Germanischer Lloyd

Final report

European Maritime Safety Agency (EMSA)

Study on Standards and Rules for Bunkering of Gas-Fuelled Ships

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European Maritime Safety Agency (EMSA) - Study on Standards and Rules for bunkering of gas-fuelled Ships

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Title:

Final report
European Maritime Safety Agency (EMSA)
Study on Standards and Rules for bunkering of gas-fuelled Ships

Abstract:

Stringent international regulations on air emissions are forcing the shipping industry to rethink it fuelling options. The IMO's Marine Environmental Protection Committee has introduced emission controls which will increasingly affect international shipping over the next decade. The introduction of Emission Control Areas (ECAs) in European, U.S. and Canadian territorial waters means that ship owners must begin to consider alternatives to traditional heavy fuel oil. One possible solution is the switch to LNG as ship fuel.

Due to the significant number of activities within the field of rule development for gas as ship fuel and bunkering of LNG the objective of this report is to provide a detailed description of the existing rule framework related to LNG bunkering. Through a gap analysis missing and foreseeable lack of rules for bunkering of LNG and related aspects are identified. This report will also provide recommendations for possible common EU wide guidelines for bunkering LNG as ship fuel.

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List of Abbreviation

BLG	IMO Sub-Committee on Bulk Liquids and Gases
ADN	International Carriage of Dangerous Goods by Inland Waterways
ADR	International Carriage of Dangerous Goods by Road
CCNR	Central Commission for the Navigation on the Rhine
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CNG	Compressed Natural Gas
DMA	Danish Maritime Authority
DNV	Det Norske Veritas
EC	European Commission
ECA	Emission Control Area
ECSA	European Community Shipowners Association
EMSA	European Maritime Safety Agency
ESPO	European Sea Ports Organisation
ETSI	European Telecommunications Standards Institute
GIIGNL	International Group of Liquefied Natural Gas (LNG) Importers
GL	Germanischer Lloyd
HFO	Heavy Fuel Oil
IAPH	International Association of Ports and Harbours
ICS	International Chamber of Shipping
IEC	International Electrotechnical Commission
IGC	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IGF	International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels
IGU	International Gas Union
IMDG	International Maritime Code for Dangerous Goods
IMO	International Maritime Organisation
ISGOTT	International Safety Guide for Oil Tankers & Terminals
ISO	International Organisation for Standardisation
LESAS	Legal and Safety Assessment
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MSC	Maritime Safety Committee of the IMO
MGO	Marine Gas Oil

NG	Natural Gas
NMA	Norwegian Maritime Authority
OCIMF	Oil Companies International Marine Forum
PMoU	Paris Memorandum of Understanding on Port State Control
PTS	Pipeline/Terminal-to-Ship
RVIR	Rhine Vessel Inspection Regulations
SIGTTO	Society of International Gas Tanker and Terminal Operators
SOLAS	International Convention for the Safety of Life at Sea
STCW	The Seafarers' Training, Certification and Watchkeeping Code of the IMO
STW	IMO Sub-Committee on Standards of Training and Watchkeeping
STS	Ship-to-Ship
TC	Technical Committee
TFEU	Treaty on the Functioning of the Union
TTS	Truck-to-Ship
UNECE	United Nations Economic Commission for Europe
WPCI	World Port Climate Initiative

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1 Executive Summary

Maritime environmental regulations and the continuous development of the economic operation of ships let to the development of numerous gas-fuelled ships and ship designs. Currently about 30 gas-fuelled vessels are operating mostly in the Baltic Sea and Norwegian waters most of them on the authority of the Norwegian administration. Hence, Norway had early on experience with gas as fuel for ships and initiated the development of the IMO's international 'Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships' in 2004. These interim guidelines (MSC Resolution 285.(86)) were adopted in June 2009 and focus on the use of natural gas on board of vessels and the requirements for the installations on board. Besides the interim guidelines, the use of LNG as a maritime fuel for ships is not formally recognized by IMO rules. To facilitate the approval process for gas-fuelled vessels a code for the use of gas as ship fuel is being developed. This 'International Code of Safety for ships using gases or other low flashpoint fuels (IGF Code)' is still under development and will cover safety and operational issues for gas-fuelled seagoing vessels. In comparison to the above mentioned guidelines, the IGF Code will have the status of an internationally adopted and legally binding regulatory instrument. Regarding the bunkering of LNG, the IGF Code will define requirements for the bunkering systems onboard the receiving vessel and general operational requirements regarding the preparation, post processing, responsibilities and communication focusing the (receiving) gas-fuelled ship. No specific operational guidance taking into account all types of bunkering modes and requirements for each kind of transfer system for all facilities involved are considered.

To close the gap regarding the bunkering of LNG as fuel for ships in the regulatory framework, another Norwegian initiative led to the establishment of the Working Group 10 (WG 10) within the Technical Committee 67 (TC 67) of the International Organisation for Standardisation (ISO) in 2011. The objective of the ISO TC 67 WG 10 is the development of international guidelines for bunkering of gas-fuelled vessels focusing on requirements for the LNG transfer system, the personnel involved and the related risk of the whole LNG bunkering process. The members of the WG 10 decided to develop a technical report as a high level document to be finalized by 2014. For the time being, with experiences of bunkering of LNG being not widespread, Working Group 10 is not able to develop an international standard for bunkering LNG.

While regulations for the use of gas on seagoing vessels and the related bunkering guidelines are already under development, similar activities for inland vessels have just started. Unlike the rule framework for seagoing vessels, the transport of LNG by inland tankers is not allowed. Within the 'European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)' the necessary entry of LNG within the cargo list is missing, which leads to the prohibition of transport via inland waterways tanker. For both unregulated items, the transport of LNG as cargo by inland waterway tanker and the use of LNG as fuel for inland waterway

vessels, activities are initiated to develop necessary appendixes of the ADN and the Rhine Vessel Inspection Regulations.

The existing guidelines of the 'International Society of Gas Tanker and Terminal Operator (SIGTTO)' and those by the 'International Oil companies Marine Forum (OCIMF)' describe the handling and transport of LNG as cargo. However, these documents cannot directly be used for regulating the bunkering of LNG as ship fuel due to the fact that these documents are dealing with the transport and transfer of large quantities of LNG as cargo and handled by an experienced crew on ships and terminals. For the bunkering of LNG as ship fuel, safety requirements given by SIGTTO and OCIMF may be adapted for the handling of smaller amounts of LNG, a bunkering process which takes place at any berth within harbour areas, between different types of bunker sources and receiving vessels as well as handling by crews with little or no experience in daily handling of LNG and in the presence of passengers on board of the vessels.

In summary, the regulatory framework for bunkering of LNG as fuel for ships including relevant regulations of the LNG supply chain (transport on inland water ways) is not available for the time being but can be based on other existing standards and guidelines e .g .the SIGTTO 'Ship to Ship Transfer Guideline' for the Ship to Ship bunkering or the ISO 28460 'Ship to shore interface and port operations' for the Terminal to Ship bunkering of LNG. Gaps (an overview of all gaps is provided in chapter 10) related to LNG bunkering could be addressed by a possible common EU regulatory instrument (i.e. legislation, recommendations or guidelines) with focus on:

- The definition of the bunkering process
- Common risk assessment procedure for approval processes
- Common risk evaluation criteria
- Common safety distances for bunkering processes
- Environmental aspects due to the release of methane
- EU wide procedures for the definition of gas quality and sampling

For all possible LNG bunkering activities and related processes the general safety principle as stated in the Draft LNG bunkering of the ISO TC 67 Working Group 10 should be followed:

"***Safety*** *should be the primary objective for the planning, design and operation of facilities for the delivery of LNG as marine fuel*".

2 Introduction

2.1 Objective

Stringent international regulations on emissions are forcing the shipping industry to rethink its fuelling options. The IMO's Marine Environmental Protection Committee has introduced emission controls, which will increasingly affect international shipping over the next decade. The introduction of Emission Control Areas (ECA's) in European, U.S. and Canadian territorial waters means that ship owners must begin to consider alternatives to traditional heavy fuel oil. One solution is the switch to LNG as ship fuel.

Due to the number of activities within the field of rule development for gas as ship fuel and bunkering of LNG the objective of this report is to provide a detailed description of the existing rule framework related to all elements of the bunkering supply chain, focusing on the LNG bunkering of gas-fuelled vessels wherefore the rule development activities have recently been started. A gap analysis identifies the existing and foreseeable remaining items and the possible need for any further rule development regarding bunkering LNG at an EU level. Based on the gap analysis and further input from stakeholder interviews and conferences, this final report of the "study on standards and rules for bunkering gas-fuelled ships" provides recommendations for possible common EU wide guidelines for bunkering gas-fuelled ships.

2.2 Methodological Approach

This study was commissioned by EMSA to follow-up on the in 2011 published Commission Working Paper titled "Sustainable Waterborne Transport Toolbox[1]", the recommendations of the EU co-financed study "North European LNG Infrastructure project" coordinated by the Danish Maritime Authority and the conclusions of the Commission/EMSA LNG expert working group meetings which were organised in April and June 2012[2]. One of the conclusions of these meetings were to carry out an in-depth gap analysis looking into the existing regulatory framework for LNG bunkering as well as the different guidelines currently under development. A kick-off meeting took place mid August in Lisbon with the responsible EMSA project officer. Questionnaires aiming to identify possible regulatory gaps were sent to the participants of the Commission/EMSA LNG expert working group and a number of other identified stakeholders (see chapter 13). Based on an explorative desk research and stakeholder input the most relevant existing rules, guidelines and the current development of the rule framework regarding the production, transport, transfer and use of LNG as ship fuel are presented within this report. The unregulated aspects within the existing rule framework regarding bunkering of LNG as ship fuel are identified and listed taking into account the objectives and the current work development of the Standardisation bodies. The study also

[1] SEC(2011) 1052 final, 16 September 2011

[2] http://www.emsa.europa.eu/main/sustainable-toolbox/meeting.html

includes recommendations for possible common EU wide guidelines for bunkering gas-fuelled ships to cover the identified gaps and possible solutions for remaining gaps are recommended. Interim results of the desk study and stakeholder input from the first questionnaire including a first draft of the possible common European LNG bunkering guideline were presented and discussed during the third Commission/EMSA LNG as shipping fuel working group which took place in Brussels in December 2012. Stakeholders were invited to send in further comments on the preliminary results which were consequently integrated in the final report.

2.3 Limitations to the Study

Focus of this study is the International and European situation regarding rules and guidelines for bunkering gas-fuelled ships, both existing or under development. It should be recognized that there are various regulatory/standardization initiatives still on-going and that new developments have been mentioned until February 2013. As for national and local guidelines and regulations, a number of examples from European countries and ports have been taken into account. With the except for examples of national rules and guidelines from the United States no countries outside of the EU have been considered in this study.

3 Classification of the Bunkering Process

In order to get an overview of the existing rule framework for bunkering gas-fuelled vessels possible LNG bunker operations and the related LNG supply chain is identified in the following and is used to classify the rule framework by means of a technical approach along the LNG supply chain.

3.1 Overview of possible LNG Bunkering Operations

The use of Liquefied Natural Gas (LNG) as a ship fuel is one possible solution to reduce the atmospheric emissions from shipping to air. To ensure a competitive fuel supply, LNG bunkering must be possible for each type of gas-fuelled vessel under the same conditions as bunkering Heavy Fuel Oil (HFO). This includes the safe bunkering of LNG during cargo loading and unloading, as well as during passenger embarking and disembarking operations. An overview of the range of possible LNG bunkering operations within a port is illustrated in Figure 1.

