



SUPER-LNG



DELIVERABLE T2.5.1: GUIDELINES FOR EMERGENCY PLANNING OF LNG INFRASTRUCTURES IN PORT AREAS



SUPER-LNG Project is supported by the Interreg ADRION Programme funded under the European Regional Development Fund and IPA II Fund.

Deliverable Number	T2.5.1
Deliverable Name	GUIDELINES FOR EMERGENCY PLANNING OF LNG INFRASTRUCTURES IN PORT AREAS
Activity Number	T2.5.
Work Package Number	WP2
Authors	D. Poggiali, F. Pilo, G. Pio, T. Iannaccone, M. Carboni, E. Salzano
Partner(s)	UNIBO, CNVFF
Submission Date	25/06/2020
Version Number	1
Dissemination Level	<i>Confidential or Public etc</i>
Approved By	
Approval Date	
Last modified	



DOCUMENT VERSION HISTORY

Version	Edit by	Date of edit	Approved by	Date of approval	Details
1	Ernesto Salzano	30/06/2020			



TABLE OF CONTENTS

Document Version History	3
Table Of Contents	4
Introduction	5
1. Emergency planning indications from the European agencies.....	6
1.1 EMSA guidance on LNG bunkering	6
1.2 IACS bunkering guidelines (ref. to sections 4.1.3.1 and 4.1.3.2).....	8
2. Emergency planning indications from the current literature	9
2.1 BP Process Safety Series - LNG Fire Protection and Emergency Response	9
2.2 BP Process Safety Series, LNG masterplan for Rhin-Main-Danube	11
3. Emergency planning experience from existing LNG sites in Europe	15
3.1 LNG Terminal adriatico s.r.l. – Italy	15
3.2 Dunkerque LNG terminal – France	19
3.3 Port of Helsinki – Finland.....	21
3.4 Świnoujście LNG Terminal - Poland	23
4. Emergency planning experience from existing LNG sites outside Europe	25
4.1 Federal Energy Regulatory Commission (FERC) Draft Guidance for LNG Terminal Operator’s Emergency Response Plan - USA	25
4.2 Darwin LNG – Australia.....	26
5. A new guideline for the lng emergency response in ports	30
6. References	31



INTRODUCTION

An emergency plan is a written set of instructions that describes what workers and others at the workplace should do in an emergency. The Emergency Plan includes protocols to ensure close coordination with local area emergency response organizations and agencies. When there are conflicts within the standards or regulations, or pre-established site safety guidelines, the more stringent shall govern. The kinds of emergencies to plan that must be considered are fire, explosion, medical emergency, rescues, incidents with hazardous chemicals, bomb threats, armed confrontations, and natural disasters. The emergency plan should be based on a realistic assessment of hazards associated with the work activity or workplace, and the possible consequences of an emergency occurring as a result of those hazards. External hazards should also be examined in preparing an emergency plan. In developing the plan, consideration should be given to the application of all relevant laws, including public health laws and state or territory disaster plans.

This document has been prepared to collect the procedures for responding to specific emergencies that may occur at an LNG sites. More specifically, in order to give a general view, it considers the emergency planning indications from different sources:

1. Emergency planning indications from the European agencies
2. Emergency planning indications from the current literature
3. Emergency planning experience from existing LNG sites in Europe
4. Emergency planning experience from existing LNG sites outside Europe
5. List of relevant publication or technical notes about LNG bunkering and LNG Emergency Response Plan.



1. EMERGENCY PLANNING INDICATIONS FROM THE EUROPEAN AGENCIES

The following publications provide the indication for the emergency response as given by international association as the European Maritime Safety Agency (EMSA) and the International Association of Classification Societies (IACS), which includes several member societies as the American Bureau of Shipping, Bureau Veritas, China Classification Society, the Russian, Croatian Register of Shipping, DNV GL, Indian, Korean, Polish, and Italian Register of Shipping, and others.

1.1 EMSA GUIDANCE ON LNG BUNKERING

According to EMSA, the Port Authorities & Administrations (PAAs) should ensure that, for all LNG Bunkering Projects/Activities:

- Bunker Facility Organization (BFO) draws up an internal emergency plan for the measures to be taken within the LNG bunkering Facility or whenever the LNG bunkering operation takes place, from the moment of its authorization to its conclusion;
- BFO supplies the necessary information to the competent authority, upon completion of the Internal Emergency Plan, to enable the latter to draw up external emergency plans;
- Local/National Authorities designated for that purpose by draw up an external emergency plan for the measures to be taken outside the establishment within an acceptable time frame following receipt of the necessary information from the operator pursuant to point (b).

Operators should comply with the obligations set out above within a reasonable time prior to the start of operation, or prior to the modifications leading to a change in the inventory of hazardous substances:

- containing and controlling incidents so as to minimise the effects, and to limit damage to human health, the environment and the property;
- implementing the necessary measures to protect human health and the environment from the effects of major accidents;
- communicating the necessary information to the public and to the services or authorities concerned in the area;
- providing for the restoration and clean-up of the environment following a major accident

Internal emergency plan

The following data and information should be included in the Internal Emergency Plans are:

- names or positions of persons authorised to set emergency procedures in motion and the person in charge of and coordinating the on-site mitigation action;
- name or position of the person with responsibility for liaising with the authority responsible for the external emergency plan;
- for foreseeable conditions or events which could be significant in bringing about a major accident, a description of the action which should be taken to control the conditions or events and to limit their consequences, including a description of the safety equipment and the resources available;
- arrangements for limiting the risks to persons on site including how warnings are to be given and the actions persons are expected to take on receipt of a warning;



