



**Port of  
Antwerp**

# **LNG bunkering in the Port of Antwerp**

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Note : the only correct text is the Dutch text available on the [Port of Antwerp site](#)  
under title 3.7.

# 1-Introduction

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More stringent air emission requirements for seagoing vessels are introducing a new challenge for the shipping industry. The challenges are all the more daunting in the IMO's (International Maritime Organisation) Emission Control Areas (ECAs).

One of the possible solutions for compliance with the stricter IMO sulphur emission standards is the use of LNG as propulsion fuel for shipping.

Therefore the **Port of Antwerp** seeks to promote the use of LNG as a marine fuel and is pressing ahead with preparations to receive LNG-fuelled ships, and to safely and efficiently offer LNG to these ships by 2015.

Introduction of LNG as a shipping fuel may however introduce additional risks in the port area, as it will increase the transport and handling of LNG, a dangerous substance; to ensure that the risks are acceptable regardless of the scenario, the potential risks need to be assessed.

DNVGL has been commissioned with a study to assess these risks and to develop procedures for LNG bunkering operations which are specifically tailored to the situation in the port of Antwerp.

The study will cover following aspects:

- an overall (external) risk assessment of the current bulk transport of dangerous substances by sea and inland vessels in the port (so called zero situation);
- an overall risk assessment of the future use of LNG as shipping fuel and related LNG operations;
- the redaction of operational (LNG) bunker procedures.

## Assumptions

These operational Bunker Procedures make the following assumptions.

- [1] that the design of the supply, connection and receiving systems and components has been carried out by appropriately qualified, experienced and competent companies and individuals, in accordance with recognised industry standards
- [2] that the construction of the systems and components has been consistent with the design, and carried out in accordance with recognised quality assurance and control standards;
- [3] that the maintenance of the systems and components has been in accordance with the design and construction requirements

## 2-Hazard identification

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The first stage in any risk analysis is to identify the potential accidents that could result in loss of containment and subsequent release of the hazardous substance.

The releases result in a hazard that can be either:

- Flammable
- Reactive
- Toxic

In this case, the hazard identification is achieved by a systematic review of the vessel traffic together with an effective screening process, given that the range of possible leak sizes covers the whole spectrum from a pinhole leak up to a catastrophic rupture and it would be impossible to model every possible leak size.

The main focus of these Procedures are the relevant Safety Principles to be applied,. The Guidelines address a number of operational scenarios, namely:

- shore-to-ship transfer;
- truck-to-ship transfer;
- ship-to-ship transfer;

It is important that the basic requirements laid down in this Guideline are understood and applied to each operation in order to ensure the safe, secure and efficient transfer of LNG as a fuel to the ship.

In order to understand the behavior of LNG correctly, a basic knowledge of its chemical and physical properties is needed. How natural gas behaves is determined by its properties and it also largely affects how the risks involved are assessed with respect to accidental releases of natural gas. Furthermore, differentiating between its properties in liquid- and gas phase is needed.

### 2.1 Chemical and physical properties

Liquefied natural gas (LNG) is natural gas, predominantly methane (CH<sub>4</sub>) with some Ethane, Propane, Butane, Pentane and other heavier components that have been liquefied for ease of storage or transportation. The reason why it is made liquid is that methane requires 600 times more volume in gas phase than in liquid phase, hence, it is much more efficient to transport it in liquid phase.

Methane is a colorless, odorless gas. Some properties of methane are provided below:

- Molecular weight: 16.0425 g/mol
- Density: 6.67151E-4 g/cm<sup>3</sup> (at 20 °C)
- Boiling point: -248 °F (-161.48 °C)
- Vapor density: 0.55 (relative to air)

Further fire hazard properties of LNG as well as Diesel and Gasoline are summarized

*Fire hazard related properties of methane (LNG) and other light hydrocarbon fuels*

