CleanPort

Cofinanciado por el Mecanismo «Conectar Europa» de la Unión Europea

EMSA Guidance on LNG Bunkering to Port Authorities and Administrations

Proyecto “CleanPort”. Barcelona, 25 Abril 2019.
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1. Antecedentes.
2. Development. Step-by-Step approach.
3. Regulatory Framework.
4. Environmental Best Practice in LNG Bunkering.
5. Planning & Operations.
6. Risk & Safety.
7. Control Zones

Guidance on LNG Bunkering

to Port Authorities and Administrations

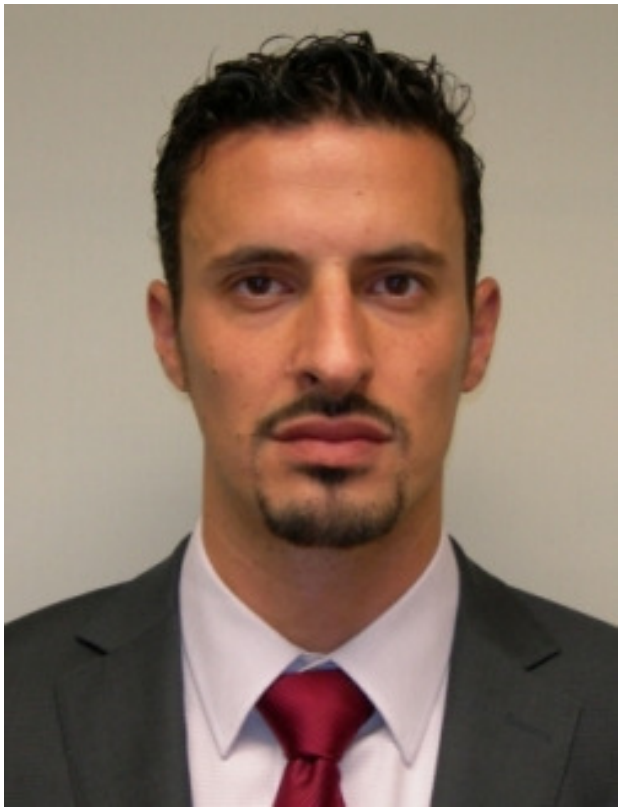
Date: 31-01-2018

EMSA

antecedentes

CleanPort

- IMO MSC.285(86) Directrices Provisionales sobre la seguridad de las instalaciones de Motores de Gas Natural en los buques (01/06/2009).
- Grupo de Expertos en GNL organizado por Comisión Europea y EMSA.
- Dos reuniones en Junio y Diciembre de 2012, con vistas a identificar las posibles barreras y “gaps” para el uso de GNL como fuel.
- Study on Standards and Rules for Bunkering of Gas-Fuelled Ships 2013 (EMSA-GL).
- Consultas con ISO, IAPH, SGMF, IACS, SIGTTO.
- ESSF on LNG Sub-group (2013). EMSA Technical Secretary.
- Approval of IGF Code (11/06/2015).
- Encuestas a Port Authorities and Administrations.
- Three EMSA Workshops with PA, Administrations and Industry.



Ricardo Batista

Project officer, environment and capacity building

European Maritime Safety Agency

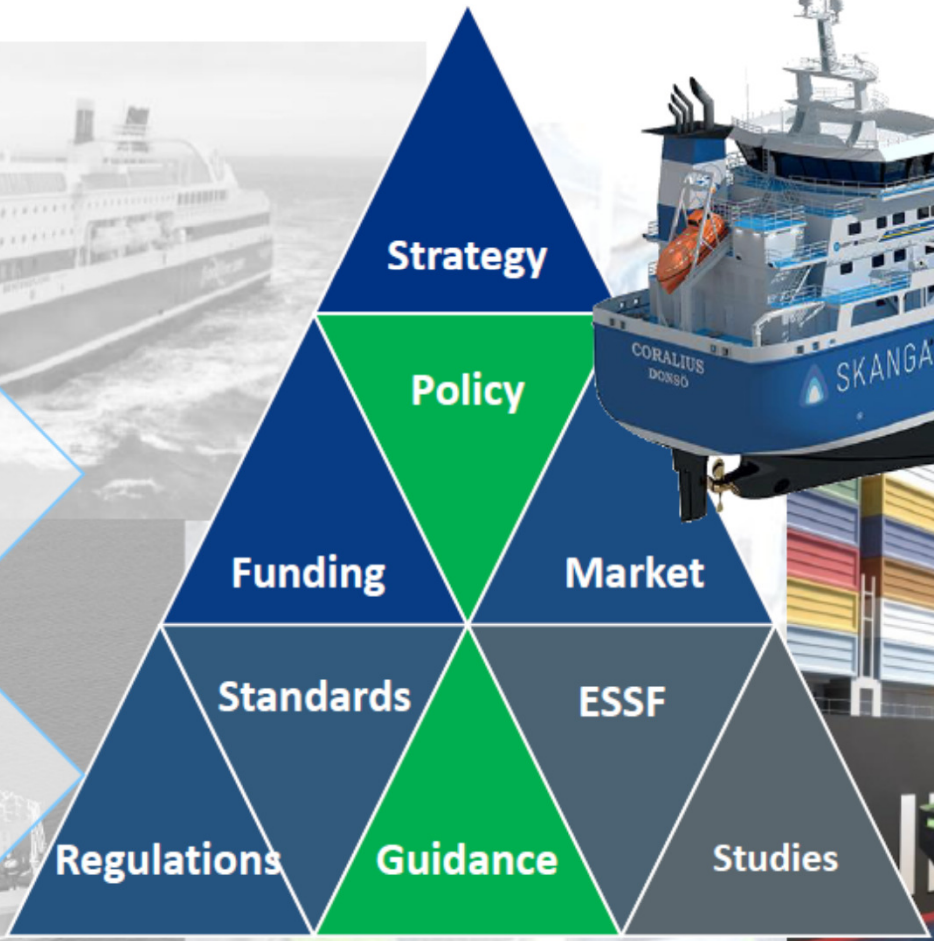
http://emsa.europa.eu/emsa-documents/latest/item/3207-guidance-on-lng-bunkering-to-port-authorities-and-administrations.html

https://gasnam.es/wp-content/uploads/2018/11/EMSA_Intro_Introduction_LNG-as-Fuel_Outlook-today.pdf

Step-by-Step

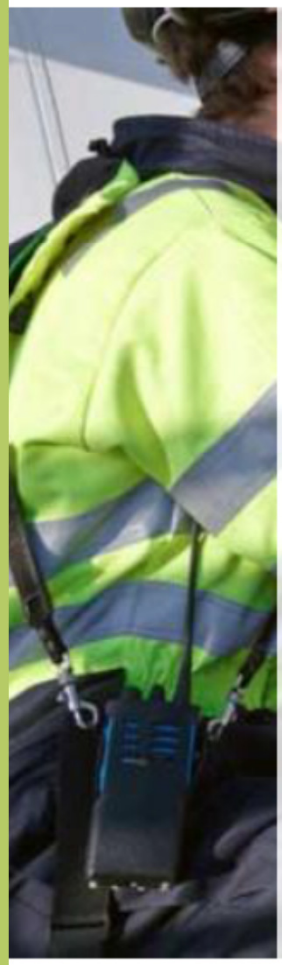
Directive 2014/94/EU on deployment of na Alternative Fuels Infrastructure

EMSA Guidance on LNG Bunkering for Port Authorities and Administrations



Step-by-Step

Key Challenges

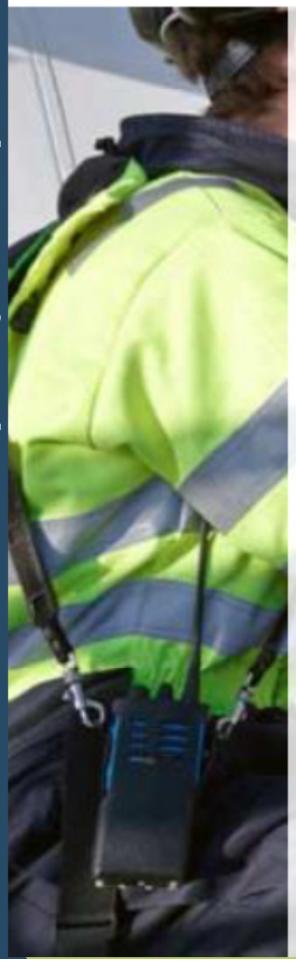


Regulatory Context	Permitting Process
• Identify the **applicable regulatory instruments** relevant to different LNG bunkering/fuelling operations.	• Define a standard **General Permitting Process Diagram** for LNG bunkering facilities and operations.

Simultaneous Operations	Safety Distances
• Devellop an **approach to facilitate the consideration, authorization and control of SIMOPs**. • Takinf into account technical and operational elements.	• **Define a standard Good Practice approach to the definition of Safety Distances for Meaningful Protection** in different LNG bunkering operations.

Step-by-Step

A. General | B. Governance | C. Risk & Safety | D. Organization | E. Bunkering | F. Emergency | G. Certification



1	**Scope and Applicability**	• **Scope and Applicability** • **List of Terms / Definitions with references.**
2	**LNG as Fuel**	• Informative section on the characteristics of LNG as fuel for shipping. • **LNG Bunkering options** and other possible operations with LNG as fuel
3	**Environment**	• Overall benefits of LNG as fuel, remarkably on the reduction of GHG/CO2 emissions - highly dependent on the adequate understanding of methane emission's environmental impact. • **Good practice guidance to mitigate the risk of natural gas emissions** during LNG bunkering operations.