SUPER- LNG

- arrangements for providing early warning of the incident to the authority responsible for setting the external emergency plan in motion, the type of information which should be contained in an initial warning and the arrangements for the provision of more detailed information as it becomes available;
- where necessary, arrangements for training staff in the duties they will be expected to perform and, as appropriate, coordinating this with off-site emergency services;
- arrangements for providing assistance with off-site mitigation action.
- an Emergency Response Plan should be prepared to address cryogenic hazards, potential cold burn injuries to personnel and firefighting techniques for controlling, mitigating and elimination of a gas cloud fire, jet fire and/or a LNG pool fire.
- the Emergency Response Plan should cover all emergency situations identified in the LNG Bunkering Operations Risk Assessment and may designate responsibilities for local authorities, hospitals, local fire brigades, Person In Charge (PIC), Master and selected personnel from the bunkering facility. As a minimum, the following situations should be covered where appropriate:
 - LNG leakage and spill on the receiving ship, on the bunkering facility or from the LNG transfer system;
 - gas detection;
 - fire in the bunkering area;
 - 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.

External emergency plans

On the other hand, the data and information that must be included in the external emergency plans are:

- names or positions of persons authorised to set emergency procedures in motion and of persons authorised to take charge of and coordinate off-site action;
- arrangements for receiving early warning of incidents, and alert and call-out procedures;
- arrangements for coordinating resources necessary to implement the external emergency plan;
- arrangements for providing assistance with on-site mitigation action;
- arrangements for off-site mitigation action, including responses to major-accident scenarios as set out in the safety report and considering possible domino effects, including those having an impact on the environment;
- arrangements for providing the public and any neighbouring establishments or sites with specific information relating to the accident and the behaviour which should be adopted.



1.2 IACS BUNKERING GUIDELINES (REF. TO SECTIONS 4.1.3.1 AND 4.1.3.2)

According to the guidelines of IACS, receiving ship operator (RSO) and bunkering facility organisation (BFO) specific safety instructions should be prepared by both parties based on the conclusions and outputs of the LNG Bunkering Operations Risk Assessment.

Internal emergency plan

The specific LNG Bunkering safety instructions should cover at least:

- 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.

In addition, the safety instructions for LNG 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.

Emergency Response Plan

An Emergency Response Plan should be prepared to address cryogenic hazards, potential cold burn injuries to personnel and firefighting techniques for controlling, mitigating and elimination of a gas cloud fire, jet fire and/or a LNG pool fire.

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

- LNG leakage and spill on the receiving ship, on the bunkering facility or from the LNG transfer system;
- gas detection;
- fire in the bunkering area;
- 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.



2. EMERGENCY PLANNING INDICATIONS FROM THE CURRENT LITERATURE

The following publications provide an overall understanding of LNG operations, including general safety issues and recommendations about scenario-specific emergency response.

2.1 BP PROCESS SAFETY SERIES - LNG FIRE PROTECTION AND EMERGENCY RESPONSE

The ERP purpose is to provide instant written instructions, guidance and helpful information for personnel to assist them at the critical early stage of a serious or major incident and to provide sufficient potential hazard information to enable informed decisions on the safety of personnel responding to the incident.

The Emergency Response Plans (ERPs) are intended to provide guidance for the first 20 to 30 minutes of the incident and indicate the actions and resources required to deal with the incident during this time. The ERPs should be:

- based on potential credible serious or major scenarios for that facility;
- relevant to the facility systems and equipment (site specific);
- fit-for-purpose;
- easy to use;
- helpful to the end users.

As emergency response strategies for LNG facilities, the following paragraph should be considered as the base response which can be expanded into incident specific emergency response plans for LNG facilities:

Gas cloud response strategy

- avoid water in the liquid pool as this only increases cloud size;
- check for gas drift to semi or fully-confined areas where an explosion may be possible;
- use of high expansion foam for vapour reduction;
- water curtains can dilute and divert gas;
- water monitors may offer limited dilution;
- wear full bunker gear and SCBA in case of flash fire.

LNG pool fire response strategy

- cool any heat or flame affected steelwork or plant;
- avoid water in the burning pool as this only increases fire size and radiant heat distance;
- foam can reduce fire size (radiant heat reduction);
- dry powder can be used, but the gas cloud will remain;
- combine foaming and dry power for extinguishment, or dry powder to knock down and foaming thereafter to reduce vaporization;
- wear full bunker gear, and move upwind on any extinguishment.



Jet fire response strategy

- isolate pressure source (pumps/operations);
- prioritize cooling;
- cool any flame affected steelwork or plant;
- cool radiant heat affected steelwork/plant;
- foam cannot extinguish pressure fire;
- dry powder may extinguish jet fires, but pressure gas clouds will remain;
- full bunker gear is required due to high levels of radiant heat.

Road tanker liquid spill response strategy

- deal with this in the same way as an LPG road tanker:
- Give priority to evacuation to a distance of one mile (1.6 km).
- Use water curtains if a gas cloud is present to dilute/contain/divert.
- Avoid water on LNG liquid as this will increase gas cloud.
- Evacuate all responders once water curtains are in place.
- Wear full bunker gear and self-contained breathing apparatus (SCBA) in case of a flash fire.

Road tanker spill fire response strategy

- Deal with this in the same way as an LPG road tanker.
- Give priority to evacuation to a distance of one mile (1.6 km).
- Cool the tanker if on fire but expect greater fire intensity if liquid LNG is involved in the fire.
- Cool any nearby plant, equipment or other heat affected exposures.
- Evacuate all responders once cooling is in place.
- Wear full bunker gear because of high levels of radiant heat.

