. Safety Considerations							
3.1	Safety procedures and risk mitigation for SIMOPS are made aware of to all parties concerned	RS			✓	✓	✓
3.2	Establish a safe working area for bunkering operations, free from obstructions and potential hazards.	RS			✓	✓	✓
3.3	Strict zoning is implemented: operations are segregated, areas for bunkering, cargo handling, and personnel movement is clearly defined	RS			✓	✓	✓
3.4	Ignition source control: equipment ex-certified for zone 1 is used, and inspections are carried out regularly	RS			✓	✓	✓
3.5	Surveillance and monitoring of bunkering and cargo operations are increased during SIMOPS	BFO, RS			✓	✓	✓
4. Continuous Monitoring							
4.1	Ignition source & toxicity restrictions are observed Ex-proof in Hazardous zones, EEBD, PPE, Gas detection, use of antidotes/Medical assistance on board	RS			✓	✓	✓
4.2	Areas with potential gas accumulation are particularly checked	BFO, RS			✓	✓	✓
4.3	SIMOPS restrictions are observed	RS			✓	✓	✓
4.4	Maintain adequate separation between bunkering operations and cargo handling activities to prevent interference and potential hazards.	BFO, RS			✓	✓	✓

4.5	Be aware of how ship movement due to cargo operations may affect bunkering stability and prevent overflows	RS			✓	✓	✓
4.6	Address potential dust issues from cargo operations and the impact of weather conditions on dust movement.	RS			✓	✓	✓
4.7	Dedicated personnel are assigned to oversee SIMOPS activities	RS			✓	✓	✓
4.8	Dedicated personnel have specific training in managing SIMOPS and coordinating with the bunker team	RS			✓	✓	✓

Annex C: Sample Bunker Delivery Note

This annex provides a sample of a Bunker Delivery Note[2] for Methanol Fuel

Ship Name: _____ IMO Number: _____
Official Number:_____ Call Sign: _____
Date of Delivery: _____
Name of Bunker Supplier: _____
Address of Bunker Supplier: _____
Port of Delivery: _____
Total Quantity Delivered (tonnes): ___
Bunker Delivery Start Time: _____ Bunker Delivery Completion Time:_____

Properties of Methanol

Density (tonnes/m^3)	
Flashpoint (°C)	
Lower Calorific Value (MJ/kg)	
Composition	
Methanol (%)	
Ethanol (%)	
Other substance 1 (%)	
Other substance 2 (%)	
…	
…	

Signature and Seal of Bunker Supplier **Signature of Master of Receiving Ship**

_____ _____

[2] The BDN may need to be accompanied by any other document (s) (for e.g. proof of sustainability certificate (as per a recognized International Certification Scheme)) as may be required by the relevant statutory authorities/ flag Administration.