Particulars		Gasoline (100 Octane)	Diesel (fuel)	LNG	Propane (LPG)
Flash point (°C)		< -40	>62	-187 (Flammable gas)	-104 (Flammable gas)
Flammability limits (% in air)	LFL	1.4	0.6	5	2.1
	UFL	7.6	7.5	15	9.5
Auto ignition temperature (°C)		246-280	250-300	537	480
Minimum Ignition Energy (MIE) in air (mJ)		-	20	0.27	-
<p>Data sources: Hess Material Datasheet, Murphy, Michael J (1994) and Pitblado et al., 2006</p> <ul style="list-style-type: none"> <li>- <b>Flash point:</b> The minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of a liquid, as specified by test</li> <li>- <b>Flammability limits:</b> The lowest (LFL) and highest (UFL) concentrations of a combustible hydrocarbon gas in air at which the mixture is flammable.</li> <li>- <b>Auto ignition temperature:</b> Temperature at which a flammable mixture will spontaneously ignite</li> <li>- <b>Minimum Ignition Energy:</b> The minimum energy required to ignite a flammable mixture. A spark with an energy level of 0.25 (mJ) is barely visible to the eye</li> </ul>					

## 2.2 Description of physical phenomena

Due to its properties, LNG will represent other types of hazards than “conventional” bunker oils, if spilled and/ or in contact with personnel or materials. The major hazards that are particular for LNG are presented below.

### **Flash Fire**

A flash fire occurs when a cloud of gas burns without generating any significant overpressure. The cloud of methane (and the mix of ethane and propane) can only be ignited where the concentration is above the Lower Flammable Limit (LFL) and below Upper Flammable Limit (UFL). The flammable range for methane is 5% to 15% in mixture with air. Below 5% mix (methane/air) it will be too lean to ignite, and above 15% it will too rich to ignite.

The gas clouds can only be ignited at the edge as they disperse and meet an ignition source (e.g. open flame, internal combustion engine, sparks). An ignited cloud will “flash back” across all its flammable mass (i.e. that part within the flammable range – between the UFL and LFL). It will then burn at the UFL boundary until the entire hydrocarbon is consumed. The duration of the flash fire is relatively short, but it may stabilize as a continuing jet fire or pool fire from the leak origin.

The following safety instructions are to be undertaken in order to avoid fire:

- All sources of ignition in the safety zone are to be strictly prohibited
- Organize and train all personnel for fire fighting
- Advise where smoking and naked fires are NOT allowed
- Fire and gas leakage safety barriers are to be established
- Full firefighting procedures and instructions are to be established for the ship

### **Pool Fire**

For large spills, air cannot transfer enough heat to vaporize much LNG so a part of the spill is likely to end up in a liquid pool. A pool fire may result after a flash fire. A LNG pool fire generates significant thermal radiation with the surface emission power around 200kW/m<sup>2</sup> (a person in protective clothing will typically withstand 12kW/m<sup>2</sup> for a short time). Once combustion is added to evaporation, the pool will shrink significantly in size to a sustainable pool fire diameter.

### **Jet fire**

Jet fires are burning jets of gas or atomized liquid whose shape is dominated by the momentum of the release. Jet fires typically result from gas or condensate releases from *high-pressure* equipment, e.g. a high-pressure pump, high pressure piping etc. Jet fires may also result from releases of high-pressure liquid containing dissolved

gas, due to the gas flashing off and turning the liquid into a spray of small droplets. Typical conditions for this are at a pressure over 2 bar.

### **Explosion**

A vapor cloud explosion can occur when a large flammable mass of hydrocarbon vapor is ignited in a confined space (e.g. an enclosed box). In an open space, outdoors situation, there is no confinement and the experimental evidence is that methane gas will burn relatively slowly with all the expansion resulting in a vertical rise of gas. Within methane clouds, flame propagation is slow. Sufficient flame acceleration to create explosion overpressure will not occur if there is not enough congestion or confinement.

### **Asphyxia**

Methane, or natural gas, is not toxic. However, in the case of a release of natural gas in an enclosed or semi-enclosed area it can result in asphyxiation due to the lack of oxygen caused by decrease of the partial pressure of oxygen in the inhaled air, which is established when mixing methane and air. Concentrations of 50% by volume (methane in air) will cause obvious suffocation symptoms like difficulties in breathing and rapid breathing at the same time as the ability to respond deteriorates and muscle coordination weakens.