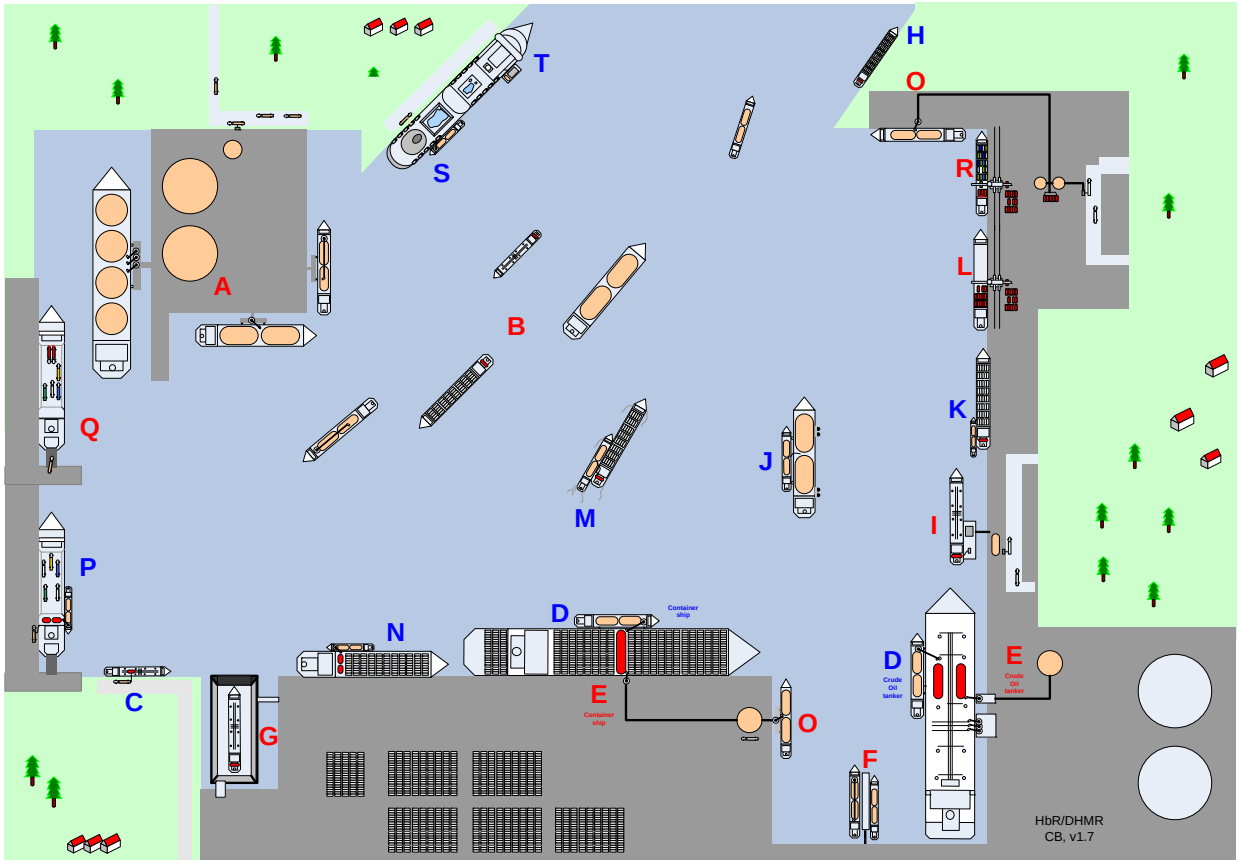

Figure 1 – Potential LNG port activities in 2020 (source: Port of Rotterdam)

Table 1 – Legend to figure 1 – Potential LNG port activities in 2020 (source: Port of Rotterdam)

A	Large LNG terminal, break bulk terminal	Import, export, gas to the grid, loading of LNG tank trucks, LNG tankers and LNG bunker vessels
B	Maritime traffic	Including inland- and seagoing LNG tankers, LNG bunker vessels, LNG fuelled inland vessels and LNG fuelled seagoing vessels
C	Inland vessel **bunkering from a tank truck**	Unloading LNG tank truck, bunkering of a LNG fuelled inland vessel or port service vessel
D	Seagoing vessel **bunkering with a large bunker vessel**	**Ship to ship LNG bunkering** of large container ships or large crude oil carriers with a large LNG bunker vessel
E	Large seagoing vessel **bunkering from the shore**	Shore bunkering of large container ships or large crude oil carriers from a local LNG buffer storage
F	Lay by berth for inland LNG (bunker) tankers	One cone berth for waiting inland LNG tankers
G	Port service/maintenance/repair for LNG	LNG-cryogenic maintenance, repairs on LNG tankers or LNG fuelled ships, cooling and de-gassing of LNG installations etc
H	Lay by berth for LNG fuelled ships	Just an 'ordinary' lay by location
I	**Bunkering from a bunker pontoon**	LNG bunkering from a bunker pontoon of inland LNG fuelled vessels, small seagoing LNG fuelled vessels, LNG fuelled port service vessels
J	Ship to Ship (STS) LNG transfer	LNG transfer between seagoing LNG tanker, floating storage, Inland LNG tankers and LNG bunker vessels
K	**STS LNG bunkering** of an inland LNG fuelled vessel	LNG bunkering of an inland LNG fuelled vessel with a small LNG (inland) bunker vessel
L	Distribution of LNG tank containers	Container vessel loading of LNG tank containers for distribution
M	Sailing **STS LNG bunkering**	LNG bunkering of an inland LNG fuelled vessel with a small LNG (inland) bunker vessel during sailing
N	**STS LNG bunkering** of a Short Sea / Feeder vessel	LNG bunkering of a LNG fuelled short sea / feeder vessel with a small LNG (inland) bunker vessel
O	Loading of a local LNG (buffer) storage	LNG transfer from a LNG tanker to a local LNG storage of bunker pontoon
P	**Ferry or Ro/Ro bunkering**	**LNG bunkering from the shore, with a LNG tank truck or STS from a small bunker barge**
Q	RoRo ship re-fuelling by tank container	Unloading (empty) and loading trailers with LNG tank container for the ship propulsion
R	Container ship re-fuelling by tank container	Unloading (empty) and loading LNG containers for the ship propulsion
S	**LNG bunkering of a cruise vessel**	**LNG bunkering** of a Cruise Ship **with a tank truck or LNG bunker vessel**
T	**Cold Ironing** of a cruise vessel	Electric power supply by floating LNG driven generator set

Current status of bunkering LNG

The construction of LNG bunkering infrastructure is currently under development. The transport and handling of LNG as cargo on land and sea have been proven for many years. For LNG bunkering of gas-fuelled vessels some experience with smaller vessels operating in the Norwegian and the Baltic Seas has been gained.

Due to the small number and size of gas-fuelled vessels, the current demand for LNG and the required bunker rates are mostly handled by LNG tank trucks using Truck to Ship transfer (TTS) between the truck and the receiving vessel.

Nonetheless, as shown in Figure 1 the following LNG supply modes are possible:

1. Ship to Ship transfer (STS)
2. Truck to Ship transfer (TTS)
3. Terminal/Pipeline to Ship transfer (PTS)
4. The use of portable tanks: In the case of using portable tank systems empty tanks will be unloaded and replaced by full portable tanks. In comparison to the above mentioned procedures the reception of LNG as fuel consists of loading / unloading and connection / disconnection of the portable tank systems

The following description of the LNG supply chain for gas-fuelled vessels is based on these four LNG supply modes.

3.2 Elements of the LNG Supply for the LNG bunker operations identified

The complete LNG bunkering supply chain ranges from the production and conditioning of Natural Gas (NG) to Liquefied Natural Gas (LNG) and its transportation via sea-going vessels and gas pipelines to storage facilities (Figure 2). These elements of the supply chain are regulated by different standards and rules. The scope of the analysis of the rule framework within this report is defined by the red-wired box in Figure 2 and consists of

- Production and storage of liquefied and compressed NG (both LNG and Compressed Natural Gas, CNG),
- Transport via pipeline, truck and vessel,
- Fuel transfer via STS, TTS, PTS transfer and loading and unloading of portable tanks,
- Gas-fuelled vessels.

The production of NG and the use of Natural Gas, Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG) as fuel for other vehicles like trucks and trains are not within the scope of this analysis.

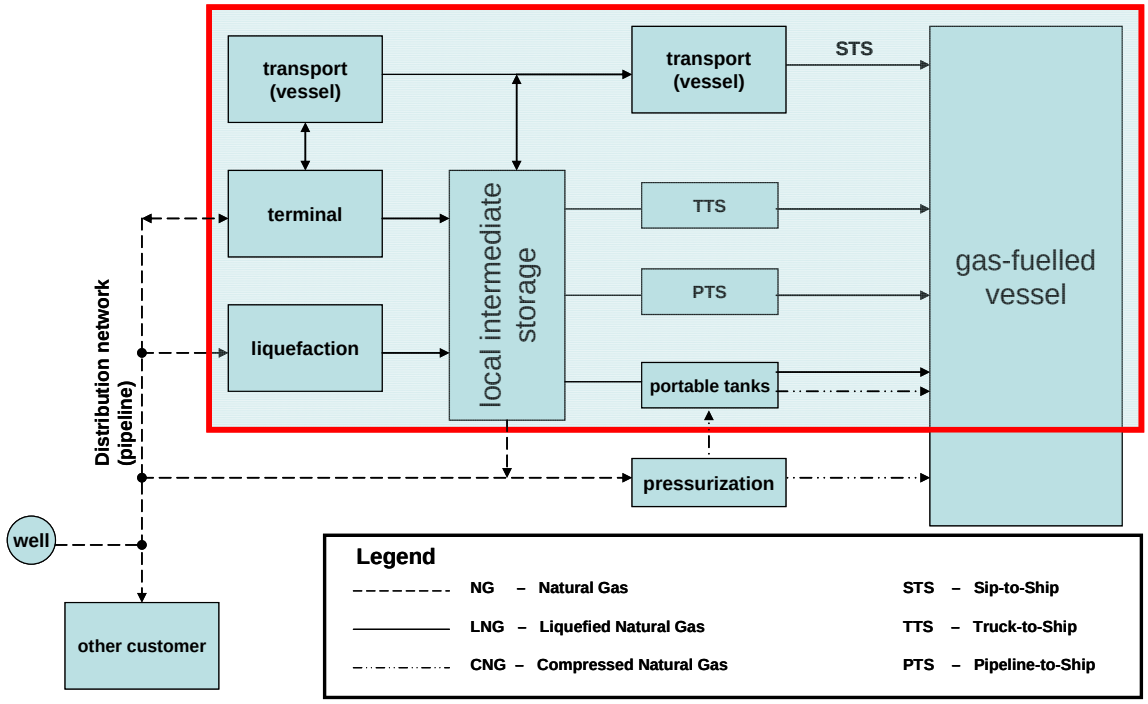

Figure 2 – The LNG supply chain

Whereas the land based transport and the distribution of LNG is organised by pipelines, trucks and portable tanks as well different types of vessels are part of LNG supply chain (Figure 1). Depending their role within the LNG supply chain the vessels will be governed by different standards and regulations regarding

- LNG as cargo
- LNG as fuel for ships
- Seagoing vessels
- Inland waterway vessels

In the following table these different types of vessel are listed which form all together the maritime segment of the LNG supply chain.