Step-by-Step

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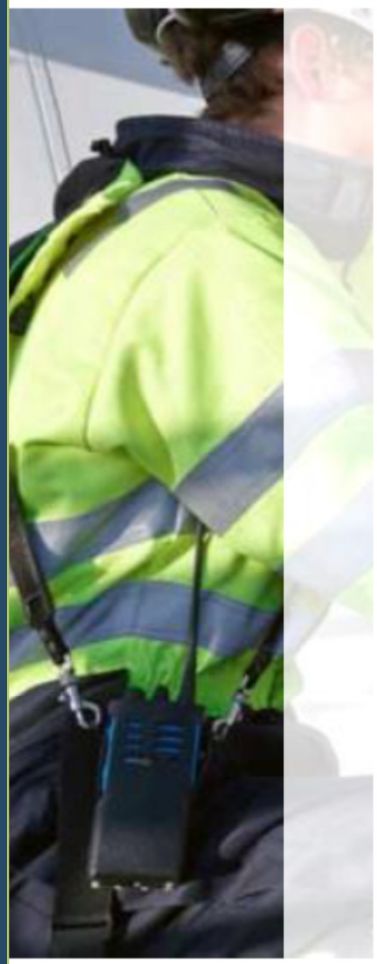
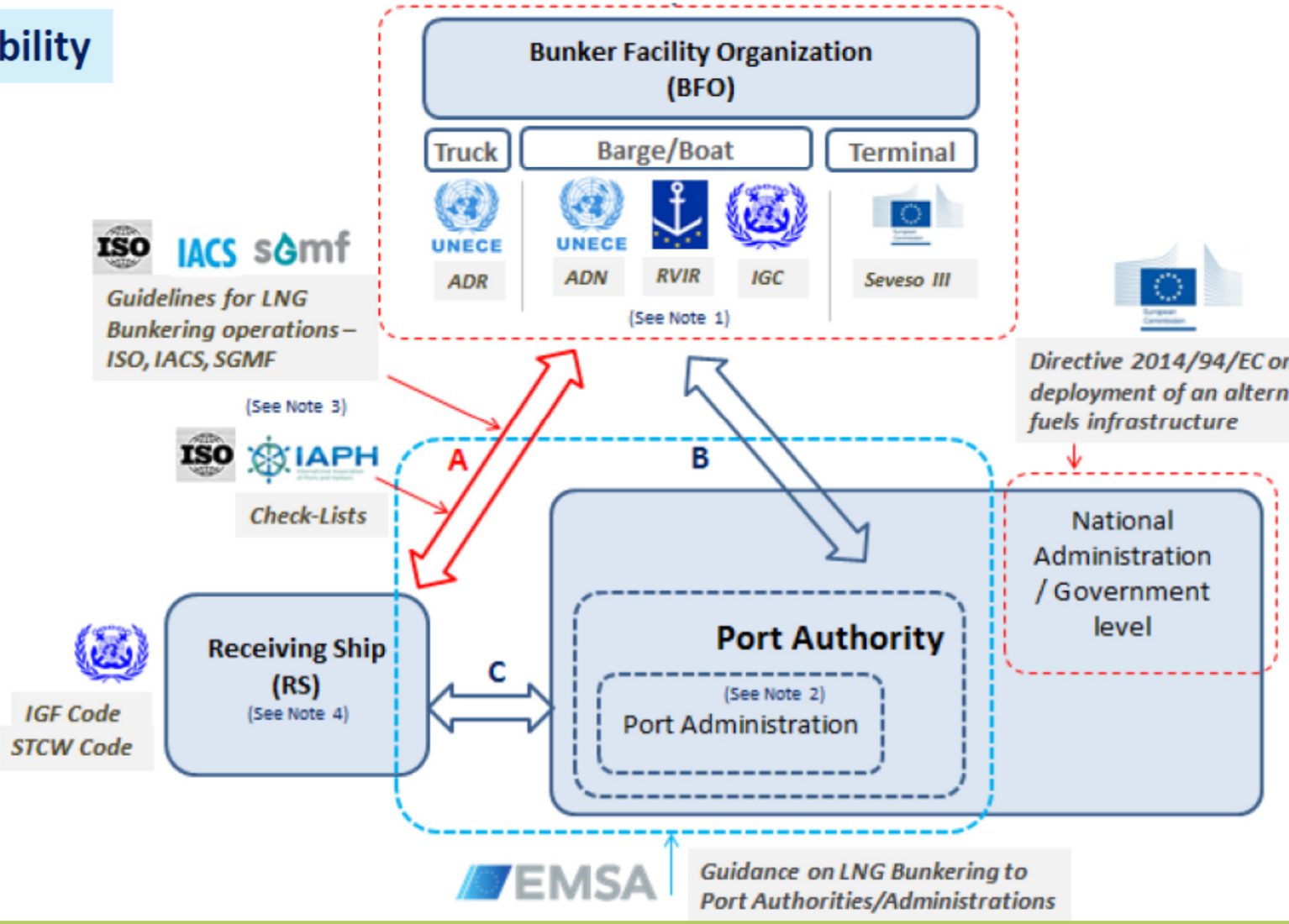
Scope & Applicability





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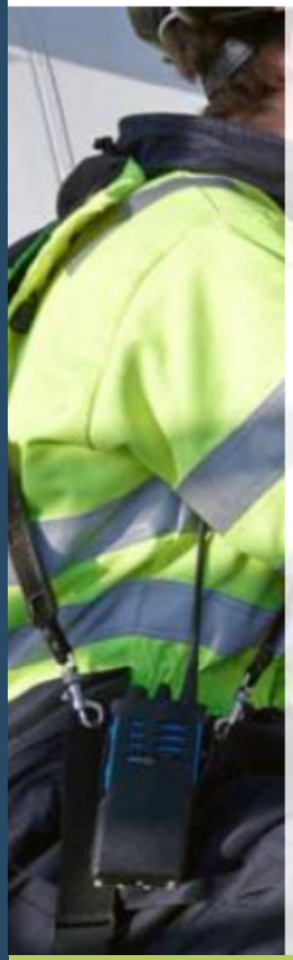

4	**Regulatory Frame**	• **Relevant instruments for LNG as fuel for shipping - Bunkering** • **Main references and applicability of different instruments on LNG Bunkering.**
5	**Ports**	• LNG Bunkering in the context of Ports Good Governance. • Main aspects of Ports Good Governance, both in the development of LNG bunkering option and .
6	**Feasibility**	• A Feasibility Study incorporates a large number of aspects that are relevant for the development of LNG Fuel infrastructure. • The elements which are relevant to Ports should be, on top of those directly related to the bunkering interface, also distribution links within Port Area, LNG small scale storage and others.
7	**Permitting**	• Sub-section intended to provide best practice in permitting processes for LNG Bunkering. • Included flow-chart with reference permitting process.

Step-by-Step

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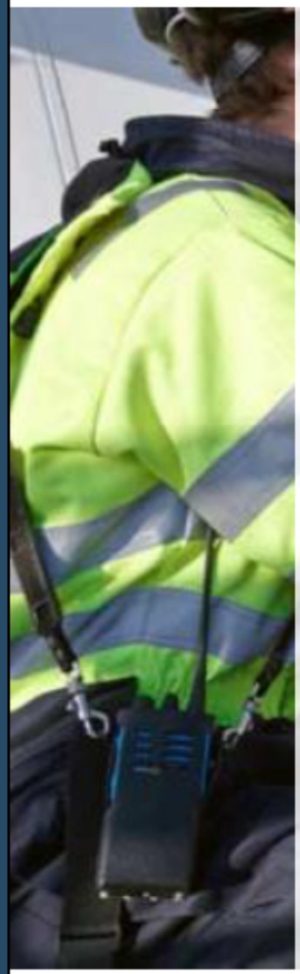
LNG Bunkering – Onsite Storage – Regulatory Context



A With onsite LNG storage

1 With re-liquefaction plant

2 No re-liquefaction

3 LNG ISO containers stored before plugging in

LNG bunker pier/ barge alongside

9

B With no LNG onsite storage

4 Multiple Truck-to-Ship Bunkering via common manifold

5 Truck-to-Ship bunkering (TTS)

6 Truck-to-Ship bunkering direct onboard (TTS_d)

7 Ship-to-Ship moored (STS_m)

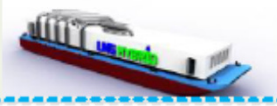
8 Pipeline-to-Ship

C With onsite temporary LNG storage

10 Temporary lay over of LNG Trailer

D Shore Side LNG Energy

11 Shore side LNG electricity supply – Power Barges



12 LNG Truck/Trailer fuelling operation

E At Anchor

13 Ship-to-Ship anchor (STS_a)

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Step-by-Step

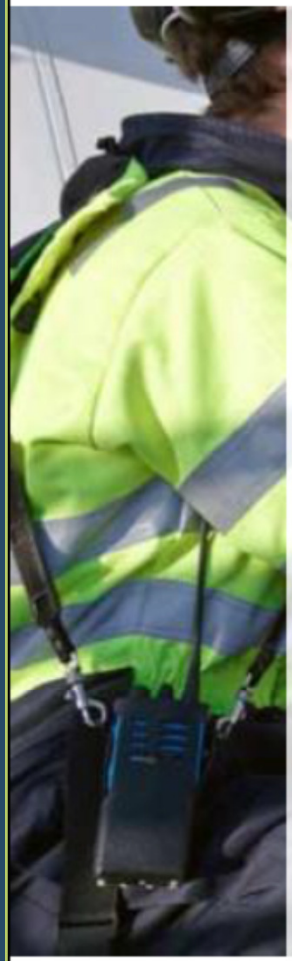
A. General | **B. Governance** | C. Risk & Safety | D. Organization | E. Bunkering | F. Emergency | G. Certification

LNG Bunkering – Onsite Storage – Regulatory Context

	Case	1	2	3	4	5	6	7	8	9	10	11	12	13
Applicable Safety Standard provisions to LNG bunkering facility	**Risk Assessment** EN ISO20519 – ISO/TS18683	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
	Emergency Response Plan (Consistent with Risk Assessment)	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑ (note 4)	☑	☑
	ADR (Carriage of Dangerous Substances road)				☑	☑					☑		☑	
	UNECE **Safety Guidelines & Good Practices for Pipelines**	☑	☑						☑					
Applicable SEVESO requirements to the LNG bunkering location	Article 7 (**Notification**)	>50t	>50t	>50t	>50t/ manifold	N/A	N/A	N/A	N/A	>50t	>50t	>50t	>50t	N/A
	Article 8 (**Major Accident Prevention Policy – MAPP**)	>50t	>50t (note 1)	>50t	>50t/ manifold	N/A	N/A	N/A	N/A	>50t	>50t	>50t	>50t	N/A
	Article 10 (**Safety Report**)	>200t	>200t	>200t	>200t/ manifold	N/A	N/A	N/A	N/A	>200t	>200t	>200t	>200t	N/A
	Article 12 (**Emergency Plan**)	>200t	>200t	>200t	>200t/ manifold	N/A (note 2)	N/A (note 3)	N/A (note 2)	N/A (note 4)	>200t	>200t	>200t (note 5)	>200t	N/A (note 6)