### **Rapid Phase Transformation (RPT)**

This is a very rapid physical phase transformation of LNG to vapor mainly due to submersion in water. It can cause a small but serious local physical explosion effect, which at greater distances can cause low overpressures. The risk of RPT is limited to the LNG/water mixing zones. DNV believes that the intensity of explosion will be much less than a detonation (supersonic velocities) and more equivalent to a pressure wave limited to sonic velocity or less. This is unlikely to damage large structural elements of a ship or jetty. No specific modeling is undertaken for RPT as it is unlikely to increase the hazard range of a major spill that has already occurred. Rapid phase changes have not resulted in any known major incidents involving LNG.

### **Brittle fracture and cryogenic burns**

The cryogenic properties are particular for LNG and it thus require special attention. In order to get the methane into liquid phase it needs to be cooled down below its boiling temperature of -248 °F (-161.48 °C) thus representing thermal hazards to personnel (e.g. in contact with the liquid). However, the extremely low temperatures are not only hazardous to people. While stainless steel and aluminum will remain ductile, carbon steel and low alloy steel will become brittle and fractures are likely if exposed to such low temperatures. Standard ship steel must therefore be protected and insulated from any possible exposure to LNG.

### **Trapped LNG**

If LNG is trapped in the piping or somewhere along the transfer line, a phase transition will cause a local pressure build up. The expansion can potentially cause a pipe burst leading to a significant release of natural gas or LNG depending on the size of the burst and operating conditions.

All pipe sections and tanks shall therefore be secured with thermal relief valves. Always take necessary precautions when encompassing system modification or maintenance, as the case of trapped liquid between two valves can lead to fatal consequences (tube cracking).

### **Boiling liquid expanding vapour explosions (BLEVE)**

Boiling liquid expanding vapour explosions (BLEVEs) are a phenomenon associated with the sudden and catastrophic failure of a pressurised vessel. In all such incidents the pressure vessel is subjected to flame impingement, and a BLEVE occurs when the heat of the fire increases the internal tank pressure, particularly at the part of the vessel not cooled by the internal liquid and the tank suddenly fails catastrophically.

Upon failure of the vessel, the sudden decompression produces a blast and the pressure immediately drops. At this time the liquid, the temperature of which is well above its atmospheric boiling point, spontaneously evaporates, creating large quantities of vapour which is ignited once it is within its flammability limits. This creates a huge fireball, with the rapidly expanding vapour producing a further blast and intensive heat radiation. Low pressure tanks i.e. <700mbar, are virtually immune from this phenomena.

# 3- Operational LNG bunkering in the Port of Antwerp

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## 3.1 Definitions and abbreviations

### 3.1.1 Abbreviations

CE: chief engineer

HMO: Harbor Master's Office

LNG: liquefied natural gas (Defined in 2.1)

LOD: Layer of Defense

MSDS: Material Safety Data Sheet

PoA: Port of Antwerp

PPE: Personal protective equipment

QCDC: Quick connect/Disconnect coupling

### 3.1.2 Definitions

For the purposes of this document, the terms and definitions given in ISO/IEC Guide 73 and the following apply:

ALARP: reducing a risk to a level that represents the point, objectively assessed, at which the time, trouble, difficulty and cost of further reduction measures become unreasonably disproportionate to the additional risk reduction obtained

breakaway coupling: coupling which separates at a predetermined section when required and each separated section contains a self-closing shut-off valve, which seals automatically. A break away coupling can be activated automatically by excessive forces or through mechanical/hydraulic controls.

Consequence: outcome of an event

Dry disconnect coupling :quick coupling which connects and disconnects with minimum LNG release and each separated section contains a self-closing shut-off valve, which seals automatically

ESD (emergency shutdown): method that safely and effectively stops the transfer of natural gas and vapour between the Receiving Ship and Supply Facilities

ERS/ERC (Emergency Release System/ Emergency Release Coupling): ESR/ERC enables release of all bunker transfer hoses by activation of the emergency release coupling in the event of an emergency such as ships breaking away from one another during an STS. It should be capable of operating in the event of a ship blackout

Hazard: potential source of harm

hazard identification (HAZID): brainstorming exercise using checklists where the potential hazards in a project are identified and gathered in a risk register for follow up in the project

hazard and operability study (HAZOP): systematic approach by an interdisciplinary team to identify hazards and operability problems occurring as a result of deviations from the intended range of process conditions

mitigation: limitation of any negative consequence of a particular event

probability: extent to which an event is likely to occur

protective measure: means used to reduce risk

risk: combination of the probability of occurrence of harm and the severity of that harm

safety: freedom from unacceptable risk

safety zone: the area around the bunkering station where only dedicated and essential personnel and activities are allowed during bunkering

topping up: final sequence of LNG transfer to ensure correct filling level in receiving tank.