Jetties spill strategy

(Where a run-off channel is provided to the containment basin).

- Activate hi-ex foam coverage in channel and basin.

Ship manifold gas cloud strategy

Onshore Fire Department

- Contact ship master and confirm jetty head/ship conditions and gas cloud conditions.
- Strategy generally the same for LNG gas cloud response strategy.

Ship actions

(Manifold incidents should be short-lived due to isolation valves and emergency shutdown capability.)

- Halt cargo operations and actuate water spray system for gas cloud control/dilution.
- Ensure ship fire pump is running.
- Monitor gas detection for gas migration on ship.



SUPER- LNG

- Leaking LNG loading line isolated and drained down.
- Prepare ship dry powder system in case of ignition.
- Prepare ship-cooling monitors ready in case of ignition.

Ship manifold pool fire strategy

Onshore Fire Department

- Contact ship master and confirm jetty head/ship conditions and gas cloud conditions.
- Strategy generally the same for LNG pool fire response strategy.

Ship actions

- Halt cargo operations.
- Alert port authority/other shipping in docks and request fire tugs.
- Onshore operator actuate jetty monitors and high-ex foam pourers if beneficial for fire control.
- Actuate ship water spray system and ensure fire pump is running.
- Monitor gas detection on ship.
- Ship fire team in full personal protective equipment and SCBA move to available water monitors if safe to do so.
- Isolate and drain down LNG line if safe to do so.
- Direct monitor cooling streams on to flame and radiant heat affected piping, valves, manifold and steelwork.
- Advise shore control room and/or fire tugs of fire extent and conditions.
- Consider the best strategy – continue cooling or use ship/shore dry powder to extinguish.

2.2 BP PROCESS SAFETY SERIES, LNG MASTERPLAN FOR RHIN-MAIN-DANUBE

The LNG Masterplan is supported by a forty million Euro European Commission grant through the TEN-T Programme and is implemented by a consortium of thirty-three companies and organisations from the public and private sectors from twelve European member states.

The target group is the inland navigation sector and incident and emergency control which operate in this field.

Concerning emergency situations management, three different incident response scenario have been developed. For each scenario a specific list of emergency response actions is provided.

Scenario n°	Description of applicable accident scenarios
Scenario 1	<ul style="list-style-type: none">– Inland LNG propelled cargo vessel,– LNG fuel tank on deck,– Collision with bridge,– failure of pipe work,– Continuous release of LNG,– Vapour cloud dispersion (no ignition),– Escalation with prolonged gas/vapour concentration.
Scenario 2	<ul style="list-style-type: none">– Tank truck to ship bunkering,– LNG fuel tank below deck,



SUPER- LNG

	<ul style="list-style-type: none">– Severed hose line,– Limited release of LNG,– Unconfined spill on water,– RPT,– Cryogenic damage to ship– No ignition of LNG vapour cloud.
Scenario 3	<ul style="list-style-type: none">– Inland LNG tanker/bunker ship,– LNG cargo tanks,– Container falls from bunkered ship onto bunkering ship,– Short continuous release of LNG,– Unconfined spill on water,– RPT,– Delayed ignition of LNG vapour cloud.
Scenario 4	<ul style="list-style-type: none">– Inland LNG propelled cargo vessel,– LNG fuel tank on deck,– Collision with another vessel,– Direct ignition of cargo (e.g. gasoline),– LNG fuel tanks exposed to heat radiation,– Escalation with prolonged exposure, cooling required within 15 minutes.

Scenario 1 specific actions

First responders (ship's crew)

- Confirm LNG release
- Notify emergency services
- Try to isolate leakage (activate ESD)
- Eliminate any ignition sources on board.
- Activation of water curtains (if fitted) to mitigate gas dispersion over a navigational bridge.
- Shut down ventilation to ship to prevent gas being drawn into ship
- Start-up fire pump and water protection systems (if fitted)
- Consider putting ship into shore at a safe location (if possible)
- Evacuate all unessential persons (passengers and crew)
- Prepare to receive emergency services

Second responders (emergency services and river/port authorities)

- Approach upwind of incident
- Make contact with master of vessel/port authorities
- Assess extent of gas cloud
- Eliminate ignition sources in path of gas migration
- Set up water spray to disperse gas cloud
- Fire boat to set up water spray to mitigate / disperse gas cloud
- Monitor extent of gas cloud with gas detection equipment. Track gas cloud visually with thermal imaging camera.
- Continually assess incident conditions for ongoing safety and provide water spray control support. Advise if any further evacuation requirements are necessary.
- Prepare for fire



SUPER- LNG

- Aftercare: control for 'gas pocketing' in all buildings and enclosed spaces in vicinity of vapour cloud area
- Cordon off incident area and evacuate surrounding area lying in path of gas cloud
- Restrict or control navigation traffic around incident area

Scenario 2 specific actions

First responders (ship's crew)

- Confirm LNG release
- Activate ESD on LNG transfer system
- Shut down ventilation systems
- Notify emergency services
- Assess the risk of vapour cloud ignition
- Evacuate ship before vapour cloud reaches the ship's bridge / accommodations.
- Go to the authorities and give all relevant technical LNG and vessel data.
- In case of fire: abandon vessel.

Second responders (emergency services and river/port authorities)

- Rescue ship crew if it is necessary/ possible.
- Use defensive strategy.
- Support water curtain/ shield or spray to disperse vapour cloud.
- Investigate vessel integrity for cryogenic damage.
- Control navigation traffic around incident area.