Step-by-Step

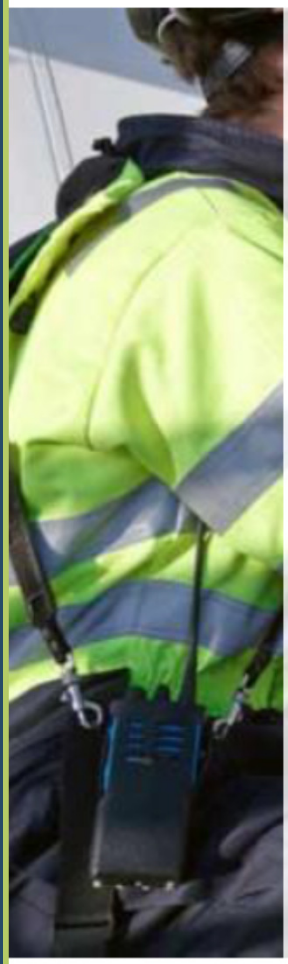
A. General | B. Governance | **C. Risk & Safety** | D. Organization | E. Bunkering | F. Emergency | G. Certification



8	**Risk**	• **LNG Risk / Safety including information on LNG safety hazards, risk assessment options, HAZID, HAZOP and related concepts.** • **Good practice guidance on how to assess/evaluate Risk Assessment Reports. List of relevant elements/contents for a Risk Study on LNG Bunkering.** • **Risk Criteria – Existing Risk Criteria applicable to LNG Bunkering.**
9	**Control Zones**	• Good practice in the approval and **definition of Control Zones, in particular of Safety Zone and Hazardous Zone.** • Examples of best practice application in the definition of Control Zones. • Safety Distance for **Meaningful Protection**

Step-by-Step

Meaningful Protection



Hazardous Zones

- Protection againts risk of ignition in locations where a frequency of occurence of explosive atmospheres is known.
- Present at all times, not dependent on operations, as long as the LNG bunkering lines, equipment and storage elements are not inerted
- Effective establishment of Hazardous Zones approved as per design and project elements .

Safety Zone

- Protection against risk of ignition in locations where explosive atmospheres may be present as a result of an accidental LNG release during LNG bunkering.
- Present only during LNG bunkering operation.
- Different calculation methodologies for best estimate of LNG vapour cloud dispersion

Security Zones

- Protection against external factors, derived from other operations and activities within the port area, in the vicinity of the LNG bunkering location.
- Present during LNG bunkering, from pre-bunkering to post-bunkering phases.
- Based on the situational awareness and evaluation of PAAs.

PAA Evaluation

- Evaluation based on the operational activity and infrastructure surrounding the LNG bunkering location.
- PAAs should exercise a critical evaluation of how effective are the control zones in the guarantee of acceptable risk levels .
- Location and context specific
- Should look for potential ignition or gas trapping potential points in the vicinity of th Safety Zone.

Meaningful Protection

- Meaningful Protection will derive from the effective implementation of the three defined Control zones (or more, depending on possible local/port requirements), added to the PAA Evaluation.
- Should include a discussion between different involved stakeholders, including aspects discussed in the risk assessment and addressing in particular infrastructure, multi-operator involvement, operations in the vicinity and passing tnautical and road raffic.

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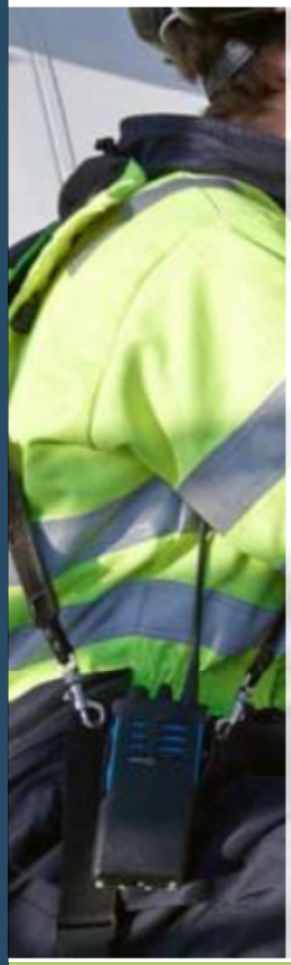
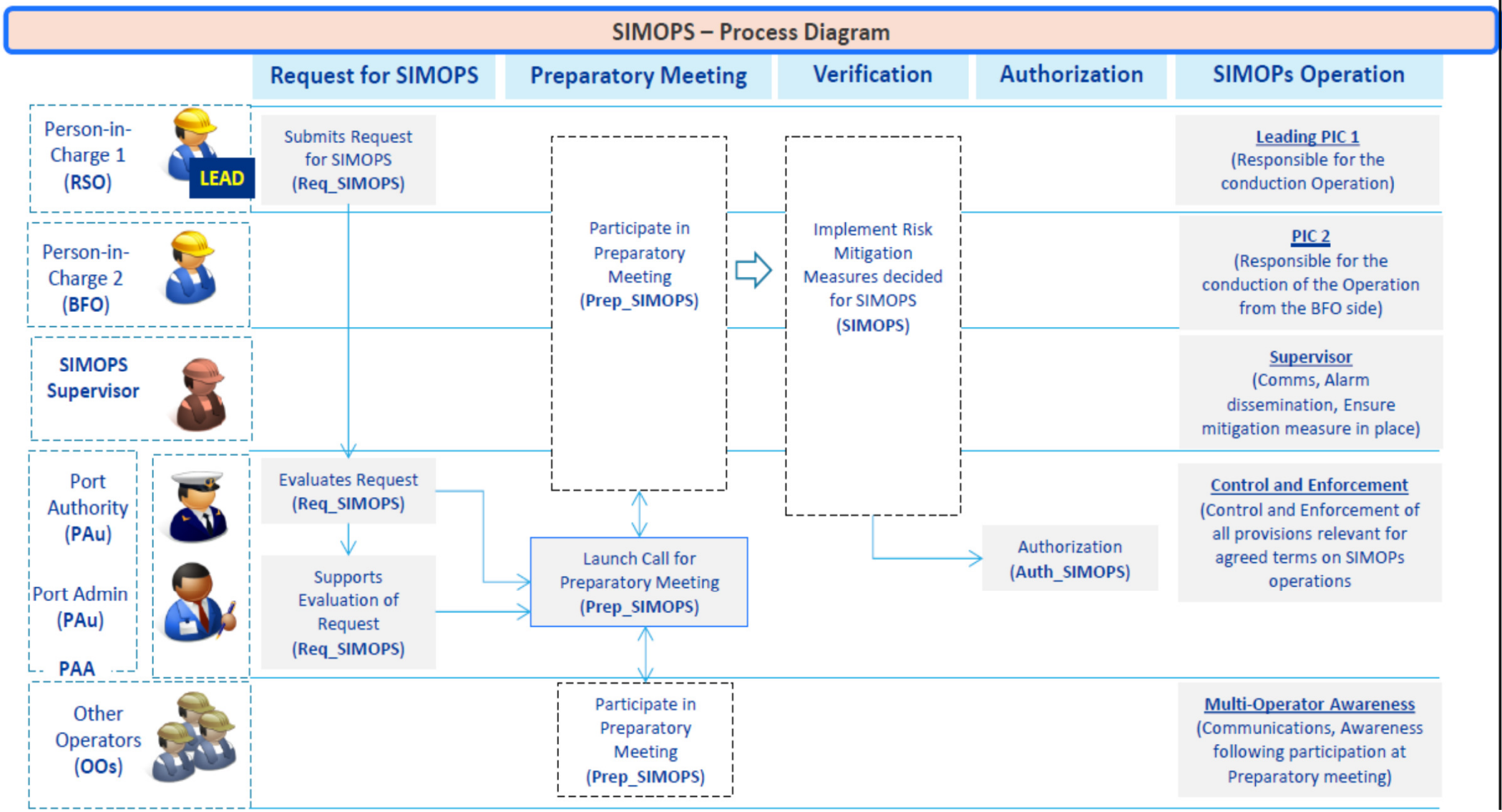
Step-by-Step



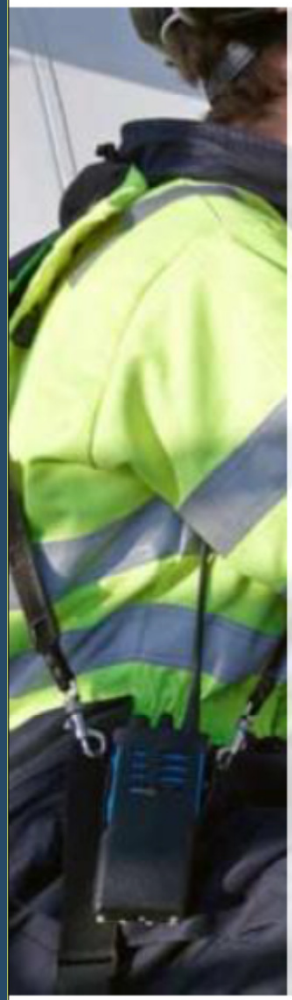
10	**Process Map & Organization**	• **The core process of LNG Bunkering operation is defined, with consideration for different LNG Bunkering concepts.** • **Definition of Responsibilities.**
11	**SIMOPS**	• Procedure for **Simultaneous Operations** – SIMOPS Supervisory Role.