## **3.2 LNG Transfer**

### **3.2.1 Scope:**

These bunkering procedures aim at establishing a safe and time efficient bunkering procedure for LNG, encompassing the entire bunkering operation, both the operational bunkering process and the technical solutions needed.

The following procedures have been developed in a project that DNV Belgium has executed for port of Antwerp and is based on a literature study of existing bunkering procedures available to DNV and Port of Antwerp, resulting in a state-of-the art, completed with the results of a HAZID study.

It is assumed that the bunkering will take place in the port area. Port of Antwerp lies within an urban/industrial area. This means that the strictest requirements will be necessary for safety aspects / external risks.

### **3.2.2 LNG Environmental Impact**

One of the main reasons for building vessels fueled with LNG is their environmentally friendly profile both under normal operations and in the event of an accident. Using LNG instead of diesel is more environmentally friendly for the following reasons:

- The greenhouse gas reduction from combustion of LNG instead of diesel is due to the higher hydrogen content compared to diesel or HFO. The release of NOX, SOX and particles are reduced significantly (82-84 %, 100% and 67 %, respectively). The reductions are dependent on engine size and type.
- Accidental spills of LNG to the marine environment would result in a relatively small and thin film, which is so volatile it would only affect the immediate surroundings. The majority of the fuel would evaporate immediately and be removed from the sea. Comparatively, a diesel oil release of the same magnitude (same mass of fuel) would result in an oil slick about 1000 times larger, more persistent and much more detrimental to sea-mammals, birds, and aquatic wildlife.

Potential environmental hazards:

- Methane gas might be released through the vent mast due to different reasons, such as pressure build up in the LNG tank. Methane is a more severe greenhouse gas than CO<sub>2</sub> (greenhouse gas potential 20 to 25 times greater than CO<sub>2</sub>) and therefore methane releases should be kept to emergencies only. Running the engines or boiler on gas to lower the pressure in the LNG tanks is better for the environment than lowering the pressure by releasing methane. The most likely source of methane releases will be due to purging of the gas pipes to ensure that no gas is trapped. This will be done when shutting down the engines or switching to diesel fuel. The amount of methane gas released in these scenarios will most likely be minor as well as the frequency thereof.
- Releases of sub-surface LNG (a worst-case scenario for releases to the aquatic environment during e.g. capsizing) would result in a gaseous flow to the surface of methane and ethane, which could saturate the surrounding waters with these gases. The concentrations are not, however, considered sufficiently high to cause long-term effects on the affected environment.
- The components that may be liquid at deeper waters (butanes and pentanes) have such a low density that these too are expected to flow rapidly to the surface if released after e.g. capsizing or sinking of the vessel. Rapid dilution of these components, to concentrations well below acute and chronic effect levels, ensures that negligible environmental effects are expected from such a spill.

## 3.3 LNG Practical Transfer Procedures

### 3.3.1 General Information

#### 3.3.1.1 Documents to be available at the scene of the bunker transfer:

- MSDS of supplied LNG
- Certificates of all LNG Transfer equipment, of personal protection equipment and fire fighting equipment
- The Emergency Response Plan
- Class certificate of all ships involved
- Crew Training Certificates

The above mentioned documents should be handed over to the HMO upon request.

All relevant documents with regard to the bunkering operation, such as bunker checklists and fuel transfer documents shall be retained with the receiving vessel for at least one year.

#### 3.3.1.2 Compatibility between receiving vessel and supplier:

It must be clarified at an early stage before the start of the bunkering operations that mooring and bunker equipment of receiver and supplier are compatible so that bunker operations can be conducted in a safe way.