Scenario 2 specific actions

First responders (ship's crew)

- Confirm LNG release
- Activate ESD on LNG transfer system
- Shut down ventilation systems
- Notify emergency services
- Assess the risk of vapour cloud ignition
- Evacuate ship before vapour cloud reaches the ship's bridge / accommodations.
- Go to the authorities and give all relevant technical LNG and vessel data.
- In case of fire: abandon vessel.

Second responders (emergency services and river/port authorities)

- Rescue ship crew if it is necessary/ possible.
- Use defensive strategy.
- Support water curtain/ shield or spray to disperse vapour cloud.
- Investigate vessel integrity for cryogenic damage.
- Control navigation traffic around incident area.

Scenario 3 specific actions

First responders (ship's crew)

- Confirm LNG release from the vessels due to the impact of a container falling onto deck
- Activate ESD at the LNG system
- Notify Emergency Services



SUPER- LNG

- Activate water spray systems if available/possible
- Shutdown ventilation systems
- Assess the risk of vapour cloud ignition reaching accommodate
- Give to the authority's and give all relevant technical LNG and vessel data.
- Try to extinguish fire with Dry chemical Powder
- If not safe; abandon the vessel in upwind or crosswind direction.

Second responders (emergency services and river/port authorities)

- Rescue shipboard crew if it is necessary/ possible.
- If Fire is still burning upon arrival extinguish with Dry Chemical powder.
- Setup a Fire boat with monitors for cooling the vessel structure. (or from shore side)
- Deploy water spray cooling for the other fuel tanks, cargo and dangerous goods affected by the fire radiation.
- Starting to prepare the salvage operation for the casualty.
- Control navigation traffic around incident area.

Scenario 4 specific actions

First responders (ship's crew)

- Confirm gasoline release
- Notify emergency services
- Try to isolate leakage
- Start-up fire pump and water protection systems (if fitted)
- Consider putting ship into shore at a safe location (if possible)
- Evacuate all unessential persons (passenger and crew)
- Prepare to receive emergency services

Second responders (emergency services and river/port authorities)

- Approach incident site from upwind direction
- Contact vessel Master
- Set-up water spray to cool LNG fuel tanks
- Set-up foam water to extinguish pool fire
- Continually assess incident conditions for ongoing safety and provide water spray control support. Advise if any further evacuation requirements are necessary.
- Cordon off incident area and evacuate surrounding area lying in path
- Restrict or control navigation traffic around incident area
- Fire boat to set up foam water / water spray to extinguish fire and to cool surroundings.



3. EMERGENCY PLANNING EXPERIENCE FROM EXISTING LNG SITES IN EUROPE

3.1 LNG TERMINAL ADRIATICO S.R.L. – ITALY

The following list of actions needs to be followed by the LNG carrier Master in case of an emergency situation arising on the LNG carrier or the terminal, in addition to specific LNG carrier emergency procedures.

- Sounds a continuous blast on the whistle;
- Sounds the general alarm;
- Stops all cargo transfer and prepares to disconnect loading arms;
- Informs the Terminal Representative;
- Initiates the LNG Carrier emergency response procedure;
- Informs the Maritime Authority;
- If necessary, request mobilization of the tugs fire-fighting capability (Terminal operator will be responsible for informing all relevant functions within Terminal personnel and arranges for the Terminal fire-fighting capability to be mobilized as required);
- Coordinates the firefighting operations on board and directing the use of official emergency teams and the Terminal firefighting equipment. If the fire cannot be controlled or contained or if the Terminal installation is seriously endangered, the Master and Terminal Offshore Installation Manager shall determine the necessity of removing the LNG Carrier from the berth;
- Upon notification of any incident associated with the LNG Carrier, communications will be established between the Offshore Installation Manager, Master and Maritime Authority to confirm appropriate level of response.

The following incidents may potentially occur while the LNG Carrier is alongside the facility (Non exhaustive list):

- Fire/Explosion
- Pollution
- Uncontrolled release of LNG or NG Vapours
- Man Overboard
- LNG Carrier out of position
- LNG Carrier-related incidents, including, mechanical failure affecting cargo operations,
- Accident/medical emergency, power failure and failure of ship's mooring lines.

The following are immediate actions that need to be accomplished in case of emergency by terminal operator LNG carrier master and tugs and boat pilots. Action required by LNG Carrier berthed alongside the Terminal jetty will depend on the nature, location and proximity of the incident to the jetty.



LNG CARRIER RELATED INCIDENTS	LNG Carrier	Terminal Operator	Tugs & pilot
Initiate emergency cargo transfer shutdown and closure of ESD valves.	X		
Initiate the General Alarm.	X		
Notify Terminal operator and Maritime Authorities of the nature and location of incident (e.g. Mooring Failure/LNG Carrier out of position/Fire) and action being taken by LNG Carrier's crew.	X		
Inform on board terminal Representative and Pilot.	X		
Notify Tugs to be on stand-by and ready to provide assistance as required.	X		
Prepare for loading arm disconnection and unmooring, including emergency unmooring	X		
Initiate emergency shut-down of cargo transfer.		X	
Initiate Terminal Emergency Response Plan.		X	
Establish communications with stand-by tugs.		X	
Establish communications with on board Terminal Representative.		X	
Notify Maritime Authorities of the nature of incident and to stand by in case assistance is required.		X	
Go to immediate stand-by.			X
Initiate water spray or deluge systems if required (Tugs).			X
Await instructions as directed by Terminal operator or LNG Carrier Master.			X