Step-by-Step

A. General | B. Governance | C. Risk & Safety | **D. Organization** | E. Bunkering | F. Emergency | G. Certification

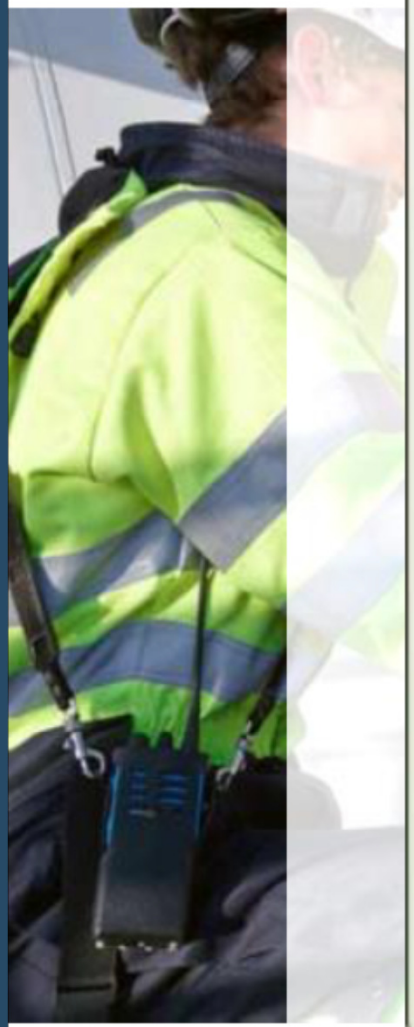


Step-by-Step



12	**Bunkering**	• **Bunkering process, with outline of the relevant events in bunkering.** • **Definition of the main technical concepts in the bunkering operation.** • **Outline of the necessary actions, from a Port Authority perspective, to be taken before, during and after LNG bunkering operation is authorized.** • **Procedures in Communications, Approval of Bunkering Operation, Implementation of Safety Controls, Verification**
13	**Incident Reporting**	• Definition of Good practice procedure for LNG Bunkering incident and near-miss reporting. • Check list / template provided with the essential elements suggested for LNG bunkering incident, or near-miss, reporting.
14	**Emergency Preparedness & Response**	• **Best practice in Emergency, Preparedness and Response in the case of LNG related incidents, addressing all hazards listed in sub-section 8.** • **Emergency Plan for LNG Bunkering.**

Step-by-Step



External Emergency Response
Local Fire Dept/ Emergency Response

- Local (External) Emergency level
- External Emergency Response

Site Emergency Response
Evacuation Procedures
Site Fire Brigade

- Local (Internal) Emergency level
- Onsite Fire brigade
- Port Area Emergency Plan

Mitigation
Mechanical Mitigaton Systems
Safety Instrumented System (SIS)
Operator Supervision

- Water curtains
- Physical barriers
- Foam blanket

Prevention
Mechanical Protection system
Process alarm with operator corrective action
Safety Instrumented System (SIS)

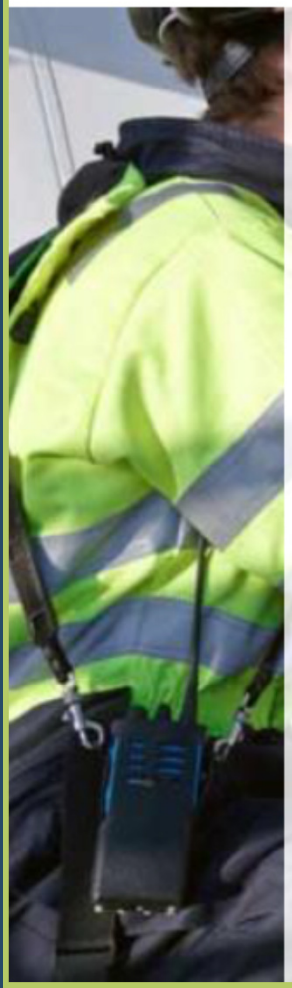
- ESD
- ERS/ERC
- Ventilation/Energy Shutdown

Control & Monitoring
Basic Process Control Systems (BPCS)
Monitoring Systems
Operator Supervision

- CCTV
- Instruments
- Alarms with visual/audible alert

LNG Bunkering

Step-by-Step

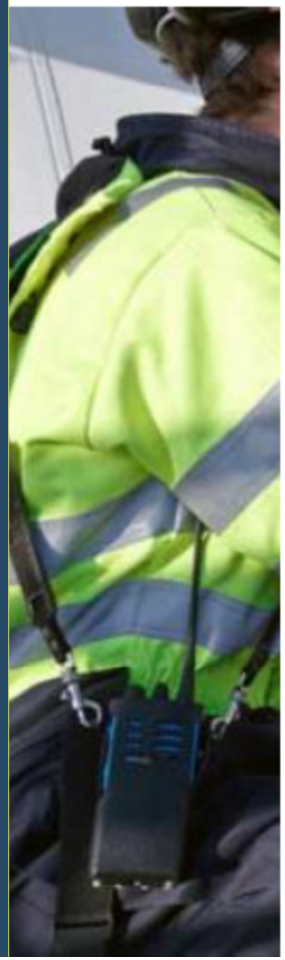


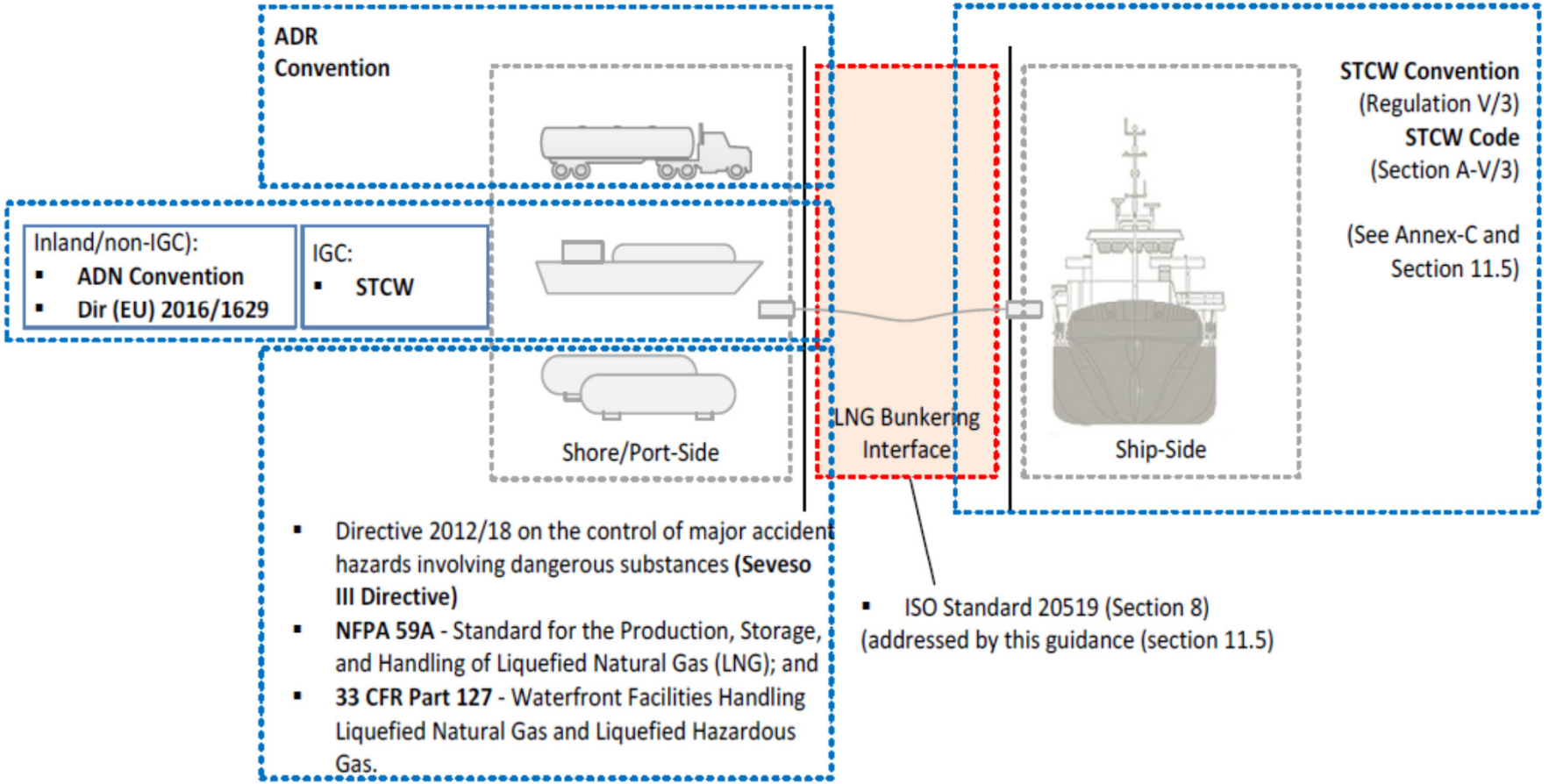
15	**Certification, Accreditation**	• **Definition and differentiation of the different concepts.** • **Certification of LNG Bunkering equipment. Identification of relevant certification processes** • **Good practice for the application of an Accreditation scheme for the BFO Bunker Facility Operator (Bunker supplier).**
16	**Qualification** **Training**	• **Qualification** for the necessary competencies to operate in LNG bunkering • **Training** for and on LNG Bunkering. In addition to the competences and qualification requirements. Training program for the Port Authority on LNG Bunkering supervision and Emergency response

Step-by-Step

A. General | B. Governance | C. Risk & Safety | D. Organization | E. Bunkering | F. Emergency | **G. Certification**

Training & Qualifications in the Interface





Regulatory Framework

High-Level Regulatory Instruments

High Level	•**IGF** Code/ SOLAS/ STCW •MARPOL - MARPOL Annex VI •EU Sulphur Directive •Alternative Fuel Infrastructure Directive •**National** Regulations	High level instruments are relevant in the definition of the **main drivers for adoption of LNG as an alternative fuel**. Mostly environmental related, globally/regionally binding.
Standards	•**ISO** Technical Specifications and International Standards •EN Standards •Equipment Standardization	Technical Standards are relevant for LNG bunkering operations and equipment, including small scale LNG storage. They are binding through reference to higher level regulatory instruments.
Class Rules	•**IACS** URs/Recs •**Class Rules** for Construction •Guidance Notes •Guidelines	Class Rules are relevant instruments for Classification Societies to ensure safety, quality and compliance in the application of international regulations, following a common technical interpretation of different provisions.
Industry Guidance	•**SGMF Guidelines** •Industry Guidance •Guidance Notes •LNG Bunkering Check Lists	Industry references are fundamental in definition of the best practices in LNG bunkering, both on equipment, safety, operations and outline of responsibilities. Non-binding set of best practices.
Port Local Regulations/ Byelaws	**Port specific regulations** Ports can set rules by themselves, addressing specific operational aspects and their specific context. Port Byelaws often reflect the nature of each port authority management principle. They are of local and limited application.	