Dependent of the bunker scenario (Ship- ship, terminal- ship, truck- ship) the adequate bunker checklists for LNG of the Port of Antwerp shall be used, filled in and followed scrupulously:

- [LNG terminal-ship checklist ENG](#)
- [LNG truck-ship checklist ENG](#)
- [LNG ship-ship checklist ENG](#)

### 3.3.2 Approval and information

- Bunker suppliers and bunker vessels must have an **accreditation of the Harbour Masters Office** before they can deliver LNG in the Port of Antwerp. This accreditation shall only be granted after a positive evaluation of de used Bunker and Safety Procedures and other requirements. The application for accreditation will be submitted at least **14 working days before the first bunker operation.** The application Procedure will be part of Port Instructions

- Each individual bunker operation with LNG shall, additionally, be submitted to the Harbour Masters Office **3 working days in advance**. The following information is necessary:
  - o where and when shall the bunker operation take place
  - o method of delivery (ship- truck- terminal)
  - o data of supplier and receiving ship
  
- The ACC shall be notified at least **4 hours before start**, and after the completion of the LNG bunker operation.
- **The Harbour Master or his deputy can always**, without any compensation for involved parties, cancel or abort the bunker operation for reason of adverse weather conditions or other safety issues. He can always impose additional requirements on safety issues.

### **3.3.3 Debunkering Operations**

Debunkering operations are forbidden in the Port of Antwerp without special authorization from a Harbour Master.

### **3.3.4 Responsibilities and qualifications**

#### **6.3.4.1 Responsibilities:**

Responsible persons to be considered:

Captain, chief engineer, skipper of the receiving vessel

Captain, chief engineer, skipper, truck driver of the supplier.

Terminal operators, personnel on duty in the LNG transfer zone.

#### **3.3.4.2 Responsibilities and control: (not limited to)**

##### **Responsibilities for the supplier:**

- Responsible for the means of communication, if necessary
- Responsible for the condition of LNG equipment and bunker line from the supplier to the receivers manifold.

### **Responsibilities for the receiver:**

- Overall responsibility of bunker operation
- Responsible for the LNG equipment on board starting at the manifold.

### **Responsibilities for both parties involved:**

- Each party is responsible for the completing and monitoring of his part of the checklists.
- Each party can always abort the bunker operation.
- Each party is responsible for an efficient emergency response
- Each party is responsible for the training and rest periods of his staff, the implementation and follow up of all applicable safety measures

#### 3.3.4.3 Training of personnel involved:

Level of training of personnel involved with 'gas' operations is determined by IMO MSC (86), STCW, ISO guidelines for systems and installations for the supply of LNG as fuel for vessels, ADN/ADR, ...

Qualification requirements for terminal personnel are industry standards eg SIGTTO, ISGINTT and dedicated LNG handling training.

All personnel, involved with bunker activities with LNG, should have followed a relevant training.

### **3.3.5.General Safety**

#### 3.3.5.1 Lines of Defence - LOD (ISO guideline):

To insure a safe LNG bunker operation, ISO uses 3 lines of defences:

- First line of defence  
Requirements for operations, systems and components aiming at prevention of accidental releases that could develop into hazardous situations
- Second line of defence  
Requirements for containing and controlling hazardous situations in the case of an accidental release of gas
- Third line of defence

Establishing emergency preparedness through procedures and plans to minimize consequences and harmful effects in situations that are not contained by the second LOD

#### 3.3.5.2 Weather conditions:

- LNG bunker operations are not allowed when wind exceeds force 8 (Beaufort).
- When wind exceeds force 6, permission has to be obtained from HMO
- The local situation shall be very important.
- The vessels involved shall be moored in a way that they can always resist the forces due to wind, swell or waves or other external factors.
- No LNG bunker operations shall be started in an on- going electrical storm.

If during LNG bunker operations an electrical storm appears with lightning strikes in the neighbourhood, the operation should immediately be suspended and all systems secured.

Before restarting the operations permission has to be obtained from HMO.

- During the entire bunker operation the complete bunker area has to be clearly visible at all times.

During the night there should be enough safe lighting to achieve this goal.

If visibility is restricted due to fog or smoke, the operation is to be aborted until the all area is visible again.

#### 3.3.5.3 Safety zone:

- Safety zones have been determined based on the vapour dispersion for the largest credible leak.
- The area(s) must be indicated in a clear way, both on board the vessel(s) as ashore.
  
- It must be monitored that persons, not needed for the operations, stay outside the restricted area and that in the restricted area all safety regulations are followed.

This safety area is considered to be a part of the second line of defence.

No other activities are allowed in the safety area.