Table 2 – Types of vessels involved in the LNG supply chain

Cargo transport from terminal to terminal or intermediate storage:
Large LNG Carrier: LNG Cargo Storage Capacities from 120,000 m³ up to 267,000 m³
Medium and small scale LNG Carrier: LNG Cargo Storage Capacities from 10,000 m³ up to 120,000 m³
LNG Fuel supply within the Port:
Large Seagoing Bunker Vessels: LNG Cargo Storage Capacities up to 15,000 m³
Inland Waterway Bunker Barges
Port Vessels: Barges, Lighters, Pontoons operating for LNG supply only within the Port Area
Gas-fuelled vessels (Customer):
Seagoing Vessels
Inland Vessels
Port Vessels: Tugs, Barges, Lighters only operating within the Port Area

3.3 Categorisation of the relevant rule framework of possible LNG supply chains

The LNG supply chain as illustrated in Figure 2 contains various elements related to onshore and maritime operations which are regulated by different rules and guidelines. With regard to the LNG bunkering process the LNG chain can be separated into

- Production and Storage of LNG (onshore)
- Transport of LNG as Cargo (onshore and maritime)
- Bunkering LNG as fuel (bunkering)
- Use of LNG as ship fuel (maritime)

Besides the categorisation into onshore and maritime regulations, the regulatory framework can be separated into LNG cargo handling and the use of LNG as ship fuel. The change of the definition from LNG as cargo to LNG as ship fuel takes place during the LNG bunkering process as shown in Figure 3. The LNG bunkering process is seen as having its own regulation apart from LNG as cargo handling and the use of LNG as ship fuels. The use of portable LNG tanks (not shown in figure 3) instead of fixed LNG fuel tanks onboard is regulated by different rules and standards (see Figure 4 and Figure 5).

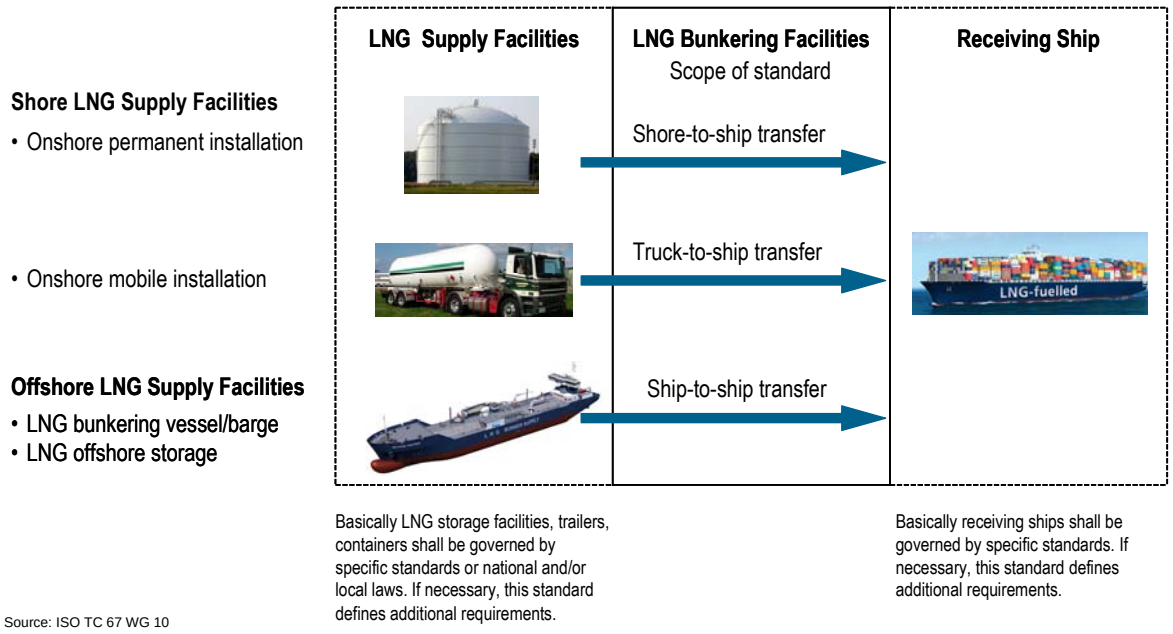

Figure 3 – Interfaces between LNG supply facility and receiving ship (source: ISO TC 67 WG10)

An overview of the defined categorisation used for the analysis of the rule framework of the LNG bunkering supply chain is illustrated in Figure 4 and shown in Table 3.

Table 3 – Categorisation of the rule framework

Onshore regulations	**Maritime regulations**
Storage and production facilities	Offshore LNG production
Transport (pipeline and road vehicles)	Transport (seagoing and inland vessels)
Shore interfaces	Gas-fuelled vessels (seagoing and inland vessels)
	Ship interfaces
Bunkering	

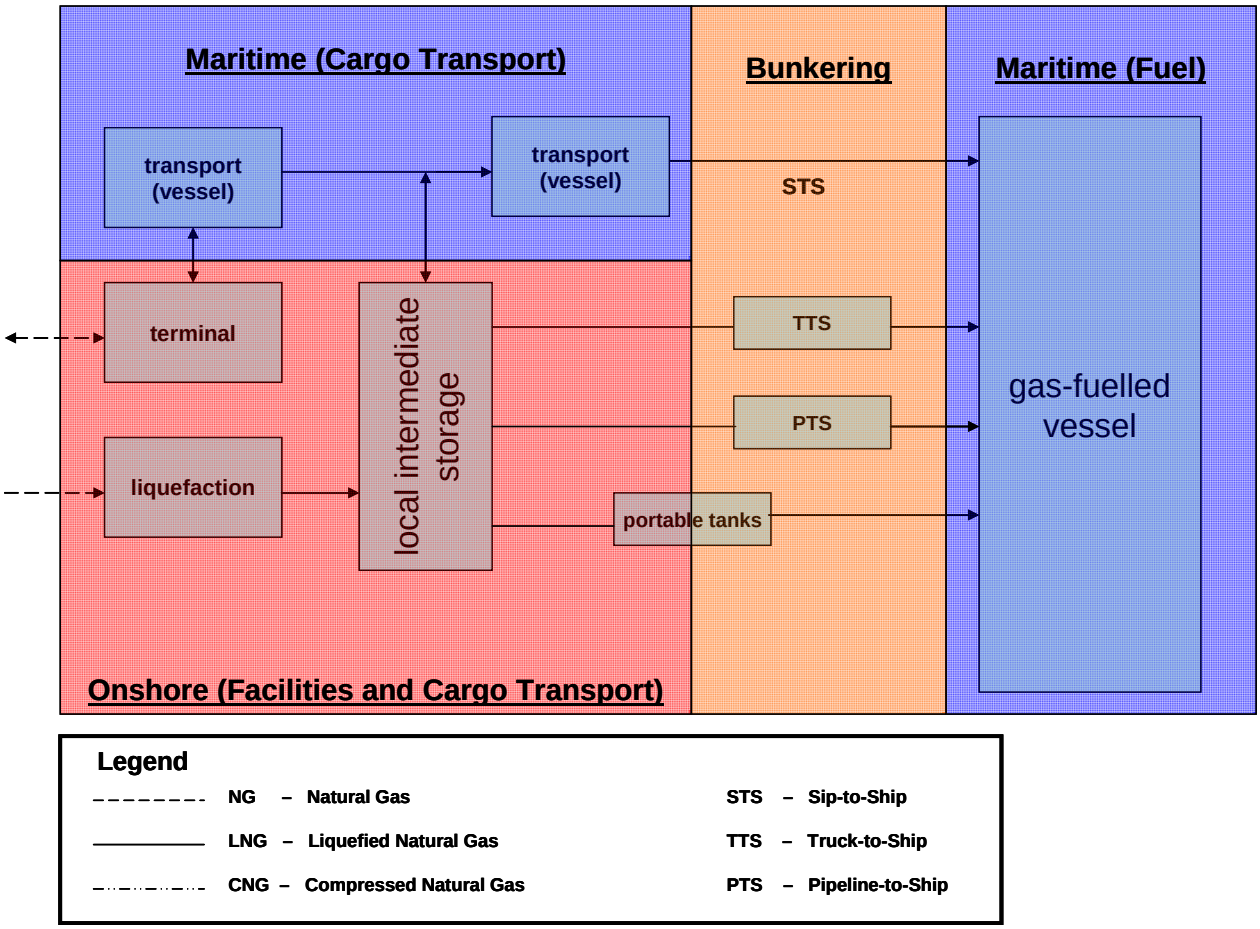

Figure 4 – Regulatory categorisation of the LNG supply chain

4 Relevant Standardisation Bodies

In the following chapter the most relevant standardisation bodies responsible for the rule development concerning safety, technical, operational and training aspects of the relevant parts of the LNG supply chain for bunkering gas-fuelled ships (see Section 3.2) are described. The detailed description and a gap analysis of the relevant rules and guidelines regarding bunkering LNG can be found in Chapters 6, 7 and 8.

4.1 International Bodies

4.1.1 International Maritime Organisation (IMO)[3]

The International Maritime Organisation (IMO) is a United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. To accomplish these objectives the IMO is adopting its own standards for maritime safety and security, efficiency of navigation and prevention and control of pollution from ships. One of the most important roles of the IMO is the implementation and revision of international conventions related to shipping including safety. The three most important international conventions are the 'International Convention for the Safety of Life at Sea (SOLAS), the 'International Convention for the Prevention of Pollution from Ships (MARPOL)' and the 'International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW)'.

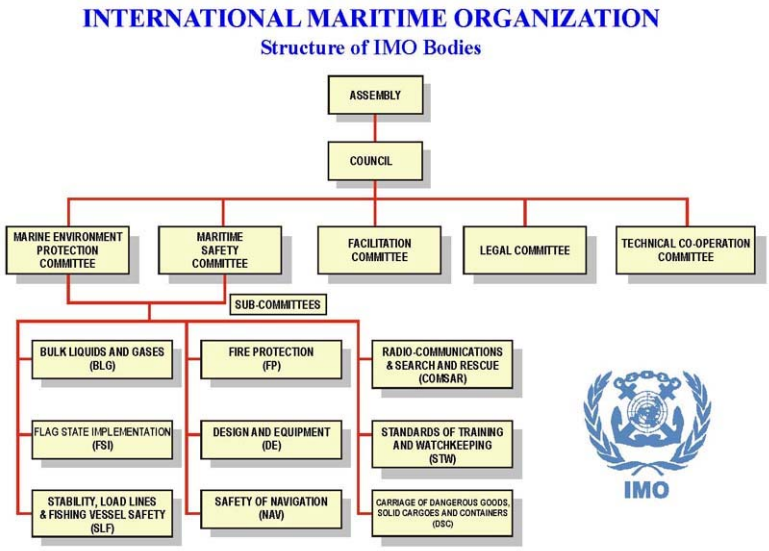

Figure 5 – Organisation structure of the International Maritime Organisation

[3] www.imo.org

At the IMO, The Maritime Safety Committee (MSC) is responsible for the consideration and submission of recommendations and guidelines on safety (s. Figure 5). The MSC is assisted in their work by nine sub-committees which are also open to all member states. Regarding gas as ship fuel the most relevant sub-committees are 'Bulk, Liquids and Gases (BLG)' and on 'Standards of Training and Watch keeping (STW)'.

Most relevant IMO regulations related to the LNG supply chain are:

- The SOLAS convention including requirements for maritime fuels;
- The STCW convention including training requirements for crews;
- The 'International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code, referenced within SOLAS Chapter VII, Part C)' including requirements for the construction and operation of LNG tanker;
- The 'Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships MSC.285(86)';
- The 'International Code of Safety for Ships using Gases or other low Flashpoint Fuels (IGF Code, in development, will be referenced within SOLAS) including requirements for the construction and operation of gas-fuelled ships.

4.1.2 International Organisation for Standardisation (ISO)[4]

The International Organisation for Standardisation (ISO) is a non-governmental organisation and a network for national standard bodies developing standards for all kinds of industries on international level. The ISO is also involved in the development of standards for the shipping industries and closely works together with the IMO.