Regulatory Framework

EN ISO 20519 - Specification for bunkering of liquefied natural gas fuelled vessels

Transfer system design requirements (Section 5)

- **Bunker vessel requirements**
- **Receiving Vessel requirements**
- **Facility requirements**
- **Transfer equipment requirements** (list of standards applicable to the transfer system components)
- **ESD/ERS systems** (Emergency Release System, including requirement for Emergency Release Coupling, **ERC**). Outline of functional requirements for system components.
- **Specific Requirements for**
  - **System Support**
  - **Hoses, corrugated metallic or composite**
  - **Transfer Arms**
  - **Bunkering Connections**
  - **Insulation Flange**
  - **Fall arrest**
- **Transfer system design analysis**
- **Maintenance/Maintenance manual**

LNG bunkering processes and procedures (Section 6)

- **Mooring**
- **Communication in preparation for a transfer**
  - **Information that the BSO shall provide to the RSO**, for each transfer and, specifically, for the first transfer.
  - **Information that the RSO shall provide to the BSO**, for each transfer and, specifically, for the first transfer.
- **Risk Assessment**
  - **Conditions Considered** for the Risk Assessment
  - **Methodology**
  - **Acceptable bunkering parameters**
- **Vessel Safety Assessment**
- **Transfer Procedures,** including aspects related to the PICs, manifold and hose watch during transfer, references to CCTV, check-lists, PPE

Management System/ Quality Assurance (Section 7)

- **Management Systems**
  Conformance with EN ISO 20519, through management objective in one of the following accredited management systems:
  - ISO 9001
  - ISO 14001
  - ISM
  - ISO/TS 29001
  - API Spec Q1
- **Management systems for transfer equipment manufacturers**

Regulatory Framework

A. General | B. High-Level | C. Standards | **D. Guidelines** | E. Ports Reg | F. Seveso | G. Governan

EN ISO 20519 - Specification for bunkering of liquefied natural gas fuelled vessels

Personnel training (Section 8)

- **Vessel personnel training requirements**
  - Minimum requirements: STCW, IGC and IGF provisions as applicable.
- **Additional training requirements for personnel involved in bunkering operations on vessels** (additional to requirements in STCW, ADR, ADN)
  - For personnel with assigned duties to LNG bunkering:
    - **Onboard a vessel**
    - **Port**
- **Documentation of training**

Records and Documentation (Section 9)

- **List of relevant records and documents that should be maintained for compliance with EN ISO 20519:**
  - Transfer System analysis
  - RSO vessel certification
  - BSO vessel certification
  - ISO 20519 compliance document for port facilites, vehicles, portable tanks.
  - Listing of maintenance and inspection of selected equipment (all the equipment listed in the transfer system)
  - Copies of all completed check-lists
  - Training Records
  - Copies of the Risk Assessment
  - **LNG Bunker Procedures Manual**
  - Bunkering parameters for the transfer system described, BFO and (to be kept by all parties adhering to EN ISO 20519)

Check-Lists (Annex A)

- **Minimum Check-list template included for:**
  - Planned Operations Checks (to be filled within 48h in advance)
  - Pre-Operational Checks (Pre-Bunkering check-list) – vessel-to-vessel
  - LNG Transfer (Checks immediately before transfer of LNG) – tank-to-tank.
  - SIMOPS
  - Post-bunkering (vessel-to-vessel)

Risk Assessment & Controlled Zones (Annex B)

- **Criteria and methodology for Control Zones definition** (same approach as ISO/TS 18683)

Regulatory Framework

ISO/TS 18683 - Guidelines for systems and installations for supply of LNG as fuel to ships

Properties and behaviour of LNG (Section 5)

- Properties and behaviour of LNG
- Description and hazards of LNG
- Potential hazardous situations associated with LNG transfer
- Composition of LNG as a bunker fuel

Safety (Section 6)

- Objectives
- General Safety Principles
- Approach

Risk Assessment (Section 7)

- **Qualitative Risk Assessment**
  - Main steps
  - Study basis
  - HAZID
  - Determination of Safety Zones
  - Determination of Security Zones
  - Reporting
- **Quantitative Risk Assessment**
  - Main steps
  - Study basis
  - HAZID
  - QRA calculation
  - Frequency Analysis
  - QRA Report

Functional requirements for LNG bunkering system (Section 8)

- Design and operation basis
- Compatibility between supplier and ship
- Prevention of releases of LNG or natural gas to the atmosphere
- Safety
- Functional requirements to reduce risk of accidental release of LNG and natural gas
- Requirements to contain hazardous situations
- Emergency preparedness.

Environmental Best Practice

		Bunkering Hoses Connection	Inerting Ox	Purge & Cool-down with LNG Vapour	START Bunkering Transfer	Top-Up	STOP Bunkering Transfer	Drain Bunkering lines	Inerting NG	Bunkering Hoses Disconnection
When Procedure complete	Objective/Description	▪ Following preliminary checks (see section 12, bunkering hoses are connected. ▪ Main transfer hoses and vapour return hoses can be considered	▪ Inerting of bunkering lines to displace oxygen from inside of the bunkering line – to avoid formation of explosive atmosphere ▪ Inert Gas used	▪ Also known as Gassing-up, or gas filling. ▪ Can be done with vapour purge line or with small volumes of new LNG ▪ Allows thermal shock to be avoided	▪ With cold lines and tanks both bunkering/transfer sides at similar temperatures, the bunkering begins.	▪ As the receiving ship tank is filled and aproaching its full conditon the rate must be reduced and the pressure constantly monitored. ▪ Procedure to be agreed between BFO and RSO.	▪ Once ensure no LNG is in the bunkering lines transfer is stopped. ▪ ESD shall not be used to stop bunkering transfer	▪ Drainage of bunkering lines to allow all liquid LNG to be displaced out of the bunkering line into RSO tank. ▪ LNG to vaporize in the lines while the valves leading to the ship's fuel tank are left open	▪ Inert the LNG bunker lines to prevent a flammable gas mixture from accumulating in the pipes or hose. ▪ Nitrogen typically used ▪ Also known as "Purging"	▪ Bunkering hoses disconnected after confirmation of <2% methane in volume inside the bunkering lines.
	Contents in the hose	Air	Inert Gas (nitrogen)	Warm LNG/ LNG Vapour	LNG liquid	LNG liquid	LNG vapour	LNG vapour	Inert Gas (nitrogen)	Air (nitrogen remain inerting the RSO bunker line)
	Temperature	Ambient	Ambient	Warm LNG (just above -160ºC)	LNG	LNG	LNG vapour	Warm LNG (just above -160ºC)	Ambient	Ambient
Environmental Risk Assessment	Potential for Methane release	▪ No potential methane release	▪ No potential methane release	▪ Potential for methane release if connections are not tight.	▪ Potential for methane release if connections are not tight. ▪ Potential pressure increase if RSO tank not cold enough (leading to PRV release)	▪ Methane release can occur if filling rate is not adjusted/ reduced when the tank filling is above 90% ▪ Tank overfilling leading to PRV release	▪ Potential for methane release due to overpressure in the bunkering transfer line (trapped volume) ▪ Potential for release is higher if ESD is used to stop bunkering.	▪ Liquid LNG in the bunkering line to vaporize onto RSO tank. ▪ If pressure in RSO tank exceeded (by excess of LNG vapour) PRV may be released.	▪ Operation with the highest potential for methane release. ▪ When displacing LNG vapour from the bunkering lines with nitrogen there is the risk of sending mixture to the atmosphere.	▪ Methane release to the atmosphere is possible if gas reading confirmation <2% methane has not been properly done.
	Methane Release Mitigating Measure	▪ **Bunkering hoses to be properly connected.** ▪ **Standard QC/DC to be used** ▪ **Flanges inspected before connection for dirt, moisture or condensations**	▪ **Check connections for leakages.** ▪ **Where any leak is suspected, stop Inerting for tightening/repair.** ▪ **Pressure test bunkering line**	▪ **Check connections for leakages.** ▪ **Where any leak is suspected, stop coo-down for tightening/repair.** ▪ **Pressure test bunkering line and inert.**	▪ **Start bunkering transfer only when temperatures are checked and agreed for stable transfer.** ▪ **Check carefully pressure at the receiving**	▪ **BFO and RSO to agree on a top-up rate.** ▪ **Carefull monitoring of pressure and tank level throughout bunkering transfer.** ▪ **Do not use ESD for automatic sut-down by high tank level**	▪ **Valve from the RSO to remain open for draining - purging.** ▪ **Control required from BFO to ensure that supply tank remains at adequate temperature and pressure.**	▪ **Drain procedure to be properly controlled.** ▪ **Ensure maximum LNG is drained in liquid form, minimizing the need to vapourize.** ▪ **Straighten "U" shapes in the hose to avoid LNG accumulations**	▪ **BFO and RSO should agree how to properly manage and dispose of the remaining NG and N2 so that no methane release occurs.** ▪ **NG/N2 mixture to be either compressed back to proper BFO tank, or consumed in GCU.**	▪ **Careful measurement of methane concentration before disconnecting hoses.** ▪ **Repeat Inerting procedure if concentration is >2%.**

VAPOUR MANAGEMENT

- Vapour management **should be agreed between BFO and RSO, in strict observation of PAA requirements on this matter**.