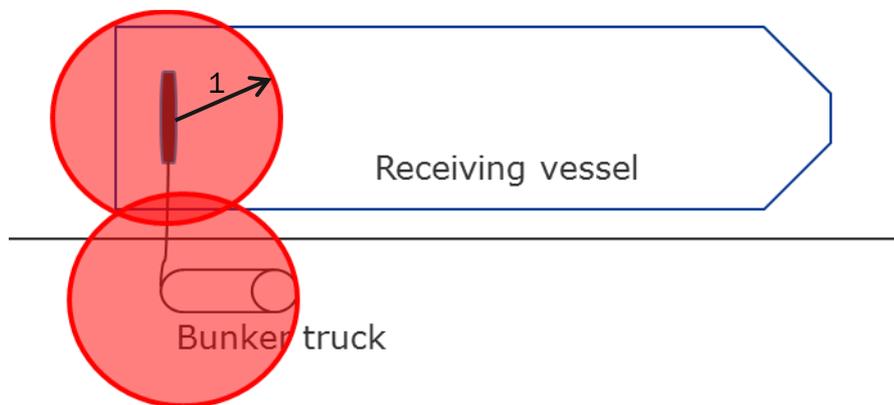
3.3.5.4 Different Safety Zones: (see drawings next page)

Truck- ship: 25 m around manifold and truck (1)

Ship- ship: 30 m around manifolds (2)+ length of bunker vessel (3) and width 2 containers.(4)

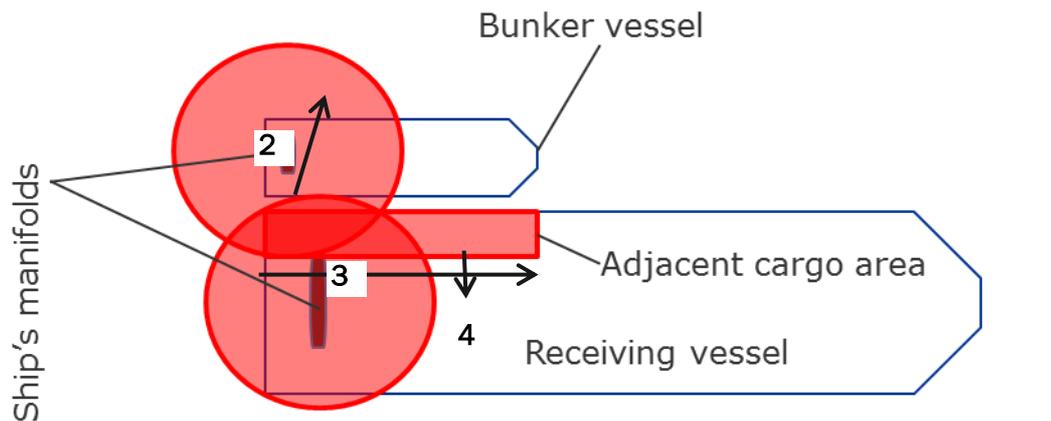
Terminal- ship: 25 m around manifold of the vessel and terminal (1)

**TRUCK/ TERMINAL- SHIP**



Or Manifold Terminal

## SHIP- SHIP



### 3.3.5.5 ESD system:

Each truck, terminal and ship shall have an independent Emergency Shut- Down system for a quick and safe shut-down of the transfer pump and all bunkering system valves in case of an emergency.

### 3.3.5.6 Scuppers:

The scuppers on board the vessels should be open to avoid the formation of a liquid pool, which may result in a pool fire.

### 3.3.5.7 Unplanned stop of operations:

If LNG transfer has come to a unplanned stop, all system should be brought to a safe condition. Before restarting, the system should be re- checked as per pre- bunkering procedures.

## 3.3.6.General conditions for communication:

### 3.3.6.1: Languages

English shall be used in communication between all parties involved, unless otherwise agreed between all parties.

### 3.3.6.2 Communications between receiver and supplier

A reliable means of communication shall be available between all parties involved during the complete bunkering operation. If necessary, the supplier will normally deliver (safe) means of communications.

In case of failure of these means of communications, the bunkering operation will be aborted.

The operations can only be resumed after the communication has been restored.

Exception to above mentioned use of (electronic) means of communications can be granted if the responsible person for the receiver and the one for the supplier can continually see each other and talk from their normal working position.