The ISO standards are developed by the Technical Committees (TC) under which working groups (WG) may exist in which the experts develop the ISO standards (Figure 6). The Technical Committees involved in the development of standards related to the gas industry are:

- TC 28 Petroleum products and lubricants
- TC 67 Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries
- TC 193 Natural Gas

[4] www.iso.org

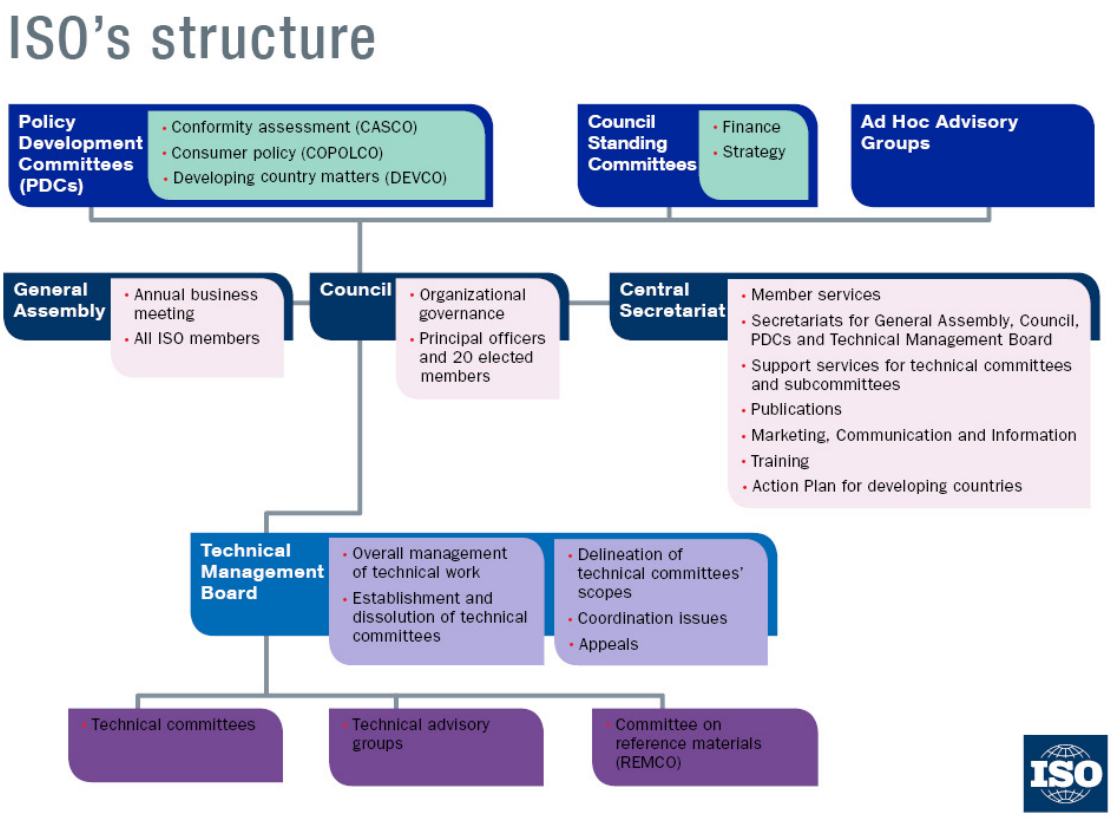

Figure 6 – Organisation structure of the International Organisation of Standardisation

Most important standards related to the LNG supply chain are:

- The Standard for 'Installation and equipment for liquefied natural gas – Ship to shore interface and port operations (ISO 28460:2010)' including the requirements for ship, terminal and port service providers to ensure the safe transit of an LNG carrier through the port area and the safe and efficient transfer of its cargo;

- The 'Guidelines for systems and installations for supply of LNG as fuel to ships (currently under development in the ISO Technical Committee 67 Working Group 10) including requirements for safety, components and systems and training;

- ISO 10976:2012 "Refrigerated light hydrocarbon fluids. Measurement of cargoes on board LNG carriers. The standard provides accepted methods for measuring quantities on LNG carriers for those involved in

the LNG trade on ships and onshore. It includes recommended methods for measuring, reporting and documenting quantities on board of these vessels and is intended to establish uniform practices for the measurement of the quantity of cargo on board LNG carriers from which the energy is computed.

4.1.3 International Electrotechnical Commission (IEC)

The International Electrotechnical Commission (IEC) prepares and publishes international Standards for all electrical, electronic and related technologies which are not covered by the ISO.

Most important standards related to the LNG supply chain are:

- The International Standard 'IEC 60092-502 – Electrical installations in ships – Part 502: Tankers – Special features' including hazardous area classification;
- 'IEC 60079 – Electrical Apparatus for Explosive Gas Atmospheres';
- 'IEC 61508 – Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems'.

4.1.4 Society of International Gas Tanker & Terminal Operators (SIGTTO)[5]

The Society of International Gas Tanker & Terminal Operators (SIGTTO) is a non-profit making organisation representing the liquefied gas carrier operators and terminal industries. The purpose of the SIGTTO is to specify and promote standards and best practice for the liquefied gas industries.

Most important guidelines related to the LNG supply chain are:

- The 'LNG Ship to Ship Transfer Guidelines' including guidance for safety, communication, manoeuvring, mooring and equipment for vessels undertaking side-by-side ship to ship transfer;
- 'Liquefied Gas Fire Hazard Management' including the principles of liquefied gas fire prevention and fire fighting;
- 'ESD Arrangements & linked ship / shore systems for liquefied gas carriers' including guidance for functional requirements and associated safety systems for ESD arrangements;

[5] www.sigtto.org

- 'Liquefied Gas Handling Principles on Ships and in Terminals' including guidance for the handling of LNG, LPG and chemical gases for serving ship's officers and terminal operational staff;

- 'LNG Operations in Port Areas' including an overview of risk related to LNG handling within port areas.

4.1.5 Oil Companies International Marine Forum (OCIMF)[6]

The Oil Companies International Marine Forum (OCIMF) is a voluntary association of oil companies with an interest in the shipment and terminal operation of crude oil, oil products, petrochemicals and gas. The OCIMF aims engender the safe and environmentally responsible operation of oil tankers, terminals and offshore support vessels by promoting continuous improvement in standards of design and operation.

Most important guidelines related to the LNG supply chain are:

- The 'International Safety Guide for Oil Tankers & Terminals (ISGOTT)' published by OCIMF together with the International Chamber of Shipping (ICS) and the International Association of Ports and Harbours (IAPH) including operational procedures and shared responsibilities for operations at the ship/shore interface;

- The 'Ship to Ship Transfer Guide (Liquefied Gases)' published together with the ICS and SIGTTO including guidance for safety, communication, manoeuvring, Mooring and equipment for vessels undertaking ship to ship transfer of liquefied gases between ocean-going ships;

- The 'Ship Inspection Report Programme (SIRE) – Vessel Inspection Questionnaires for Oil Tankers, Combination Carriers, Shuttle Tankers, Chemical Tankers and Gas Carriers' which enabled OCIMF members to share their ship inspection reports with other OCIMF members.

4.1.6 Intergovernmental Organisation for International Carriage by Rail (OTIF)

Objective of the OTIF is to develop the uniform system of law which apply to the carriage of passengers and freight international through traffic by rail. The most important publication related to the LNG supply chain is the "Convention concerning International Carriage by Rail (COTIF) Appendix C – Regulations concerning the International Carriage of Dangerous Goody by Rail (RID)".

4.2 European bodies

4.2.1 European Commission (EC)

The European Commission (EC) is the institution responsible to propose laws for adoption by the European Parliament and the Council of the EU. Once EU legislation has been adopted, the Commission ensures that it is correctly applied by the EU member countries[7].

The existing legal framework allows the Commission to request one or several European standardisation organisation to draft a European standard or European standardisation deliverable. European standards are adopted by the European standardisation organisations, namely CEN, CENELEC and ETSI. The rules for the cooperation between European standardisation organisations, national standardisation bodies, Member States and the Commission, the establishment of European standards and European standardisation deliverables are established in EU Regulation 1025 / 2012 on European standardisation adopted at the 25th of October 2012.

Most important acts from the Commission related to the LNG supply chain are:

- The 'Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances' (Seveso II directive) including obligations of the operator and requirements for measures to prevent and inform about major-accident with dangerous substances;

- The 'Directive of the European Parliament and of the Council laying down technical requirements for inland waterway vessels (2006/87/EC and amending Directives 2006/137/EC, 2008/87/EC, 2008/126/EC, 2009/46/EC) including requirements for certification, carrying dangerous goods and inspections;

- Directive 2010/75/EU of the European Parliament concerning integrated pollution prevention and control (IPPC) defining obligations with which industrial activities with a major pollution potential must comply. It establishes a procedure for authorising these activities and sets minimum requirements to be included in all permits, particularly in terms of pollutants released. This directive replaces 2008/1/EC;

- ATEX Directive 94/9/EC (ATEX 95) concerning equipment and protective systems intended for use in potentially explosive atmospheres;

[6] www.ocimf.com

[7] ec.europa.eu/atwork

- ATEX Directive 99/92/EC (ATEX 137) concerning the minimum requirements for improving the health and safety protection of workers potentially at risk from explosive atmospheres;

- Commission Decision 2010/769/EU "on the establishment of criteria for the use by liquefied natural gas carriers of technological methods as an alternative to using low sulphur marine fuels meeting the requirements of Article 4b of Council Directive1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels as amended by Directive 2005/33/EC of the European Parliament and of the Council on the sulphur content of marine fuels" concerning the use of mixture of marine fuel and boil-off gas to reduce emissions from ships.

4.2.2 European Committee for Standardisation (CEN)8

The European Committee for Standardisation (CEN) is an international non-profit association providing a platform for the development of European standards and other technical specifications. CEN is a major provider of European standards and technical specifications and is the only recognized European organisation for the planning, drafting and adoption of European standards.