- **Options**: 1) accumulated in the RSO tank as NG compressed on top of the tank; 2) Top-spray filling to reduce pressure; 3) Vapour return lines for BOG collection by BFO; 4) GCU (BFO or RSO) or 5) re-liquefaction on either side

Planning & Operations

A. LNG Bunkering Map | B. Responsibilities | C. SIMOPS | C. LNG Bunkering Management Plan

Planning Stage

FEASIBILITY → **RISK ASSESSMENT** → **LNG BUNKERING MANAGEMENT PLAN**

Scoping → Evaluation → Permit Application → Scoping → HAZID → Risk Assessment → Prepare → Submit/Approval

PERMITTING

• Before developing a Feasibility Study for LNG Bunkering BFO/RSO have shared the Concept Project with PAA. • Location specific elements have been collected. • Technical solution feasibility has been assessed.	• All concept project elements defined from Feasibility Studies. • Risk Assessment methodology accepted and Risk Criteria informed by PAA/competent authorities. • Risk Assessment conducted with involvement of all Stakeholders • Possible Safeguards added to the LNG bunkering project.	• Complete LNG bunkering project (technical and operational) defined. • Elements for LNG Bunkering Management Plan to follow IACS Rec.142 (Sections 1.5 and

Operation

PRE-BUNKERING			CONNECTION	BUNKERING		COMPLETION	POST-BUNKERING
Preparations	Safeguards	Authorization	Connection	Test	Transfer	Completion	Disconnection
General	Control Zones	Check-List	Leak test	ERS	Control	Draining/ Stripping	Documentation
Compatibility	PPE	Procedure	Grounding	ESD	Supervision	Purging	Incident Reporting
Individual Safety	Cryo Protection		Purging/ Inerting	Cooldown test	Monitoring	Inerting	
Local Conditions	Detection and Alarms				BOG		
Mooring	Electric Isolation				Top-Up		
Communications	ERS						
Personnel							
Pre-Cooling							

Planning & Operations

A. LNG Bunkering Map | B. Responsibilities | **C. SIMOPS** | C. LNG Bunkering Management Plan

Operation ID (figure 11.1)	Short Description
A	**Load-on/Load-off** containers with overhead gantry crane (separated from bunkering location by >2xSD)
B	**Load-on/Load-off containers with overhead gantry crane** (inside the Safety Zone)
C	**Corrective Maintenance operation inside the Ship bunker station** (Hazardous Zone)
D	**Corrective Maintenance operation inside the Ship** (outside Control Zone reach)
E	**Operation on Hazardous Zone, onboard**
F	**Operation outside the LNG bunkering scenario,** occurring at a nearby warehouse/infrastructure
G	**Operation outside the LNG bunkering scenario, occurring at a nearby berth –** handling of hazardous substances

- During Planning RSO/BFO submit elements relative to SIMOPS (this will however be only the case where RSO/BFO share an agreement for LNG bunkering, having been involved in preliminary Risk Assessment study, HAZID, and in the overall design of operations.
- Elements relevant to SIMOPS **should be included in the LNG Bunkering Management Plan**, to be approved by PAA.
- There should also be evidence of an Internal Emergency Response Plan, inclusive of SIMOPS elements.

PLANNING/ Permitting Phase

1 **RISK ASSESSMENT Evaluation for SIMOPS**
RSO/BFO include elements relative to SIMOPS in the LNGBMP, including safeguards derived from Risk Assessment

SIMOPS Request

PRE-OPERATION Pre-Bunkering Phase

2 **Verification RISK ASSESSMENT for SIMOPS**
Check Risk Assessment scenarios cover the intended SIMOPS details Pre-Bunkering

3 **SIMOPS Meeting Pre-Operation**
PAA to launch call for SIMOPS meeting - All stakeholders involved to be called for meeting

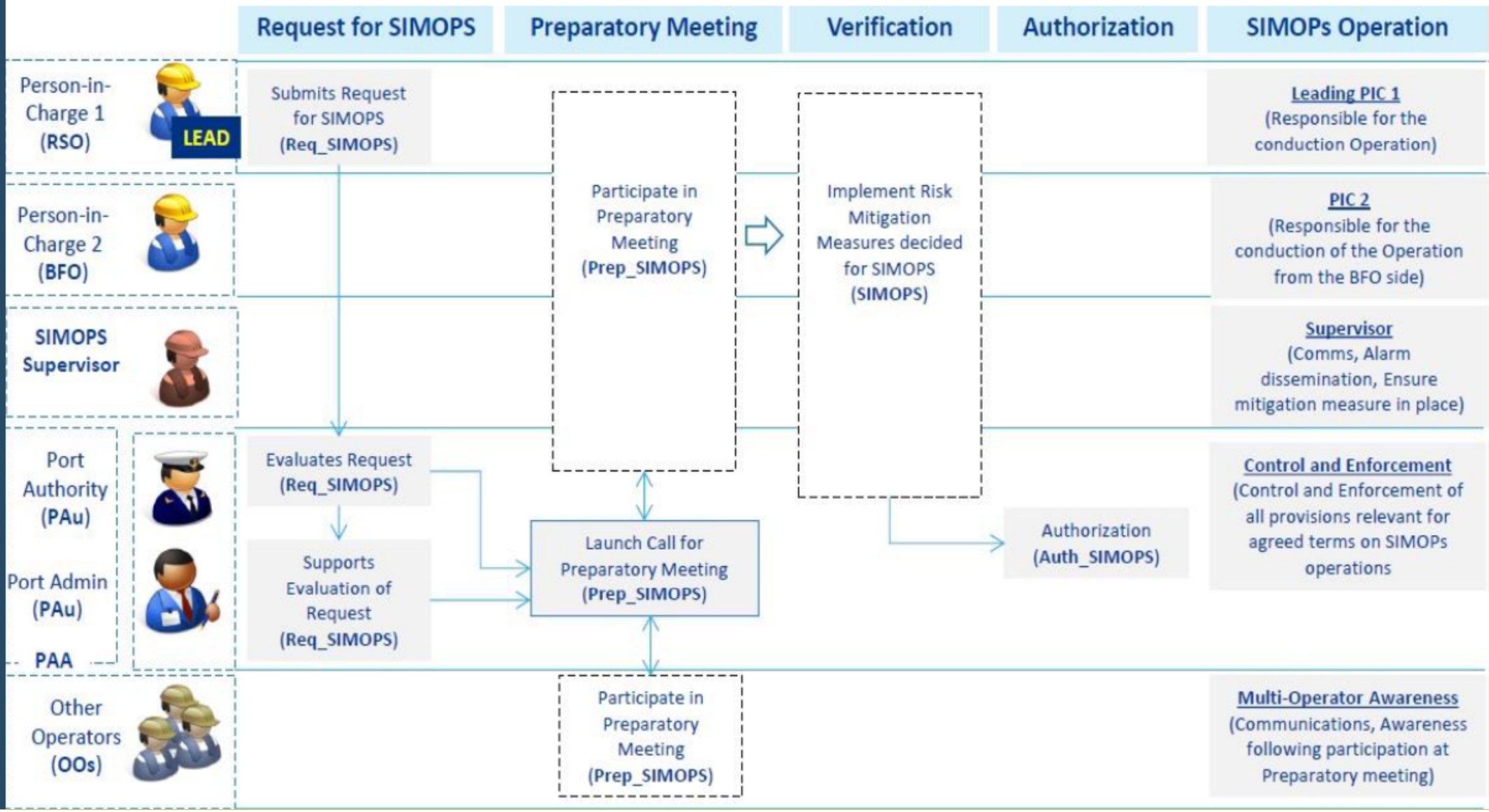
OPERATION Bunkering Phase

4 **SIMOPS Execution**

	Security Zone (No RA)	Safety Zone (QualRA)	Hazardous Zone (QRA)
2	**Security Zone** For the Security zone no special recommendation is given. To be considered in a QualRA for especially complex operations, in specific relevant situations.	**Safety Zone** Verify that SIMOPS required are covered by adequate Risk Assessment, approved in the LNGBMP. **For SIMOPS in the Safety Zone a QualRA is recommended.**	**Hazardous Zone** Verify that SIMOPS required are covered by adequate Risk Assessment, approved in the LNGBMP. **For SIMOPS in the Hazardous Zone a QRA is recommended.**
3	**Security Zone** Determine whether operations within Security Zone may affect LNG bunkering. **PAA provide operational overview of the port area in the Security Zone envelope**	**Safety Zone** Agree with all stakeholders involved on the operations that may take place simultaneously in the Safety Zone. **SIMOPS Supervisor to hold the Overview.** Deviations from QualRA to be addressed	**Hazardous Zone** Discuss any SIMOPS intended for the Hazardous Zones. **Check conditions in existing QRA.** **SIMOPS Supervisor to hold the Overview** No Deviations from QRA are possible
	SIMOPS – AUTHORIZATION		
4	**Security Zone** Monitoring of operations taking place within the Security Area of the PAA responsibility. Communications established with PIC (Lead).	**Safety Zone** SIMOPS in Safety Zone agreed. **SIMOPS Supervisor to hold the Overview.** Deviations from QualRA to be verified and registered	**Hazardous Zone** SIMOPS in Hazardous Zone **SIMOPS Supervisor to hold the Overview** At any deviation from agreed QRA condition SIMOPS to be halted.

Planning & Operations

A. LNG Bunkering Map | B. Responsibilities | **C. SIMOPS** | C. LNG Bunkering Management Plan



Risk & Safety

- Is the Whole System represented?
- IS it detailed enough?
- Are all Operational scenarios considered?

- Is the HAZID Team Competent enough? And its Team Leader?
- Is there representativensess ensured from all parties involved/affected)
- Has the Port Authority been represented?
- Is the Hazard List extensive?

- Are there statistics available?
- Which Method?
  - Analysis of historical incident data;
  - Fault tree analysis;
  - Event tree analysis;
  - Simulations.

- Which Risk Criteria?
- Yearly averaged Risk Criteria or Operation Specific?
- How was the Risk Criteria defined?