### **3.3.6.Simultaneous operations:**

LNG bunkering during cargo operations and/ or with passenger on board of the receiving vessel can only be performed with a special permission of the HMO.

This authorization will depend on a positive Quantitative Risk Assessment (QRA) on this simultaneous operations. The QRA shall be handed over to the HMO, together with the request to perform a LNG bunkering, at least 3 working days in advance.

Furthermore an approval is necessary from all parties involved.

## **3.4 Truck- Ship Operational Bunkering Procedures**

- Truck- ship bunkering is prohibited at tidal quays
- A safe access to the ship from the quay is necessary at all times.

### **3.4.1 General Safety:**

#### 3.4.1.1 Safety zone

The safety zone as mentioned in 3.3.5.4 shall be established and clearly marked, ashore as well as on board

#### 3.4.1.2 Earthing- Electrostatic Charges

The truck shall be connected to a earthing point at the quay (in good working order) to prevent static build up.

The bunker line shall be electrically conductive and fitted with **at least one** insulating flange.

Steel to steel electrical contact through e.g.. mooring lines, gangways and others shall always be avoided.

#### 3.4.1.3 Fire fighting equipment:

Fire fighting equipment on board of the receiving ship and at the truck shall be tested and ready for immediate use.

Special attention is needed when using water at freezing temperature.

#### 3.4.1.4 Openings in het Ship:

All openings like windows, doors, portholes and air inlets should be closed in the safety zones during bunker activities.

### **3.4.2 Operations:**

All operations, before, during and after bunker activities will be carried out in accordance with the correspondent checklist. All these checklists will be filled in and signed by all parties involved.

## **3.5 Terminal- Ship Operational Bunkering Procedures**

-Personnel involved in LNG bunker operations at the terminal shall be qualified according to industry requirements

### **3.5.1 General Safety:**

3.5.1.2 Safety zone: The safety zones shall be established and clearly marked, ashore as well as on board

#### 3.5.1.3 Earthing- Electrostatic Charges

The bunker line shall be electrically conductive and fitted with at least one insulating flange.

Steel to steel electrical contact through e.g.. mooring lines, gangways and others shall always be avoided.

#### 3.5.1.4 Fire fighting equipment:

Fire fighting equipment on board of the receiving ship and at the terminal shall be tested and ready for immediate use.

Special attention is needed when using water at freezing temperature.

#### 3.5.1.5 Openings in het Ship:

All openings like windows, doors, portholes and air inlets should be closed in the safety zones during bunker activities.

### **3.5.2 Operations:**

- All operations, before, during and after bunker activities will be carried out in accordance with the correspondent checklist. All these checklists will be filled in and signed by all parties involved.
- Terminals providing LNG bunkering facilities must have a safety advisor and an emergency plan aligned with the emergency plan of the Port of Antwerp.
- A safe access from the terminal to the ship is necessary during the whole operation.
- Terminal- ship LNG bunkering is prohibited at tidal quays.

## **3.6 Ship- Ship Operational Bunkering Procedures**

-Only accredited bunker vessels/ suppliers are allowed to perform bunker activities in the Port of Antwerp.

-Bunker vessels for LNG have to be built as per IGC code

-A safe access to both vessels and the shore is necessary through whole operation

-Ship –ship bunkering is only allowed when the receiving vessel is safely moored alongside a fixed construction like dukdalves, jetties or quays.

### **3.6.1 General Safety**

#### 3.6.1.2 Safety zone:

The safety zones shall be established and clearly marked on both vessels. Special attention is needed to avoid objects falling on deck of the bunker vessel during loading/unloading operations.

### 3.6.1.3 Earthing- Electrostatic Charges

The bunker line shall be electrically conductive and fitted with at least one insulating flange.

Steel to steel electrical contact through e.g. mooring lines, gangways and others shall always be avoided.

### 3.6.1.4 Fire fighting equipment:

Fire fighting equipment on board of the receiving ship and at the terminal shall be tested and ready for immediate use.

Special attention is needed when using water at freezing temperature.

### 3.6.1.5 Openings in het Ship:

All openings like windows, doors, portholes and air inlets should be closed in the safety zones during bunker activities.

## **3.6.2 Operations:**

All operations, before, during and after bunker activities will be carried out in accordance with the correspondent checklist. All these checklists will be filled in and signed by all parties involved.