TERMINAL RELATED INCIDENTS	LNG Carrier	Terminal Operator	Tugs & pilot
Initiate cargo shutdown.	X		
Initiate on board emergency response plan.	X		
Standby for loading arm disconnection and unmooring, including emergency unmooring.	X		
Maintain radio contact with Terminal.	X		
Notify Terminal Representative and Pilot.	X		
Initiate the General Site Alarm.		X	
Initiate Terminal Emergency Response Plan.		X	
Inform the LNG Carrier of the nature of the incident and keep them informed of status.		X	
Notify Maritime Authorities of the nature of the incident and to stand-by in case assistance is required.		X	
Request all tugs to go to standby.		X	
Establish communications with on board Terminal Representative and to standby as directed.		X	
Go to immediate stand-by.			X
Initiate water spray or deluge systems if required (Tugs).			X
Await instructions as directed by Terminal operator or LNG Carrier Master.			X



UNCONTROLLED RELEASE OF LNG VAPOUR OR LIQUID FROM SHIP OR SHORE	LNG Carrier	Terminal Operator	Tugs & pilot
Secure all sources of ignition and impose a total smoking ban.	X		
Initiate water spray systems or deluge as required.	X		
Secure all sources of ignition and impose a total smoking ban.		X	
Allow automatic Fire and Gas, fire extinguishing and emergency shutdown and depressurization systems to work.		X	
Operate Jetty fire monitors if secure to do so.		X	
Stand-by tugs to activate firefighting and deluge systems.			X
Stand well clear upwind.			X
Await instructions from Terminal.			X
Secure all ignition sources.			X
Impose total smoking ban.			X

LNG CARRIER COLLISION WITHIN SAFETY ZONE	LNG Carrier	Terminal Operator	Tugs & pilot
Identify other vessel and render assistance as required	X		
Initiate call out of Terminal Man-overboard response team.		X	
Place medical services on standby.		X	
Stand-by tugs to respond as directed by Terminal or LNG Carrier Master.			X

In the event of a man overboard situation within the Terminal Safety Zone, all LNG Carrier movements are to be suspended while search & rescue activities take place.

Extreme caution is required by the search vessels, particularly during night hours, when approaching or entering the search area.



MAIN OVERBOARD INCIDENT WITHIN THE TERMINAL	LNG Carrier	Terminal Operator	Tugs & pilot
Throw person in the water a life buoy or floating aid.	X		
Raise the alarm by sounding three long blasts on the LNG Carrier's whistle.	X		
Inform Terminal Central Control Room who will stop the unloading if the person in the water is within 100m of the Terminal and advice circumstances.	X		
Place lookout and constantly monitor position of person in the water.	X		
Request Terminal Central Control Room to mobilize rescue from the Maritime Authorities.	X		
Stop unloading if requested or if person in water is within 100m of the Terminal.		X	
Notify Maritime Authorities.		X	
Initiate call out of Terminal Man-overboard response team.		X	
Place medical services on standby.		X	
Stand-by tugs to respond as directed by Terminal or LNG Carrier Master.			X
Remaining tugs to be mobilized, if required.			X

LNG CARRIER OUT OF POSITION	LNG Carrier	Terminal Operator	Tugs & pilot
Initiate emergency shut-down procedures.	X		
Clear manifold area in case of emergency shut-down II activation.	X		
Prepare to for tug connection and unmooring, including emergency unmooring.	X		
Initiate or confirm emergency shut-down.		X	
Prepare for Loading arm disconnection and raising of gangway.		X	
Consider Initiating Jetty area fire and deluge systems.		X	
Prepare for release of LNG Carrier, including emergency release.		X	
Proceed to LNG Carrier and prepare for connecting towlines.			X
Await instructions from Pilot or LNG Carrier master for unberthing operations			X
Remaining tugs to be mobilized, if required.			X



3.2 DUNKERQUE LNG TERMINAL – FRANCE

The Dunkerque LNG Terminal is designed to unload and reload LNG Carriers and its annual regasification capacity is 13 billion m³ gas.

The following installations are present at the terminal:

- A jetty and marine platform, designed to receive LNG Carriers between 65,000 m³ LNG up to 267,000 m³ LNG, with a guaranteed depth of 15 meters;
- Three storage tanks with a net capacity of 190,000 m³ of LNG, each;
- A regasification unit composed by 10 Open Rack Vaporisers with a maximum send-out capacity of 1.9 million Nm³/hour.

In the case of incidents affecting a LNG carrier or the jetty, the following emergency procedure and response are considered.

Fire on board the ship

At the outbreak of a fire on board the ship, the ship personnel discovering the fire, shall:

- Initiate the ship alarm system and stop LNG transfer
- Indicate the location of the fire
- If possible restrict the spread of the fire
- Report details of the fire to the Terminal Main Control Room via the UHF radio system, indicating the nature of the fire, type of assistance required and nature of casualties if any.
- LNG carrier Master shall inform the Port Authority and, if necessary request Terminal firefighting tugboat.
- LNG carrier Master is responsible for coordinating the firefighting operations on board and directing the use of the public emergency teams and the Terminal firefighting equipment
- The terminal operator is responsible for informing all other relevant functions within the plant and arranging for the Terminal's firefighting capability to be mobilized as required.
- The terminal Shift Supervisor shall act according to the "Emergency Procedures" as specified in the terminal safety procedures. He will organize the access for the Public Fire Brigade by remote opening



LNG leakage on board the ship

In the event of a LNG leakage (including overflows) occurring on board, the ship's personnel shall immediately:

- Activate the emergency shutdown system to stop LNG transfer
- Inform the terminal via the UHF radio system.

Terminal operator shall immediately:

- Activate jetty water curtains and monitors to control gas cloud dispersion;
- Evacuate personnel on the jetty (if necessary) to the nearest safe location.