Data collection and description of system

Collection and analysis of complementary data

Hazard Identification (Development of scenarios)

Frequency analysis

Consequence analysis

Risk determination

Risk criteria

Risk assessment

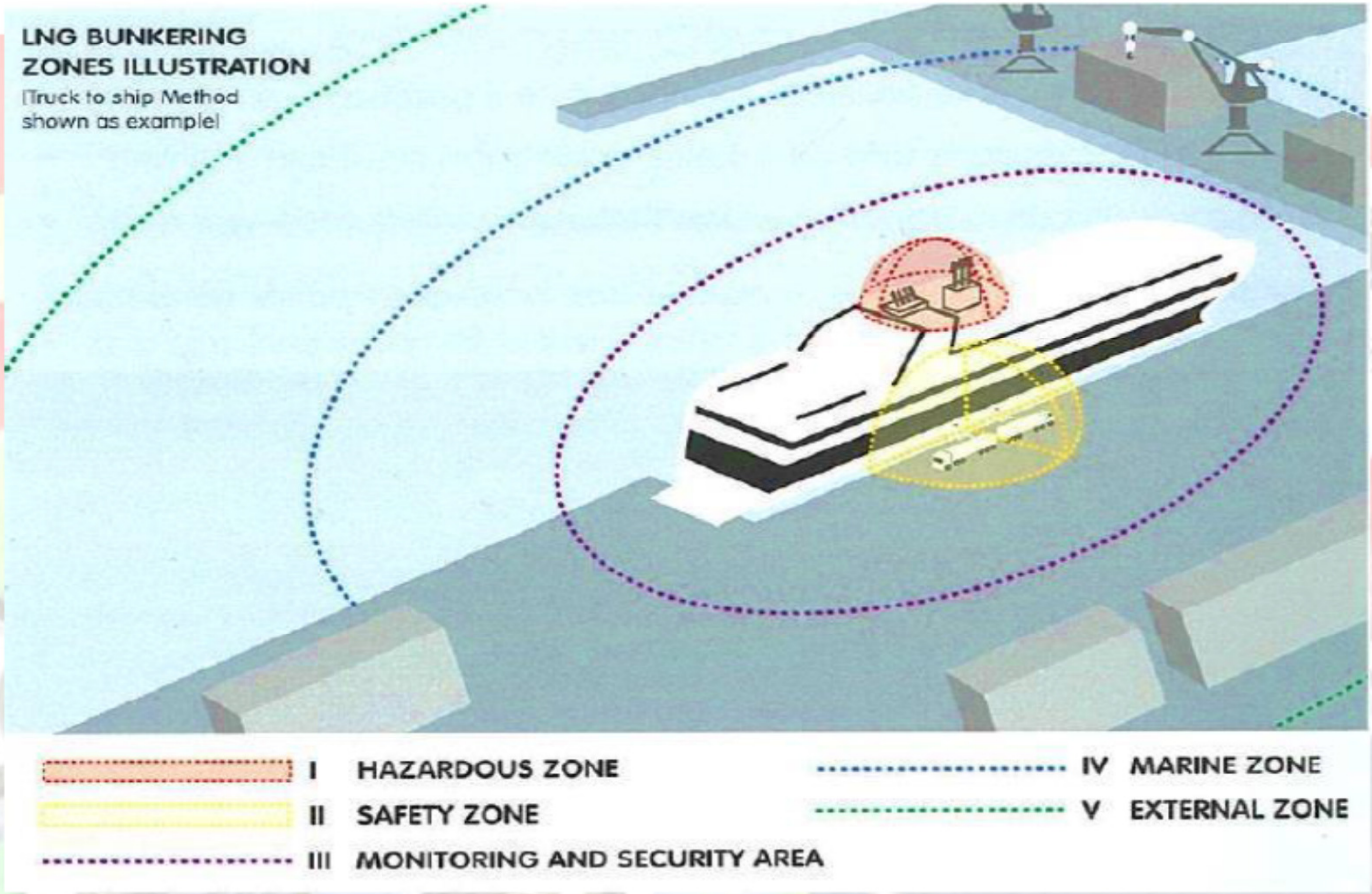
Finally Accepted Situation

Re-evaluation

Proposal of risk mitigation measures

- Software tool used is validated and recognized?
- Which previous cases? References?
- Which parametrization was used?
- Validation of the tool by experimental tests?

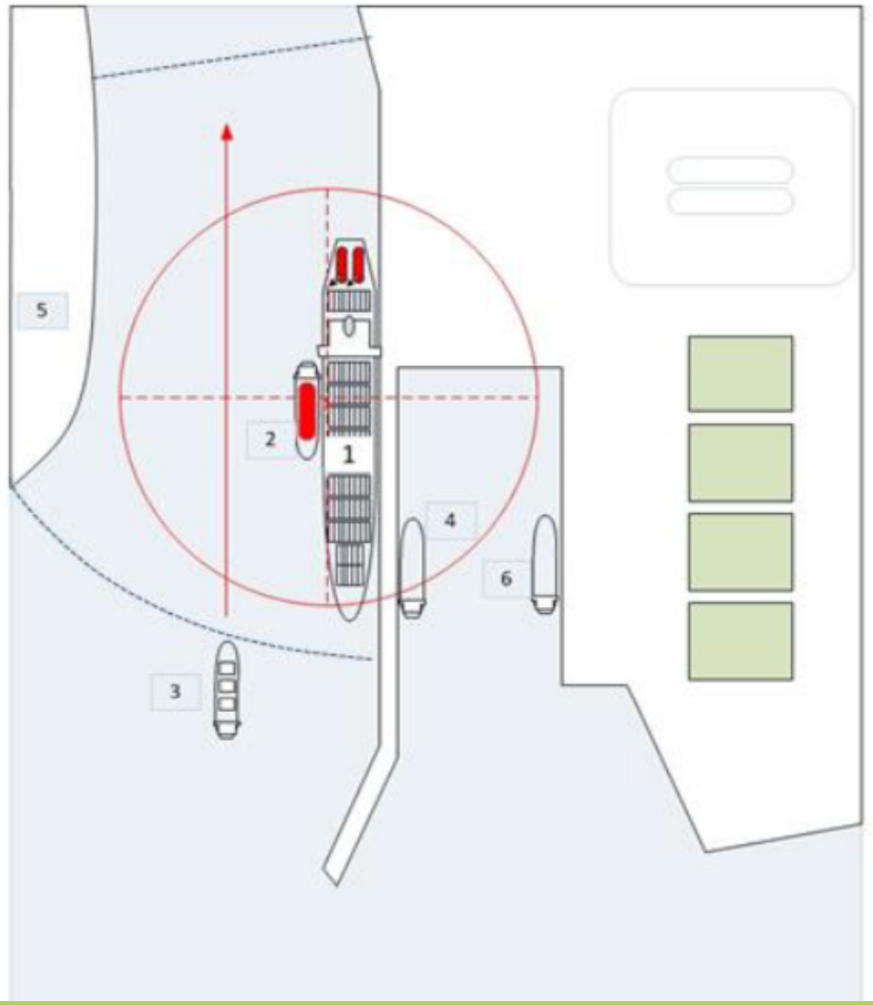
SGMF

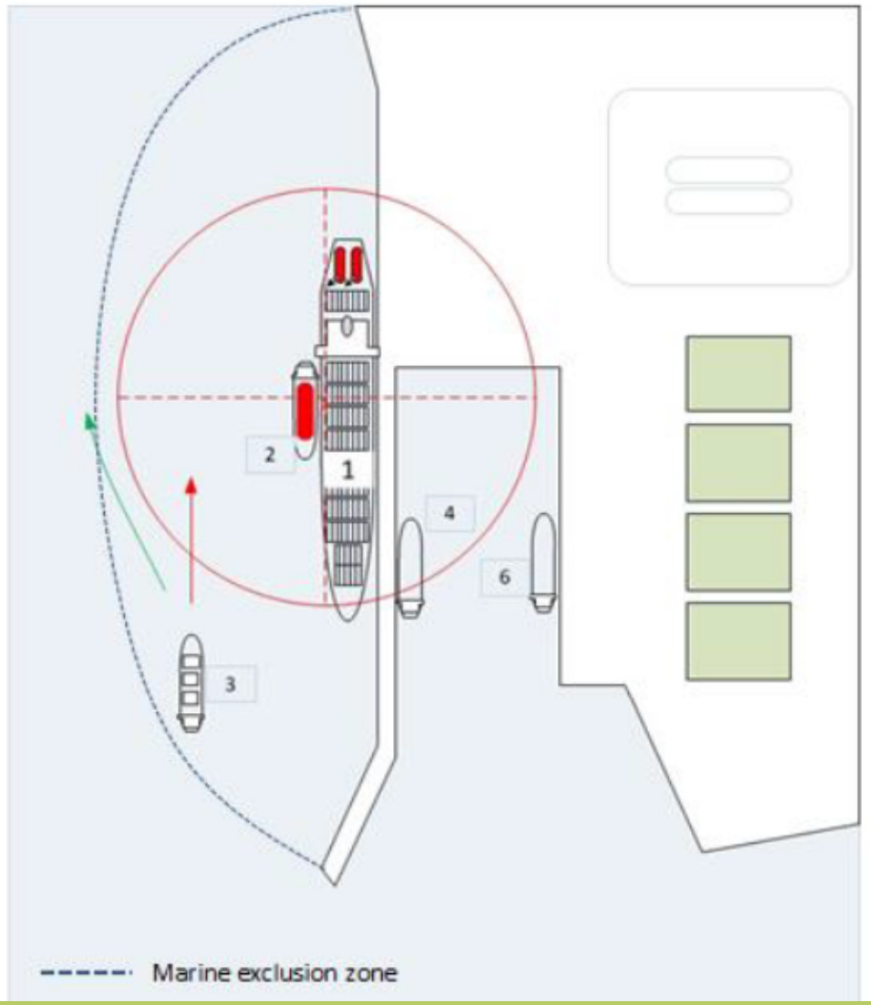

LNG BUNKERING
ZONES ILLUSTRATION
(Truck to ship Method
shown as example)
I HAZARDOUS ZONE
II SAFETY ZONE
III MONITORING AND SECURITY AREA
IV MARINE ZONE
V EXTERNAL ZONE