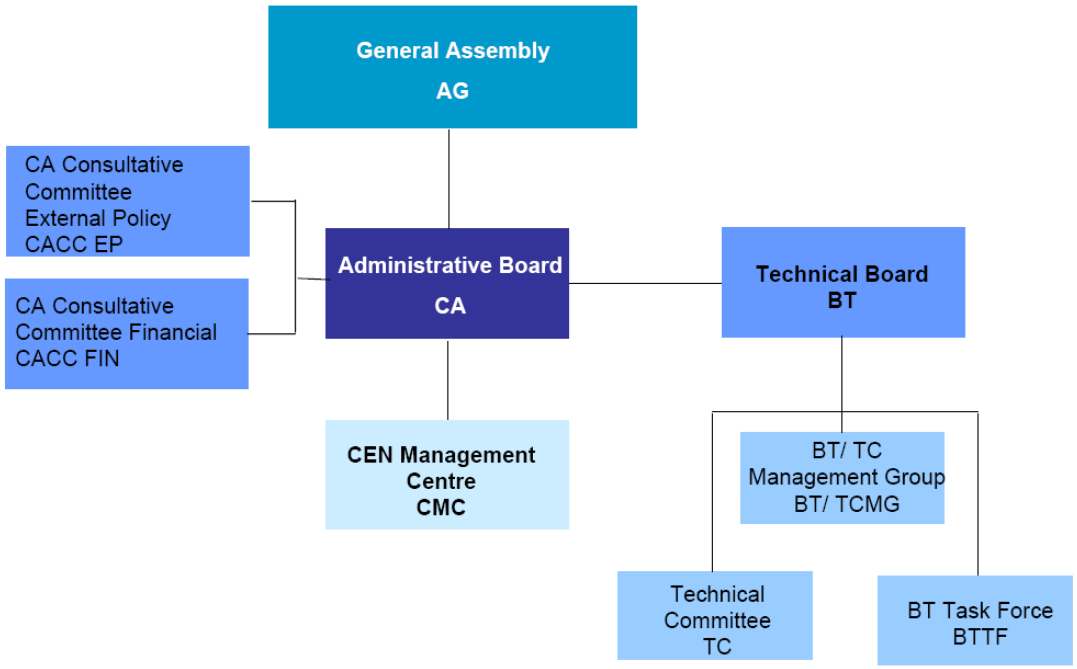

Figure 7 – Organisation structure of the European Committee for Standardisation

[8] www.cen.eu

The European standards are developed by Technical Committees (TC) which consists in of a panel of experts and is established by the Technical Board (Figure 7). The Technical Committees under which working groups (WG) may exist in which the experts develop the EU standards for the gas industry are

- CEN/TC 12 Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries
- CEN/TC 234 Gas infrastructure
- CEN/TC 235 Gas pressure regulators and associated safety devices for use in gas transmission and distribution
- CEN/TC 237 Gas meters
- CEN/TC 282 Installation and equipment for LNG

Most important standards related to the LNG supply chain are:

- European Standard 'EN 1160 Installations and equipment for liquefied natural gas. General characteristics of liquefied natural gas and cryogenic materials' including guidance on characteristics of liquefied natural gas and cryogenic materials;
- European Standard 'EN 1473 – Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations' including guidelines for the design, construction and operation of all onshore liquefied natural gas installations including those for liquefaction, storage, vaporisation, transfer and handling of LNG;
- European Standard 'EN 1474 - 1 – Installations and equipment for liquefied natural gas - Design and testing of marine transfer systems – Part 1: Design and testing of transfer arms' including specifications of the design, safety requirements and inspection and testing procedures for liquefied natural gas transfer arms intended for use on conventional onshore LNG terminals;
- European Standard 'EN 1474 - 2 – Installations and equipment for liquefied natural gas - Design and testing of marine transfer systems – Part 2: Design and testing of transfer hoses' including guidance for the design, material selection, qualification, certification and testing details for LNG transfer hoses;
- European Standard 'EN 1474 - 3 – Installations and equipment for liquefied natural gas - Design and testing of marine transfer systems – Part 3: Offshore transfer systems' including qualification and design criteria for offshore LNG transfer systems;

- European Standard 'EN 13645 Installations and equipment for liquefied natural gas – Design of onshore installations with a storage capacity between 5 t and 200 t';

- European Standard 'EN 14620 Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0°C and -165°C'.

4.2.3 United Nations Economic Commission for Europe (UNECE)9

The UNECE is one of the five regional commissions of the United Nations. All United Nations member states may cooperate under the aegis of UNECE on economic and regional issues. The main focus of the UNECE is to promote pan-European economic integration.

The most relevant contribution related to the LNG supply chain is the work of the Transport Division which is guided by the mandates and work programmes of the UNECE Inland Transport Committees (ITC) and its subsidiary bodies. The ITC provides a pan-European intergovernmental forum to create tools for economic cooperation and to adopt international legal instruments on inland transport.

Most important publications related to the LNG supply chain are:

- The 'European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways' commonly known as ADN published together with the Central Commission for the Navigation of the Rhine (CCNR) including requirements for the transport of dangerous goods by inland vessels and for the construction of these vessels;

- The 'European Agreement concerning the International Carriage of Dangerous Goods by Road' commonly known as ADR together published together with the Central Commission for the Navigation of the Rhine (CCNR).

4.2.4 Central Commission for the Rhine (CCNR)10

The objectives of the CCNR are to ensure efficient, safe and environmentally friendly transport of the Rhine as well as ensuring sustainable development. The CCNR cooperates with the UNECE and other river commissions.

[9] www.unece.org

[10] www.ccr-zkr.org

Most important publications related to the LNG supply chain are:

- The 'Rhine Vessel Inspection Regulations (RVIR)' including the technical requirements for the license of vessels to navigate on the Rhine;

- The International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINNT)' published together with SIGTTO and OCIMF including requirements for the safe transport of dangerous goods at the interface of inland tank barges with other vessels or shore facilities (terminals).

4.3 National Standardisation Bodies

4.3.1 European Bodies

Most of the European countries have established national standardisation bodies which develop their own national regulatory instruments and as well as represent national standardisation interests e. g. as a member of ISO and CEN (s. Figure 8). However, all 30 CEN members are obliged to adopt European standards as substitutes for their former national standards.

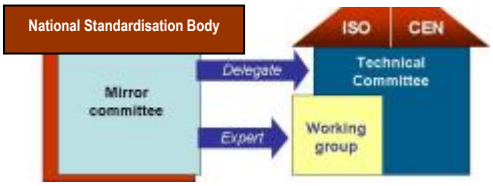

Figure 8 – National contribution to ISO and CEN work

One example for national regulations related to the LNG supply chain was drawn up by the British Standards Institution (BSI) being the UK's national standard body:

- British Standard 'BS 4089: 1999 Specification for metallic hose assemblies for liquid petroleum gases and liquefied natural gases' including specification for flexible pipes hose connectors, approval and testing.

Most of formerly relevant national standards have been integrated in or substituted by CEN European Standard.

4.3.2 American Bodies

National Fire Protection Association (NFPA) [11]

The 'National Fire Protection Association' is an international non-profit organisation based the US. The objective of the NFPA is to provide and advocate codes and standards, research, training and education related to the risks of fire and other hazards.

Most important publications related to the LNG supply chain are:

- 'NFPA 59A: Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG)' including guidance for plant siting and layout for process equipment, stationary LNG storage, vaporization facilities, components, operating, maintenance, training and the performance of risk assessment;
- 'NFPA 302: Fire protection standard for pleasure and commercial motor craft' including requirements for the design and fire safety for boats less than 300 gross tons;
- 'NFPA 52: Vehicular Gaseous Fuel Systems Code' including fire safety rules for hydrogen, compressed natural gas and liquefied natural gas fuel systems on all vehicle types;
- 'NFPA 57: Liquefied Natural Gas (LNG) Vehicular Fuel Systems Code'.

American Petroleum Institute (API) [12]

The American Petroleum Institute (API) produces standards, recommended practices, specifications, codes and technical publications that cover each segment of the industry. Most of the standards and recommended practices are dedicated to a single type of equipment.

Most important publications related to the LNG supply chain are:

- 'API RP 521: Guide for Pressure-relieving and Depressuring Systems Petroleum, petrochemical and natural gas industries' including guidance for pressure-relieving and vapour-depressuring systems of oil refineries, petrochemical facilities, gas plants, liquefied natural gas facilities and oil and gas facilities;

[11] www.nfpa.org

[12] www.api.org

- 'API Std 617: Axial and Centrifugal Compressors and Expander-compressors for Petroleum, Chemical and Gas Industry Services' including minimum requirements for axial compressors, integrally geared process centrifugal compressors and expander-compressors for use in the petroleum, chemical and gas industries;

- 'API Std 620: Design and Construction of Large, Welded, Low-Pressure Storage Tanks' including requirements for refining and storage tanks.

4.4 Class rules

The purpose of a Classification Society is to provide classification and statutory services and assistance to the maritime industry and regulatory bodies. Following the recommended collaboration between the classification societies as stated in the "International Load Line Convention" the "International Association of Classification Societies (IACS)" was formed in 1968 whit currently 13 members.

Most of this classification societies developed guidelines for the use of gas as ship fuel which are based on the 'Interim Guidelines on Safety for Natural Gas-Fuelled Engine Installations in Ships MSC.285(86)' with additional class specific requirements. Similar to the MSC.285(86) these class rules give guidance for the design, construction and operation of natural gas-fuelled ships and are not legal binding. Therefore each flag state must agree on the operation of gas-fuelled vessels sailing in their national waterways. For the time being the above mentioned class rules are used for this permission process.

In the following table the existing class rules of the IACS members based on the Interim Guidelines MSC.285(86) are enlisted.

Table 4 – Overview class rules of IACS members for gas-fuelled ships

No	Name of Class	Class short sign	First publication	Title of Guideline
1	American Bureau of Shipping	ABS	May 2011	Guide for propulsion and auxiliary systems for gas-fuelled ships
2	Bureau Veritas	BV	May 2011	Safety rules for gas-fuelled engine installations in ships; Rule note NR 529 DT R01 E
3	China Classification Society	CCS	-	-
4	Croatian Register of Shipping	CRS	-	-
5	Det Norske Veritas	DNV	Oct. 2010	Gas-fuelled engine installations
6	Germanischer Lloyd	GL	May 2010	Guidelines for the use of gas as fuel for ships
7	Indian Register of Shipping	IRCLASS	-	-
8	Korean Register of Shipping	KR	July 2012	Guidance for gas-fuelled ships
9	Lloyds Register	LR	July 2012	Rules and regulations for the classification of natural gas-fuelled ships
10	Nippon Kaiji Kyokai	NK	February 2012	Guidelines for the issuance of ship fuel gas
11	Polish Register of Shipping	PRS	July 2012	Guidelines on safety for natural gas-fuelled engine installations in ships; publication No. 88/P
12	Italian Register	RINA	June 2011	Rules for the classification of ships, Amendments to part C, Chapter 1: New Appendix 7 – Gas-fuelled ships
13	Russian Maritime Register of Shipping	RS	-	-

5 Relevant European Studies

Within the year 2012 a number of feasibility studies dealing with technical, economical and regulatory aspects for bunkering LNG as fuel for ships were carried out and finalised. The most important studies with respect to the analysis of the regulatory rule framework of bunkering LNG as fuel for ships are enlisted chronologically in a descending order by their finalising date and described:

5.1 Dutch Legal and Safety Assessment (LESAS) Project for small Scale LNG

The Dutch Organisation for Applied Scientific Research (Dutch: Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, 'TNO') started in February 2011 a joint industry project for the Legal and Safety Assessment (LESAS) of a possible small scale LNG supply chain for the Rotterdam Area. The aim of the LESAS project is to develop a roadmap towards an optimal small scale LNG supply chain for the Rotterdam area from a safety, commercial, technical and legal point of view based on the long term vision of relevant stakeholders. The project partners are Det Norske Veritas (DNV), the Netherlands Standardisation Institute (NEN) and TNO. The study is structured into 5 working packages.

The aim of the working package 3 (WP 3) is the analysis of the current framework of regulations, codes and standards for the establishment of a small scale LNG supply chain and using LNG as fuel for shipping and vehicles in the Netherlands. In the report legal aspects are identified related to the design, construction and operation of storage, transport and transfer facilities e.g. bunkering, shipping, offloading, and metering. The results of WP 3 were summarized within a NEN report in January 2012.

5.2 North European LNG Infrastructure Project

The Danish Maritime Authority (DMA) initiated and managed the project 'A feasibility study for an LNG infrastructure and test of recommendations' (North European LNG Infrastructure Project) which was started in April 2011 and co-funded by the European Union TEN-T programme "Motorways of the Seas".

Aim of this feasibility study was to set up recommendations for central stakeholders with regards to different aspects of the establishment of an LNG infrastructure.

The project was structured in eight different work packages containing an analysis, discussion and a baseline study through technical, economical and safety aspects for the establishment of a LNG infrastructure in Northern Europe. The final report of the study was published in May 2012 and can be downloaded under

http://www.dma.dk/themes/LNGinfrastructureproject/Sider/ReferenceDocuments.aspx

The recommendations as stated within the final report of the study are part of a submission of Denmark to the 17th meeting of the IMO Sub-Committee on "Bulk Liquids and Gases". The intention of the submission is to include the relevant parts of the recommendations identified within the North European LNG Infrastructure Project in the work on the development of an International Code of Safety for Ships using gases or other low-flashpoint fuels.