Fire on jetty

At the outbreak of fire on the jetty, terminal operator shall immediately:

- Activate emergency shutdown systems, ceasing all operations
- Use the fixed dry chemical system located on the road level platform
- Evacuate personnel on the jetty (if necessary) to the nearest safe location.
- Activate Powered Emergency Release Coupler (PERC) to allow LNG carrier emergency departure from the berth.

LNG leakage in jetty

If a LNG leakage occurs on the jetty, (including the transfer arms and ship manifold connections) terminal operator shall immediately:

- Activate emergency shutdown systems (if not automatically triggered)
- Inform LNG carrier via UHF radio
- Use water monitors to assist ship personnel in preventing sub cooling of non-cryogenic structures of the ship.
- Activate PERC to allow LNG carrier emergency departure from the berth.



3.3 PORT OF HELSINKI – FINLAND

The LNG fuelled Finnish Border Guard's offshore patrol vessel "Turva" bunkers LNG by truck-to-ship at the Vuosaari Harbour every second week. The processes and safety regulations were agreed upon between the LNG supplier Gasum and the Finnish Border Guard. Since the handling of LNG as fuel for ships in the Port of Helsinki is expected to increase in the near future, there is a need of a safety manual on LNG bunkering procedures for the Port of Helsinki. Currently the most practical solution for LNG refuelling of ships in Port of Helsinki is ship-to-ship (STS) bunkering. Another viable option is to perform LNG bunkering by truck-to-ship (TTS).

Education and training are essential:

- the crew of the bunker vessel shall be trained according to the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) convention.
- the crew of the receiving vessel shall be trained according to the STCW convention.
- for vessels not complying with IGF code the crew shall be trained according to requirements by the flag state.
- the crew operating the truck shall be trained according to the ADR rules.

In addition to the general requirements all personal involved in the bunker operations shall be properly trained. The training scheme shall be approved by Port of Helsinki.

As per ISO/TS 18683:2015, the training shall, as a minimum, cover the following:

- Properties and hazards of LNG relevant to the LNG bunkering operations
- Potential effects of mixing LNG with different properties
- Risk reducing measures
- International or national regulations and guidelines regarding LNG fuel transfer operations
- First aid specific to frost-bite and asphyxiation
- Safe operation of LNG fuel transfer equipment
- Procedures to be followed during normal LNG bunkering operations:
- Understanding of non-standard operations and emergencies during LNG bunkering operations with respect to recognition of different types of incidents and specific actions for each type of incident:
 - Immediate action to be taken in response to emergency situations that can occur during LNG fuel transfer operations including liquid and/or vapour leakage, fire, or emergency breakaway
 - Management of vapour and/or liquid leaks to minimise risk to personnel and assets due to cryogenic temperatures and flammable atmospheres
 - Emergency response plans

In the case of incidents affecting a LNG terminal or carrier, the following emergency procedures and response are considered.

Fire on board the ship

- Make an emergency call immediately contacting Helsinki Vessel Traffic Services (VTS) via VHF radio or phone
- Cease all cargo/bunker operations
- Start firefighting measures



SUPER- LNG

- Disconnect loading arms/bunker connections
- Stand by for unberthing

Measures to be taken in case of fire or emergency at the terminal or another vessel:

- Make an emergency call contacting Helsinki VTS via VHF radio or phone
- Stand by to cease all cargo/bunker operations
- Wait for additional instruction from port authorities or VTS
- Stand by for unberthing



3.4 ŚWINOUJŚCIE LNG TERMINAL - POLAND

The Marine LNG Terminal can be approached through the Baltic Sea; it can host LNG carriers with a cargo capacity ranging between 120000 and 217000 m³. The unloading is executed with 3 liquid unloading arms and one BOG return (Vapour Return) arm. Total gross capacity of two terminal tanks amounts to approximately 320,000 m³.

In the case of incidents affecting a LNG terminal or carrier, the following emergency procedures and response are considered.

FIRE ON THE LNG TANKER	LNG Carrier	Terminal Operator	shift manager / duty panel operator and
Inform Loading Master	X		
Inform the terminal control room by hot line.	X		
Raise General Ship Alarm. The signals must be made until a confirmation from the terminal. The alarm signals are established and confirmed during the pre-discharge meeting.	X		
Activate ESD 1 system.	X		
Activate the ship's recovery plan and begin firefighting actions.	X		
Press the nearest fire alarm activation button.		X	
Inform Loading Master		X	
Inform the shift manager in the main control room.		X	
Follow the shift manager's and loading master's instructions.		X	
Evacuate the LNG carrier area.		X	
Activate the ESD 1 system (unless the ship has already done it)			X
Confirm the halt of the loading pumps and the ESD valves with the ship and instruct the ship to stop all operations.			X
Instruct the ship to prepare to disconnect the unloading arms.			X
Instruct the unloading arms operators to drain and disconnect them.			X
Activate the ESD 2 system (If the fire covers the manifold of the LNG tanker and the situation prevents the disconnection of the arms through QC/DC).			X
Order to evacuate the personnel from the danger zone.			X
Activate fire monitors and fire assistance upon request of the ship.			X
Notify emergency services and institutions			X
Inform the Duty Officer of the Port Authority and the VTS and request a fire unit and the tugboats.			X
Activate the emergency unberthing procedure (after such decision has been made by the Loading Master).			X
Coordinate rescue and firefighting actions from land until the arrival of the National Fire Brigade.			X