Step	Description	Responsibilities
Calculate	• **Calculation of the distances and shape** of the Control Zones to establish • Clarification of the **factors affecting LNG bunkering** , in particular those with an impact on safety distance calculation.	• **Operator** (responsible for the calculation of all relevant Control Zones) • Responsible for the use of all available references for calculation
Plan	• **Define the necessary Control Zones plan** in accordance with the LNG bunkering plan. • **Draw control zones on port local map**, highlighting all infrastructure elements in the vicinity of the bunkering location	• **Operator** (responsible for the planning of all relevant Control Zones)
Share	• Communicate Control Zones' plan to other Operators in the Port Area, which are likely to be affected by their implementation and enforcement. • Receive input from other Operators - Check feasibility.	• **Operator** (responsible for sharing the pre-approved Control Zones plan with other operators)
Approve	• Submit proposed Control Zones, with supporting calculations and plan drawings • Approval of Hazardous and Safety Zones by PAAs	• **Operator** (responsible for the preparation of the Control Zones Plan and for its **submission to PAAs** • PAA (responsible for **Approval**)
Implement	• Physical implementation of the Control Zones (signs, barriers, traffic control, access control). • Determination of the necessary resources to put the Control Zones in practice.	• **Operators** are responsible for the implementation, with PAA support.
Control	• Effective enforcement of Control Zones should be possible at any point of the LNG bunkering operation • Control Zones plan should include a strategy for effective enforcement	• **Operators and PAAs should work together closely for the enforcement/ control of the different Control Zones.**

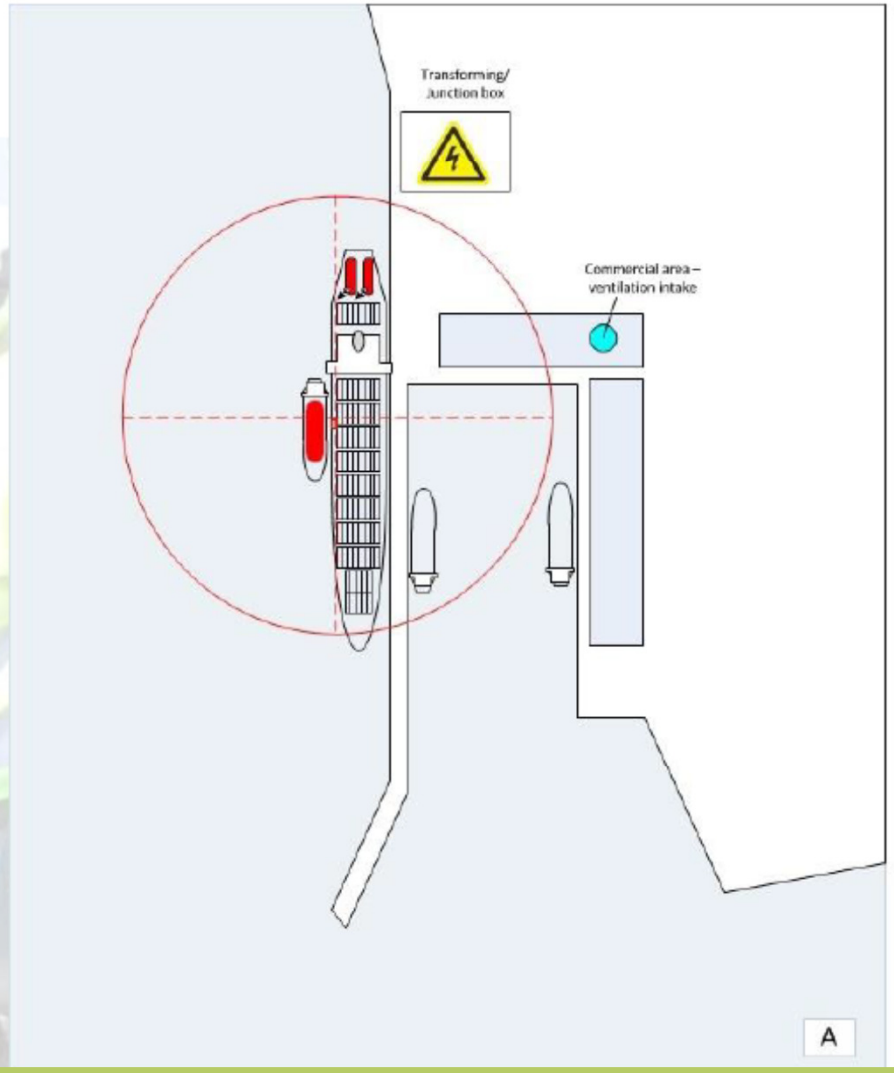
EMSA

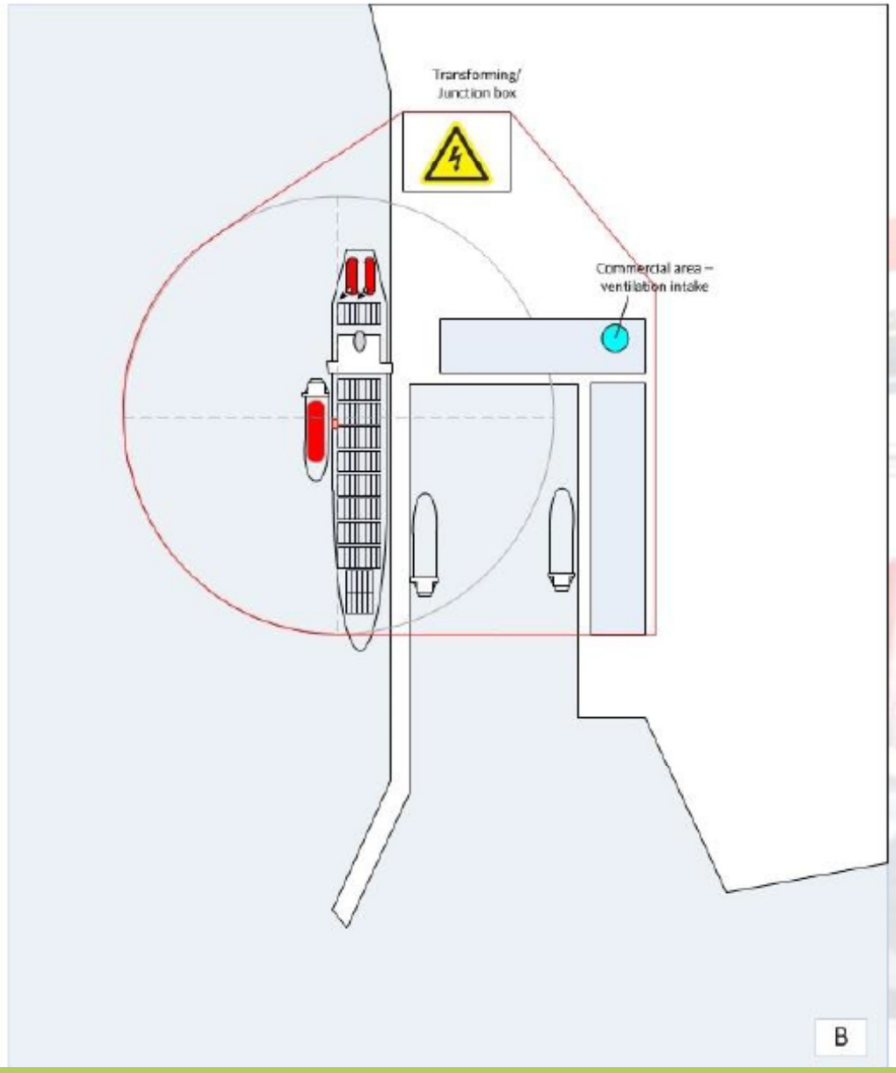
Marine Exclusion Zone – A difficult one





Control Zones

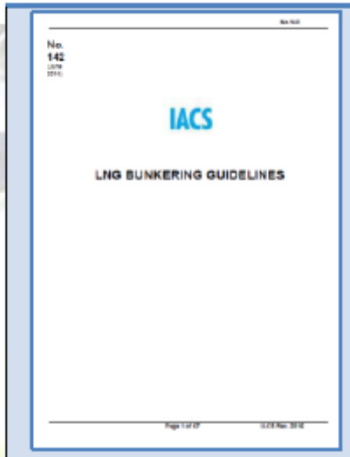




Guidelines

CleanPort

IACS Rec142 – LNG Bunkering Guidelines

Document		By	Available at	Short description
	**IACS Rec 142** LNG Bunkering Guidelines	IACS	http://www.iacs.org.uk/publications/recommendations/ (available for free)	This guideline provides recommendations for the responsibilities procedures and equipment required for LNG bunkering operations and sets harmonized minimum baseline recommendations for bunkering risk assessment, equipment and operations. IACS Rec.142 is, in practice, the result of a dedicated Working Group with experts from different Classification Societies, bringing together several references to existing guidelines/material into one document. In particular, the following items are covered: • The responsibility of different parties involved in the LNG transfer, • The LNG bunkering process, • SIMOPs, • Safety distances, • QRA and HAZID. It has been today reflected integrally into the 2nd Version of the SGMF Bunkering Guidelines.

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SGMF – Bunkering Safety Guidelines v2

Document	By	Available at	Short description
	SGMF	www.sgmf.org (available for purchase)	The Society for Gas as a Marine Fuel (SGMF) launched the first version of the SGMF Guidelines in February 2015, representing an important milestone in the efforts by different industry stakeholders to lay down best practice guidance that could support the safe development of LNG Bunkering operations. SGMF Safety Guidelines for LNG bunkering include the following parts: • **LNG Hazards**, with an extensive description of potential hazards that have to be considered when addressing safety in LNG bunkering operations. • **Safety Systems**, with • **Bunkering Procedure**, addressing the different processes in LNG Bunkering, from Compatibility Assessment to Post-Bunkering disconnection. • **Situation specific guidance**, with considerations on the different types of LNG bunkering modes that are possible.

SGMF

LNG Bunkering Guidelines

Safety Guidelines

Version 1
February 2015
Version 2
April 2017

Muchas gracias.

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Naturgy BALEARIA Port de Barcelona GOBIERNO DE ESPAÑA DIRECCIÓN GENERAL DE LA MARINA MERCANTE Ports de Balears Autoritat Portuària de Balears