5.3 Legal and Regulatory Study for LNG Supply in Flemish Ports

The Government of Flanders and the ports of Antwerp, Zeebrugge and Ghent in cooperation with the gas supplier Fluxys LNG initiated a study relating to the organisation and the facilitation of bunkering of LNG in the ports of Antwerp, Zeebrugge and Ghent.

The aim of this study is to lead to the necessary regulations concerning bunkering of LNG and ultimately create possibilities for efficient and safe LNG bunkering in ports in the near future. The study covers a market survey, the legal and regulatory framework and the logistical organisation.

This study was carried out by DNV beginning in January 2012 and was finalised in July 2012. The report of this study is available under

http://www.flanderslogistics.be/fpa/lng.php

5.4 Feasibility Study for Bunkering LNG in German Ports

The Federal Ministry of Transport, Building and Urban Development initiated a feasibility study for bunkering of liquefied gases within German ports.

The aim of the feasibility study was to give an overview of the current status of the regulatory rule framework for bunkering LNG in German ports, possible technical solutions for bunkering LNG within the port area, a risk assessment of these bunkering processes and recommendations for additional regulation for bunkering LNG within German ports.

The study was carried out by GL and was finalised in August 2012. The report only available in German and can be found under

http://www.bsh.de/de/Das_BSH/Presse/Aktuelle_Meldungen/Studie.jsp

6 Status of Onshore Regulations related to the LNG Supply Chain (Task 1)

6.1 Storage and Production Facilities

6.1.1 Siting and Design of Onshore LNG Installations

In Europe the design of LNG onshore facilities is based on existing international codes. Most of the following standards cover aspects of large scale LNG facilities but can be used for the design of LNG installations in the absence of specific standards for LNG bunker stations and certain applications:

- 'EN 1473 - *Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations for storage capacities over 200 tonnes'* is based on a risk assessment approach. According to the scope this standard covers all kinds of LNG storage but is limited to atmospheric storage tanks. Pressurized intermediate storage tanks are excluded from this standard;
- 'NFPA 59A - *Standard for the Production, Storage and Handling of Liquefied Natural Gas' - First issued in 1967' this standard is a* prescriptive code for the siting and design of an LNG facility. This is a US standard that has been used globally and can be used to support (but not replace) EN 1473 for European developments;
- 'EN 13645:2001 - *Installations and equipment for liquefied natural gas - Design of onshore installations with a storage capacity between 5 tonnes and 200 tonnes'* is based on pressure storage tanks and the Pressure Equipment Directive (PED) philosophy;
- 'EN 14620 - *Design and manufacture of site built, vertical, cylindrical, flat-bottomed steel tanks for the storage of refrigerated, liquefied gases with operating temperatures between 0°C and -165°C*' covers the design of atmospheric storage tanks within the EU. This code is a recent revision of BS 7777 and represents the most cost effective ways of designing and building LNG storage tanks. It allows larger tanks through thicker plates with a hydro test as required in API 620 Q;
- The requirements of the 'NFPA 59A - *Standard for the Production, Storage and Handling of Liquefied Natural Gas'* are prescriptive for the siting and design of an LNG facility;
- 'API 620 *Design and Construction of Large, Welded, Low-Pressure Storage Tanks'* - specifically, Appendix Q relating to double-walled, insulated low temperature storage tanks.

These standards are widely used all over the world and are the basis for both the ISO global standards as well as many regional and national standards.

6.1.2 Safety and Risk Assessment for Onshore LNG Plants

A draft technical specification titled as ISO 16901 '*safety and risk assessment for onshore LNG plants'* is currently under development.

The scope of the draft specification (ISO/TS 16901) is to provide a common approach and guidance to those undertaking assessments of the major safety hazards as part of the planning, designing and operation of LNG facilities onshore, shoreline based and other associated marine activities, using risk based methods and standards.

The standard shall be applicable to both export and import terminals but also other facilities such as satellite and peak shaving plants.

It applies to all facilities inside the perimeter of the terminal, including all hazardous materials as LNG and associated products such as LPG, pressurised natural gas, odorizers, and other flammable or hazardous products handled within the terminal.

Reference is made to ISO 31010 and ISO 17776 with regard to general risk assessment methods. The document focuses on the specific needs scenarios and practices within the LNG industry.

6.1.3 Seveso II Directive

The permit procedure and the consultation process for LNG storage facilities are also dealt with in the Seveso II Directive. The Seveso II Directive outlines specifically the control of onshore major accident hazards involving dangerous substances. It defines a number of requirements for the operators of establishments (facilities), where a certain amount of dangerous substances is present. The provisions broadly fall into two main categories related to the two-fold aims of the directive which are control measures aimed at the prevention of major accidents and control measures aimed at the limitation of consequences of major accidents.

There are two levels of controls in practice. All operators of establishments (facilities) coming under the scope of the directive need to send a notification to the competent authority and to establish a major accident prevention policy. All establishments which hold more than 50 tonnes of LNG (equivalent to 110 m^3) are falling under the scope of the directive. In addition, operators of upper tier establishments holding more than 200 tonnes (equivalent to 440 m3) need to establish a safety report before the construction is commenced. The safety report must include identification of major hazards, a quantitative risk assessment (QRA) and necessary measures to prevent such accidents, a safety management system and an emergency plan.

The directive also imposes several obligations on competent authorities, of which the most important is to examine the safety reports, to communicate their conclusions to the operator and to ensure that the public which might be affected is informed on safety measures. The competent authority has also to identify groups of establishments with possible 'domino effects' and take into account land-use planning implications of major-accident hazards.

The latter implies that member states shall control the siting of new establishments, modifications to existing establishments and new developments in the vicinity of existing Seveso sites where those could increase the risk or consequences of a major accident. Furthermore, the public shall be able to give its opinion when planning new establishments according to the Seveso II Directive.

Belgian transposition of Seveso II

The EU Council Directive 96/82/EC on the control of major accident hazards (Seveso II Directive) was transposed into Belgian Law by the so-called Samenwerkingsakkoord (SWA) 2006 (Cooperation agreement). The Flemish region has agreed to this SWA via its decree of 01/12/2006 which was published in 'Belgian Publication Journal (Belgisch Staatsblad)' on 08/01/2007. On 26/04/2007 the federal law implementing the SWA was published in 'Belgisch Staatsblad', concluding the legal conversion of Seveso directives into Belgian law and is fully applicable since 06/05/2007.

The SWA applies to industrial establishments (pipelines are not in the scope) where dangerous substances are present in quantities exceeding the thresholds laid down in the Directive. As LNG is one of those dangerous substances (Category of liquefied extremely flammable gases (including LPG) and natural gas), the onshore handling of the LNG is subject to this legislation if the threshold quantity is surpassed. For LNG, the applicable thresholds are 50 tonnes (low tier) / 200 tonnes (high tier) respectively according to the Seveso II Directive. Storage facilities, as well as production installations such as liquefaction plants with permit capacities exceeding these thresholds thus have to comply with SWA.

British transposition of Seveso II

In the UK the Seveso II Directive is implemented by the Control of Major Accident Hazards Regulations (COMAH) which is enforced by the competent authorities: Health and Safety Executive (HSE), Environment Agency (EA) and Scottish Environmental Protection Agency (SEPA). The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) also apply in the UK to control the risks to safety from fire and explosions.

Dutch transposition of Seveso II

In relation to external safety, the European Seveso II Directive is implemented in Dutch legislation by the Dutch Major Hazards Decree (BRZO) and the Dutch Public Safety Decree (BEVI). This BRZO is based on the Environmental Management Acts. The BRZO focuses on the management of the most hazardous installations (about 350 in the Netherlands). In comparison the BEVI regards the regulation of land-uses around hazardous installations, i.e. the external safety regulation. Facilities falling under the Seveso II Directive (BRZO/BEVI) are responsible for the elaboration of a quantitative risk assessment (QRA). The LNG terminal in Rotterdam is a BRZO installation. For this LNG terminal and other large scale LNG applications (storage capacity more than 100.000 m³ LNG) an Environmental Impact Assessment (EIA) including the QRA is mandatory.

German transposition of Seveso II

In Germany the Seveso II Directive was transposed into the 'Störfallverordnung' which is referenced in the 'Bundesemissionsschutzgesetz' (BImSchG). Approval processes of LNG storage and conditioning facilities are related to the BImSchG and will be handled by the 'Störfallverordnung'. In the German 'Störfallverordnung' facilities must be equipped with the 'state of the art' safety technology. At the moment this state of the art safety technology relating to LNG bunkering facilities is not defined and best practice for small scale LNG bunkering facilities is not available. With respect to the related authority rules and standards, defining the current state of the safety technology as baseline for the approval process of LNG storage / conditioning facilities is needed.

The exemplary transpositions of the Seveso directive II into national law as discussed above is summarized in the following table

Table 5 – Overview exemplary transposition of Seveso II directive into national laws and regulations

country	Title	Comment
Belgium	Samenwerkingsakkoord (SWA) 2006	Cooperation agreement
UK	Control of Major Accident Hazards (COMAH) Regulations	
The Netherlands	Dutch Major Hazards Decree (BRZO); Dutch Public Safety Decree (BEVI).	
Germany	'Störfallverordnung'	Regulation; referenced in the law 'Bundesemissions-schutzgesetz (BImSchG)'

6.2 Transport via Road Vehicles

The transport of hazardous goods by road is covered in the *European Agreement concerning the International Carriage of Dangerous Goods by Road*, commonly known as ADR (‘*Accord européen relatif au transport international des marchandises Dangereuses)* from the Economic Commission for Europe (UNECE or ECE). The ADR is translated and included in the national legislation of the applicable countries. The ADR describes that, excluding some excessively dangerous goods, other dangerous goods may be transferred internationally in road vehicles subject to compliance with:

- The conditions mentioned in Annex A for the goods in question, in particular with regards to their packaging and labelling and
- the conditions mentioned in Annex B, in particular with regards to the construction, equipment and operation of the vehicle carrying the goods in question.

Related to the LNG value chain it can be concluded that the transport of LNG is subject to the conditions that are set in ADR Annex A (with respect to the construction of the LNG tank and labelling/indication of the hazardous materials contained) and Annex B (with respect to the construction of the tank). Trucks that are using LNG as a fuel are subjected to Annex B with respect to the construction of the truck (e.g. for the fuel tank of the truck).

6.3 Shore Interfaces

The requirements for a LNG carrier, LNG terminals and port service provider to ensure a safe manoeuvring of the gas carrier within the port area and a safe and efficient transfer of LNG are described in the EN ISO 28460:2010 ‘*Petroleum and natural gas industries – Installation and equipment for liquefied natural gas – Ship-to-shore interface and port operations*’.

This International Standard was developed by the Technical Committee ISO TC 67 “Materials and offshore structures for petroleum, petrochemical and natural gas industries” together with the Technical Committee CEN / TC 282 “Installation and equipment for LNG”.

ISO 28460:2010 is applicable to

- pilotage and vessel traffic services (VTS);
- tug and mooring boat operators;
- terminal operators;
- ship operators;

- suppliers of bunkers, lubricants and stores and other providers of services whilst the LNG carrier is moored alongside the terminal.

ISO 28460:2010 includes provisions for

- a ship's safe transit, berthing, mooring and un-berthing at the jetty;
- cargo transfer;
- access from jetty to ship;
- operational communications between ship and shore;
- all instrumentation, data and electrical connections used across the interface, including Offshore Power Supply (OPS, cold ironing), where applicable;
- the liquid nitrogen connections (where fitted);
- ballast water considerations.