SUPER- LNG

LNG LEAK FROM THE LOADING SYSTEM OF THE SHIP	LNG Carrier	Terminal Operator	shift manager / duty panel operator and
Inform Loading Master	X		
Inform the terminal control room by hot line.	X		
Raise General Ship Alarm. The signals must be made until a confirmation from the terminal. The alarm signals are established and confirmed during the pre-discharge meeting.	X		
Activate ESD 1 system.	X		
Activate the ship's recovery plan and begin firefighting actions.	X		
Inform Loading Master		X	
Inform the shift manager in the main control room.		X	
Inform the Duty Officer of the LNG carrier via radio or hotline			X
Activate the ESD 1 system			X
Confirm the halt of the loading pumps and the ESD valves with the ship and instruct the ship to stop all operations.			X
Instruct the ship to prepare to disconnect the unloading arms.			X
Instruct the unloading arms operators to drain and disconnect them.			X
Order to evacuate the personnel from the danger zone.			X
Inform emergency services and institutions in accordance with the list of contacts in section I of the present instruction.			X
Inform the Duty Officer of the Port Authority and the VTS			X
Activate the emergency unberthing procedure (if necessary to do so).			X



4. EMERGENCY PLANNING EXPERIENCE FROM EXISTING LNG SITES OUTSIDE EUROPE

4.1 FEDERAL ENERGY REGULATORY COMMISSION (FERC) DRAFT GUIDANCE FOR LNG TERMINAL OPERATOR'S EMERGENCY RESPONSE PLAN - USA

Each LNG terminal operator must develop an Emergency Response Plan with written procedures for responding to: emergencies within the LNG terminal; emergencies that could affect the public adjacent to an LNG terminal; and emergencies that could affect the public along the LNG vessel transit route. The Emergency Response Plan must be prepared in consultation with the U.S. Coast Guard and state and local agencies, and it must be approved by the Commission prior to the start of construction.

The list of topics that must be addressed in the Emergency Response Plan is provided below:

Organization and Contacts

- Structure of the incident management organization of the LNG terminal.
- List of designated agency contacts – name, title, organization, and phone number of all required agency contacts.

Response to Emergencies within LNG Terminal

- Identification of the types and locations of specific emergency incidents that may reasonably be expected to occur at the LNG terminal due to operating malfunctions, structural collapse, personnel error, forces of nature and activities adjacent to the terminal, including but not limited to:
 - LNG spills with no fire;
 - LNG spills with fire;
 - Release of LNG vapours or natural gas;
 - Releases of flammable refrigerants, highly volatile liquids, or other combustible gasses;
 - Building fires;
 - Grass fires, forest fires;
 - Electrical fires;
 - Severe weather (lightening, tornado, blizzard, etc.);
 - Hurricanes;
 - Emergency ship departure; unexpected disconnects;
 - Bomb threats; and
 - Accident involving LNG truck on site or enroute.
- Description of the terminal alarm system for the identified emergency incidents in II A.
- Procedures for in-plant communication and external notification in response to each identified emergency incident in II A, including incident reporting requirements.
- Procedures for responding to each identified emergency incident in II. A, using equipment appropriate for handling the emergency.
- Procedures to shelter, evacuate, assemble and account for plant personnel, contractors and visitors.
- Description of detection and shutdown systems:
 - Emergency shutdown systems (ESD) – automatic and manual actuation; location and function of ESD stations; and
 - Hazard detection initiated shutdown systems.



- Hazard fire control equipment – quantity, capacity and location of all units (fire water, deluge, dry chemical, high expansion foam, etc). Include a matrix and a plot plan.
- Local agency response for each of the identified emergency incidents in II A.

Emergency Evacuation Adjacent to the LNG Terminal and Along LNG Vessel Transit Route

- Detailed procedures for recognizing an uncontrollable emergency and taking action to minimize harm to terminal personnel and the public.
- Scalable procedures for the prompt notification of appropriate officials and emergency response agencies based on the level and severity of potential incidents, and the sequence of such notifications.
- Procedures for notifying residents and recreational users within areas of potential hazard, including:
 - Locations of permanent sirens and other warning devices; and
 - Emergency coordinator on each LNG vessel to activate sirens and other warning devices.
- Emergency procedures, including evacuation, for areas adjacent to LNG terminal and LNG vessel transit route. Procedures need to be developed with the local agency(ies) having the authority to implement evacuation, shelter in place, and control of highway access/egress.
- Include maps of: (1) areas or zones to be evacuated; and (2) evacuation routes and methods of egress for residents, workers and any visitors adjacent to LNG terminal and along the route of the LNG vessel transit.
- Emergency evacuation instructions explaining the types of emergencies, methods of notification, company and local authority contacts, and maps of emergency planning areas and evacuation routes should be clearly explained in a public pamphlet or booklet and distributed to all residences, institutions, commercial establishments and recreational areas that are located within areas potentially exposed to a hazard from an incident adjacent to LNG terminal and along the route of the LNG vessel transit.

Training and Exercises

- Provisions for the annual review of Emergency Response Plan by terminal operator and appropriate agencies.
- Plan for the initial and continuing training of terminal emergency personnel.
- Plan for the initial and continuing training of first responders.
- Procedures for emergency response drills and exercises.
- Provision for annual emergency response drills by terminal emergency personnel, first responders, and appropriate federal, state and local officials and emergency response agencies.

4.2 DARWIN LNG – AUSTRALIA

The principal LNG plant facilities are: a single LNG process train, one LNG Storage tank, a LNG loading jetty, ground and elevated flares, refrigerant storage vessels, boil-off gas compression, a remote impoundment basin, a utilities area, a control room and administration buildings. LNG is stored in a conventional double containment storage tank of 188,000 m³ capacity. LNG is exported from the tank by pumping through a cryogenic pipeline to a loading jetty. LNG is transferred by in-tank pumps from the storage tanks during ship loading at a total rate of approximately 10,000 m³/hr. The capacity of a LNG ship will be up to approximately 174,000 m³.