The scope of ISO 28460 is limited to conventional onshore LNG terminals and to the handling of LNG carrier in international trade. However, it can provide guidance for offshore and coastal operations.

During the 'North European LNG infrastructure project' of the Danish Maritime Authority a detailed analysis of ISO 28460 was carried out to asses whether this standard is suitable for LNG bunker vessels and bunker barges or not. Due to the fact that LNG bunker vessel traffic can be considered similar to that of other dangerous cargo it was concluded that the ISO 28460 standard may also be applicable for LNG bunker vessels and barges with proposed minor modifications.

In the following an additional analysis whether ISO 28460 is suitable for bunkering of LNG as ship fuel for all types of vessels is suitable or not is carried out:

<u>ISO 28460 is structured as followed:</u>

1 Scope
2 Normative references
3 Terms, definitions and abbreviated terms
4 Description and hazards of LNG
5 Potential hazardous situations associated with LNG transfer
6 Possible factors affecting ship / shore interface and port operations

7 Jetty
8 Marine operations
9 Hazardous areas and electrical safety
10 Security
11 Hazard management
12 Access and egress
13 Onshore power supply
14 Ship/shore communications
15 Cargo transfer
16 Provision and training of staff

Possible legitimacy of ISO 28460 to regulate LNG bunkering from shore side

The scope of ISO 28460 is limited to conventional onshore LNG terminals and to the handling of LNG carrier. Bunkering of LNG as ship fuel from shore side is not covered. To enable a possible regulation of bunkering LNG as fuel from shore side the scope of ISO 28460 should be extended or ISO 28460 should be referenced with additions to the scope within a further regulatory text.

References, Definitions, Behaviour of LNG

General explanations and definitions as described in Chapter 2, 3, and 4 of ISO 28460 apply also to LNG bunkering procedures. Normative references should be added by the Interim Guideline MSC.285(86), the IGF Code (currently under development) and the LNG bunkering guideline currently under development by ISO TC 67 WG 10. Definitions should be added to the receiving vessel (gas-fuelled ship) and a differentiation between LNG bunkering (as fuel) and transfer of LNG as cargo.

Additional factors affecting the ship

Chapter 6 of ISO 28460 describes the 'Possible factors affecting ship / shore interface and port operations' within the scope of a LNG carrier. To cover all ship types in case of bunkering LNG as fuel additional factors affecting the ships should be considered:

- The embarking and disembarking of passengers during bunkering LNG (in case of passenger ships to be bunkered)
- The loading and unloading of all kinds of cargos during bunkering LNG (in case of cargo vessels)

The passage regarding manoeuvring of the LNG carrier along the pier should be adapted to 'manoeuvring of the vessels' to cover all kinds of receiving vessels and LNG tanker or barges.

Marine operations

Safety distance as mentioned in Chapter 8.4.1 of ISO 28460 should also be considered for all kind of receiving vessels. 'Tanker' should be replaced by 'vessel'. In addition the requirements for the berth as defined for LNG carrier in Chapter 8.4.2 should also be valid for all kinds of receiving vessels. Therefore 'Liquefied Natural Gas Carrier' should be replaced by 'vessel'.

The mooring requirements defined in Chapter 8.4.5 are only valid for LNG carrier. Therefore 'vessel' should be replaced by 'LNG Carrier'.

The requirements for the transfer station as defined in Chapter 8.4.8 should be also referenced to the requirements of the MSC.285(86) and the IGF Code regarding the bunker station of receiving vessels.

Hazardous Areas

Additionally the requirements for hazardous areas should make reference to the IGF Code and the LNG bunkering guideline under development by ISO TC 67 WG 10.

6.3.1 Transfer Arms and LNG connectors

The EN 1474 *Installations and equipment for liquefied natural gas - Design and testing of marine transfer systems'* is implemented throughout Europe. The standard specifies the design, material selection, minimum safety requirements and inspection and testing procedures for LNG transfer between ship and shore. Although the requirements for remote control power systems are covered, the standard does not include all the details for the design and fabrication of standard parts and fittings associated with loading/unloading arms. The content of this standard is supplementary to other local or national standards and regulations and requirements of EN-ISO 28460.

The EN 1474 series consist of three parts:

- Part 1 Design and testing of transfer arms – most specific
- Part 2 Design and testing of transfer hoses
- Part 3 Offshore transfer systems

Transfer hose systems can be used for the transfer of LNG from shore-to-ship, from truck to ship or from ship-to-ship. The hose systems shall comply with the requirements of EN 13766, the IMO IGC Code and EN 1474 Part 2.

EN 13766:2003 *Thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for the transfer of liquid petroleum gas and liquefied natural gas – Specification:* This European Standard specifies requirements for two types of thermoplastic multi-layer (non-vulcanized) hoses and hose assemblies for carrying liquefied petroleum gas and liquefied natural gas. It specifies sizes from 25 mm to 250 mm, working pressures from 10.5 bar to 20 bar and operating temperatures from -200°C to +45°C.

ISO/TC 67/WG 10 PT 1 is working on a standard connection size or nozzle for LNG refuelling on ships. A review of the LNG fuelling process and nozzles/connections specification are part of this working group scope. The aim is to get an ISO standard on the process and equipment used in LNG marine fuel, bunkering including training and safety.

6.3.2 Pipeline Regulations

In the Netherlands pipelines have to comply with the external safety of pipelines regulations. The regulation is intended for pipelines carrying natural gas and petroleum products fall within the scope of the External Safety of Pipelines Decree.

A uniform calculation methodology has to be applied site-specific and group risks regarding the construction and permitting of an LNG pipeline. For the approval the Dutch NEN 3650 and the US ASME B 31.8 pipeline standards with detailed requirements for the design, construction and operation of pipelines are considered.

The main regulation for transportation of gaseous products through pipelines in Belgium is the Gas Law 1965 (“Gaswet”) concerning the transport of gaseous products by means of pipelines and the Royal Decree from the 11th of March 1966 dealing with safety measures to be observed during the construction and exploitation of gas transport by means of pipelines. The ‘Gaswet 1965’ limits the scope of these regulations to transportation installations and do not include the LNG pipelines linked to local LNG bunkering installations as foreseen in the ports. Those will be covered under the Seveso II and Vlarem regulations for onshore facilities.

7 Status of Maritime Regulations related to the LNG Supply Chain (Task 1)

7.1 Transport via Seagoing Vessels

7.1.1 Construction and Operation of LNG Tankers[13]

The '*International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code)*' defines the design and construction standards of ships involved in the sea transport of liquefied gases and certain other substances in bulk. The code describes the requirements for the equipment to minimize the risk to the ship, its crew and to the environment, considering the nature of the products involved. The IGC Code is currently under review and the update is expected to be adopted with the SOLAS review in 2014.

The purpose of the IGC Code is to provide an international standard for the safe carriage of liquefied gases and certain other substances by sea. Under consideration of the different products carried, it prescribes the design and construction standards for the ships as well as qualification and training requirements for its crew and measures to avoid impact on the environment.

The IGC Code is applicable for vessels transporting liquefied gases; therefore it is applicable to LNG carriers and small scale LNG carriers in international voyages.

7.1.2 Training for Seagoing Gas Tanker Crews

The minimum requirements for qualification and training of gas tanker crews are stated within Chapter 18 of the current draft of the revised IGC Code:

'Personnel training

18.7.1 Personnel shall be adequately trained in the operational and safety aspects of liquefied gas carriers as required by the STCW Convention, the ISM Code and the Medical First Aid Guide (MFAG).

As a minimum:

1 All personnel shall be adequately trained in the use of protective equipment provided on board and have basic training in the procedures, appropriate to their duties, necessary under emergency conditions;

[13] IMO BLG 17/9 Draft revised International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code), June 2012

2 Officers shall be trained in emergency procedures to deal with conditions of leakage, spillage or fire involving the cargo and a sufficient number of them shall be instructed and trained in essential first aid for the cargoes carried.'

The mandatory minimum requirements for the training and qualification of the crew of liquefied gas tankers are stated in section A-V/I-2 of the 'Seafarers' Training, Certification and Watch keeping (STCW) Code

The requirements for each kind of crew member include

- Competence;
- Knowledge, understanding and proficiency;
- Methods for demonstrating competence;
- Criteria for evaluating competence.

7.2 Transport via Inland Waterway Vessels

7.2.1 Construction and Operation of LNG Inland Tankers

For the transport of dangerous goods on inland waterways the ADN has been published by the UNECE and the CCNR. The objective of the ADN is to:

- Ensure a high level of safety for the international carriage of dangerous goods by inland waterways and contribute effectively to the protection of the environment, by preventing any pollution resulting from accidents or incidents during such carriage;
- Facilitate transport operations and promote international trade in dangerous goods.

The provisions annexed to the ADN concern dangerous substances and articles, provisions concerning their carriage in packages and in bulk on board inland navigation vessels or tank vessels, as well as provisions concerning the construction and operation of such vessels. They also address requirements and procedures for inspections, the issue of certificates of approval, recognition of classification societies, monitoring and training and examination of experts.

In 'Table A' of this addendum, a list of substances is mentioned specifying the conditions of transportation via inland waterways for each of the substances. As LNG is not included in this list, it is prohibited to transport LNG as cargo (UN number 1972) through inland waterways.

Currently, activities have been started for an extension of Table A of the ADN to enable the transport of LNG on European inland waterways. The Dutch delegation initiated the formation of a Working Group 'LNG as Cargo'. This informal Working Group has met in October 2012 for the first time.

7.2.2 Training for Inland Gas Tanker Crews

In an attempt to approve LNG as a fuel and to quickly gain some practical experience, the CCNR, at the request of the Netherlands and following extensive consultations, has made recommendations for four dangerous cargo tankers to use LNG on a trial basis up until 2017. Requirements for competence and training are stated in this special dispensation. Due to the gap in the ADN for carrying liquefied gases, training aspects are also not regulated.

7.3 Gas-fuelled Seagoing Vessels

7.3.1 Using Gas as Ship Fuel for Seagoing Vessels

The 'International Convention for the Safety of Life at Sea (SOLAS) is an international maritime safety treaty concerning the safety of merchant ships. SOLAS requires Flag States to ensure that their ships comply with minimum safety standards in construction, equipment and operation.

In SOLAS II-2 Part B 'Prevention of fire and explosion' Regulation 4 chapter 2.1 'Limitations in the use of oils as fuel' item .1 is stated:

'except as otherwise permitted by this paragraph, no oil fuel with a flashpoint of less than 60ºC shall be used.'

Herewith, the use of LNG is not foreseen by the SOLAS Convention. Hence the development of the "International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels (IGF Code)" was initiated by the Norwegian administration.

7.3.2 Construction and Operation of Gas-fuelled Seagoing Vessels

Based on experience with a few small gas-fuelled vessels the Norwegian authority proposed in 2004 the development of an international code for gas-fuelled vessels. Since that time the IMO subcommittee on Bulk, Liquids and Gases (BLG) started its work with the development of the 'interim guidelines on safety for natural gas-fuelled engine installations in ships', resolution MSC.285(86) which covers the use of NG as fuel for ship including the use of CNG and LNG.

These interim guidelines build the baseline for the further development of the IGF Code which will cover the use of LNG and further low flash point fuels and further energy converters, e.g. fuel cell systems. The goal of the IGF Code is:

- To provide safety measures for ships using gas as fuel including liquefied gas tankers;
- To address natural gas fuel and also other gas fuel types, such as butane, hydrogen, propane;
- To cover the energy conversion systems of relevance (low and high pressure ICE, gas turbines, boilers, fuel cells);
- To address issues not already covered by SOLAS and serve as an addition to SOLAS.