Emergency procedures for defined events

Vessel Fire/Explosion/Vapour Release at Berth

A vessel fire/explosion/vapour release could occur whilst the vessel is alongside the facility, undertaking operational activities. The prime consideration is the safety of personnel and the protection of the integrity of the vessel and facility. Quick response is essential in these situations and could require the towing of the affected vessel away from the facility.

VESSEL FIRE/EXPLOSION/VAPOUR RELEASE	Emergency Commander	Control Room Supervisor	Emergency Coordinator	On-Scene Coordinator	Emergency Team Leader	Incident Recorder	Communications Officer
Record details from the person reporting the incident		X					
Initiate the general Site Alarm.		X					
Notify the Emergency Commander.		X					
Activate the Emergency Response Team and make an initial public address.	X						
Notify the Operations Section Chief and maintain an open line of communication.	X						X
Notify Operations Team Leader	X						
Notify Port Facility Security Officer or Delegate	X						
Contact the Vessel Master and determine status, control and injuries and provide assistance as required.	X		X				
Notify emergency services	X		X				
Notify Darwin Port, and Maritime Safety Authority.	X						X
Contact the On-Scene Coordinator and determine status, control and injuries on the Jetty.	X		X				
Assess all information & determine actions to be taken.	X		X	X			
Adjust operations as appropriate and update personnel via public address system.	X						
Prepare to receive casualties.			X	X			
Complete the Muster Check.				X			
Initiate a search for any missing persons.	X						
Determine the extent of damage to the facility and if there is a threat to its integrity – if safe	X			X			
Discuss with Harbour Master if there is a need to tow the vessel away from facility.	X			X			

Hydrocarbon release



Emergency Team Actions

- Verify that all personnel have been evacuated
- Complete rescues (if safe to do so)
- Keep product from entering sumps and drainage inlets
- Implement containment measures if possible
- Disperse any gas products emanating from liquid spill
- Consider foam application (Hi-Expansion for Propane and LNG / B Class foam for diesel fuel)
- Avoid any contact with spilled LNG

HYDROCARBON RELEASE – PROCESS AREAS	Emergency Commander	Control Room Supervisor	Emergency Coordinator	On-Scene Coordinator	Emergency Team Leader	Incident Recorder	Communications Officer
Record details from the person reporting the incident		X					
Initiate the general Site Alarm.		X					
Notify the Emergency Commander.		X					
Activate the Emergency Response Team (ERT)	X						
Shutdown/isolate the involved equipment or process.	X						X
Request assistance from emergency services	X						
Make appropriate public address and all channel Radio announcement.	X						
Monitor adjacent gas detectors and CCTV.		X					
Notify the Operations Section Chief and maintain an open line of communication.	X						
Notify Operations Team Leader	X						X
Notify On-Scene Coordinator to proceed to the incident location and set up forward command post in a safe location upwind of the affected area.		X					
Set up forward command post, establish communications and report on the situation.			X				
Identify hazards, minimise risks, set objectives and devise an incident control plan.	X		X				
Brief ERT and commence implementation of the plan.	X						
Ensure location of the ERT is tracked on the incident board.			X				
Assess all information, amend action plan as appropriate.	X						
Mark up Response Board detailing weather conditions, etc.							X
Complete Muster Check			X				
Initiate search for any missing persons.	X						



Activate site Oil Pollution Emergency Plan if required	X						
Consider evacuation of process site – consider weather conditions	X						
Ensure Emergency Response procedures are followed.	X						
Consider potential for escalation / offsite impact. Relay this information to emergency services.	X						
Determine if full process system shutdown and depressurisation required if not already conducted	X						
Maintain a detailed log of events.							X

Emergency response training & competency requirements

Fire Fighting Training

All Operations personnel working at the Darwin LNG facility shall have completed training and attained competency in firefighting. Competencies shall comply with the PMA08 Chemical, Hydrocarbon and Oil Refining Training Package (or equivalent) (Australian training package).

Emergency Response

Personnel required to undertake emergency response duties will be trained in appropriate competencies and skills. Training will include (but not be limited to), incident command, confined space entry, breathing apparatus, firefighting, rescue, hazardous materials, working safely at heights, first aid depending on assigned roles and responsibilities. The Terminal Competency Coordinator monitors competency currency of emergency response personnel.



5. A NEW GUIDELINE FOR THE LNG EMERGENCY RESPONSE IN PORTS



6. REFERENCES

EMSA (2018). Guidance on LNG Bunkering to Port Authorities and Administrations. European Maritime Safety Agency.

IACS (2016), LNG Bunkering Guidelines, Report 142. International Association of Classification Societies.

SIGTTO (2001) A Guide to Contingency Planning for Marine Terminals Handling Liquefied Gases in Bulk, 2nd Ed., Witherby Publishing Group, UK.

SIGTTO (2004) Liquefied Gas Fire Hazard Management, 1st Ed., Witherby Publishing Group, UK.

SGMF (2017) Bunkering of Ships with LNG - Competency and Assessment Guidelines version 2.0. The Society for Gas as a Marine Fuel.

VV.F (2015) Circolare 18 maggio 2015, prot. n. 5870 Ministero dell'Interno, Dip. VV.F- Guida tecnica ed atti di indirizzo per la redazione dei progetti di prevenzione incendi relativi ad impianti di distribuzione di tipo L-GNL, L-GNC e L-GNC/GNL per autotrazione.