The scope of the IMO IGF Code is to provide the requirements for a safe operation of the gas-fuelled vessel. As other actions will fail out of this scope e.g. for the fuel transfer system the ISO TC 67 Working Group 10 started to develop a guideline for bunkering LNG as ship fuel (see chapter 8 of this report).

7.3.3 Training for Gas-fuelled Seagoing Vessel Crews

The IGF Code will contain the minimum requirements for the training of crews of gas-fuelled seagoing vessels in Part D, Chapter 18 'training and operational requirements'. During the BLG Sub-Committee's 16th Session (BLG 16) it was decided that STCW be requested to consider matters related to training. The STCW will discuss the item after BLG 17 at STW 44 at their meeting from 19th of April to 3rd of May 2013. For the time being training requirements for crews of gas-fuelled vessels are not regulated.

7.4 Gas-fuelled Inland Vessels

7.4.1 Using Gas as Ship Fuel for Inland Vessels

The regulatory framework for inland ships and barges in Europe is covered by the ADN, the Rhine Vessel Inspection Regulations (RVIR) and the European Directive 2006/87/EG. The member states of the European Union are obliged to transcribe the European Directive into country specific law, implying that LNG as a fuel for inland shipping cannot be used in any of the member states.

The prohibition of the use of fuel with a flashpoint below 55°C is stated in Article 8.01 item 3 of the RVIR and in the European Directive 2006/87/EG which also covers the prohibition of the use of LNG. The ADN also prohibits the installation and utilization of engines that use a fuel with a flashpoint below 55°C. Hence, within the current regulatory framework the use of LNG as fuel for inland waterway vessels is not allowed.

7.4.2 Construction and Operation of Gas-fuelled Inland Vessels

The RVIR gives ship owners and ship builders the opportunity to develop alternative arrangements e.g. fuel gas supply systems to meet the requirements. These alternative arrangements are to be discussed within the CCNR (Central Committee for Navigation on the Rhine), and when an arrangement is agreed upon, it will be noted down in the vessel's certificate. To initiate such an arrangement a member state has to present a proposal for a recommendation in which the alternative is described. The proposal must demonstrate that the alternative arrangement is at least as safe as the original requirement in the RVIR.

For at least three vessels the Netherlands started a process for acceptance of LNG powered inland vessels to the UNECE, ADN and RIVR regulative bodies. Existing regulations are used to examine the vessels and their LNG system arrangements against existing legislation and requirements (IMO – draft IGF code) as far as applicable. In the Dutch example the safety of the LNG propulsion system was demonstrated through conduction of Hazard Identification (HAZID) studies.

In this HAZID analysis, the main hazard was considered to be the bunkering procedure, in particular the possibility of overfilling and thereby over-pressurising the storage tank. In the event of the overpressure during filling of the tank the proposed safety measure is the installation of two independent level gauges with automatic closure of the LNG supply valve on deck when reaching the high-high level of either of the two level gauges on the tank.

Based on these Dutch activities the CCNR has decided that the addition of regulations to the Rhine Vessel Inspection Regulations (RVIR) for the approval of LNG as a fuel will be incorporated in its work programme for 2012 / 2013 with high priority. The Swiss delegation suggested incorporating a new chapter 8b 'SPECIFIC REQUIREMENTS FOR VESSELS WITH MACHINES OPERATED ON NATURAL GAS' which is still under discussion. Those 'Basic information on the addition to the Rhine Vessel Inspection Regulations (RVIR) of regulations for the operation of inland vessels with liquefied natural gas (LNG)' is attached to this report.

7.4.3 Training for Gas-fuelled Inland Vessel Crews

The training requirements for the crews of gas-fuelled inland waterway vessels are also only mentioned in the special dispensations. For the time being the competence and training requirements for crews of gas-fuelled inland vessels are not regulated.

7.5 Ship Interfaces and Transfer of LNG as Cargo

Requirements for the bunker station, the manifold and bunkering system of seagoing gas-fuelled vessels will be covered in chapter 9 of the IGF code. Similar requirements are stated for seagoing gas tankers in the IGC Code.

Requirements for ship interfaces regarding LNG as ship fuel and cargo for inland vessels are not regulated. For the further rule development international guidelines, although not legally binding, can be used as guidance and state of the art technology.

Requirements for inland tanker concerning loading, carriage, unloading and handling of cargo are stated in the ADN part 7. Special requirements regarding the carriage of LNG are not part of the ADN as mentioned above.

Requirements for the communication equipment, mooring and transfer systems of inland tanker are stated in the '*International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT)*'. The purpose of the ISGINTT is to improve safety of transport of dangerous goods at the interface of inland tank-barges with other vessels or shore facilities (terminals). The guide is not intended to create, to replace or to amend current legal requirements, but to provide additional guidelines aside of legal requirements. For seagoing tankers the 'International Oil Tanker and Terminal Safety Guide (ISGOTT)' covers the same requirements for ship interfaces and cargo transfer as well as for LNG.

8 Status of Regulations related specifically to Bunkering LNG as Fuel (Task 1)

8.1 Overview

Current rules relating to the handling of LNG like the IGC Code dealing with LNG as cargo, define the requirements for the handling and transport of dangerous cargo. At the moment bunkering LNG as fuel for ships is not regulated on an international level. The IGF Code will not extensively cover the requirements for LNG bunker operations, only defining the requirements for the gas-fuelled ship itself. Elaborate regulations for the interface between the bunker vessel and receiving vessel are not foreseen.

The following international standards are directly related to bunkering LNG or the transfer of LNG and can give guidance for the further development of rules and standards for bunkering LNG fuelled vessels:

- ISO 28460 LNG Ship-shore Interface and Port Operations;
- IMO IGF Code draft;
- SIGTTO LNG STS Transfer Guide;
- SIGTTO ESD Systems;
- BS EN 1160 Properties and Materials for LNG;
- IMO 'Recommendations on the Safe Transport of Dangerous Cargoes and Related activities in Port Areas';
- Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents - API Recommended Practice 2003, Sixth Edition.

Further standards and guidelines define the requirements for components of LNG terminals and could be used as reference for a LNG bunker guideline to be developed:

- IMO IGC Code;
- EN 1474 part 1 LNG Transfer Arms;
- EN 1474 part 2 LNG Hoses;
- EN 1474 part 3 Offshore Transfer Systems;
- EN 1473 Design of Onshore LNG Terminals;
- NFPA 302 Fire protection standard for pleasure and commercial motor craft;
- NFPA 59A Storage and Production of LNG;

- BS EN 13645 Installations and equipment for LNG – Design of onshore installations with a storage capacity between 5 & 200 tonnes;
- BS 4089: 1999 Metallic Hose Assemblies for Liquefied Petroleum Gases and Liquefied Natural Gases;
- EU Directive 96/82/EC (Seveso II);
- SIGTTO/OCIMF Gas Carrier Manifold Guidelines;
- OCIMF/IAPH/ICS International Oil Tanker Terminal Safety Guide (ISGOTT);
- OCIMF Mooring Equipment Guidelines;
- IEC 60092 - 502 – Electrical Installations in Tankers –Special Features;
- ATEX Directive 94/9/EC (ATEX 95);
- ATEX Directive 99/92/EC (ATEX 137);
- European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

Within different expert groups the need for further regulations for bunkering LNG as fuel has been identified. The existing rule framework of the International Maritime Organisation regulates the transport of LNG as cargo for seagoing vessels, which is essential for the construction of LNG bunker vessels and will regulate the use of gas as fuel onboard of vessels. The transfer of LNG as fuel is not regulated at the moment. The existing rules regarding the transfer of LNG are related to the transfer of cargo and cannot be adapted to the bunkering of LNG as fuel. Therefore the Norwegian authority initiated the establishment of a working group for the development of a LNG bunkering guideline by the International Organisation of Standardisation (ISO). Within the ISO technical committee TC 67, the Working Group WG 10 was established to develop the '*Guidelines for systems and installations for supply of LNG as fuel to Ships*'. The working group started the development in July 2011 and will finalise the guideline by 2014.

8.2 Rules for Bunkering Gas-fuelled Vessels and related Activities

8.2.1 ISO Technical Committee 67 Working Group 1014

The ISO '*Guidelines for systems and installations for supply of LNG as fuel to ships*' will give guidance on the minimum requirements for the design and operation of the LNG bunkering facility, including the interface between the LNG supply facilities and receiving ship. It will provide requirements or recommendations for operators and for crew competences, training needs, and the functional requirements for equipment necessary to ensure safe LNG bunkering operations of LNG fuelled ships. They will be applicable to both seagoing and inland trading vessels.

The scope of these guidelines will consider LNG bunkering from shore or offshore LNG supply facilities and address all operations required such as inerting, gassing up, cooling down and loading.

The use of LNG containers to load and store LNG to be used as fuel will not be a part of these ISO guidelines. The connection of LNG containers to the ships fuel system is defined as an operational aspect onboard of the gas-fuelled vessel and should be covered by the maritime regulations. Therefore the ISO Working Group forwarded the issue of the connection and disconnection process of portable tanks to the IMO subcommittee BLG to be discussed further during the IGF code development. During the last meeting of the BLG in February 2013 "BLG 17" design requirements for portable tanks and the related systems onboard of the receiving vessels were discussed. Procedural requirements are still missing.

The objective of the ISO guideline is to standardize the ship/bunkering facility interface, connection and disconnection, the emergency shutdown interface and the LNG bunkering process control, thus ensuring that a LNG fuelled ship can refuel with a high level of safety, integrity and reliability regardless of the type of bunkering facility. The LNG bunkering interface comprises the area of LNG transfer and includes manifold, valves, safety and security systems, and the personnel involved in the LNG bunkering operations.

It also gives guidance on the requirements for carrying out LNG bunkering simultaneously with passenger transfer and/or cargo operations and/or multi-fuel bunkering.

The structure of the ISO guidelines is as follows:

1. Scope
2. Normative references
3. Terms and definitions
4. General Safety Principles
5. Bunkering Scenarios
6. Properties and behavior of LNG
7. Risk Assessment Approach
8. Functional requirements for LNG Bunkering system
9. Requirements to components and systems
10. Training
11. Requirements for documentation

Please find the current structure of the ISO guidelines attached in Chapter 15.4 to this report.

[14] ISO TC 67 WG 10 Draft 'Guidelines for systems and installations for supply of LNG as fuel to ships.' Status: October 2012

These international guidelines for LNG bunkering will be based on the assumption that the receiving ships and LNG supply facilities are designed according to the relevant and applicable codes and regulations of industry Organisations such as the International Maritime Organisation (IMO), the Society of International Gas Tankers and Terminal Operators (SIGTTO), the Oil Companies International Marine Forum (OCIMF) and other ISO, EN and NFPA standards. Relevant publications by these and other Organisations are listed in the bibliography.

Six gaps have been identified[15] regarding the development of the ISO bunkering guidelines:

- The work of the ISO TC 67 WG 10 will result in a guideline and not an international standard. The guidelines have to be implemented or referenced to in other high-level standards or regulations as they are not mandatory on their own;
- The starting and ending point of the bunkering process procedures are important to define the boundary conditions for the risk assessment of the bunkering process and to define responsibilities during the bunkering process. These procedures are not covered in the ISO guideline. Within chapter 19.3 of the draft IGF code is stated that the "responsibility and accountability for the safe conduct of the bunkering operation are jointly shared between the Master of the receiving vessel and the Master of the bunkering vessel". Responsibilities for other bunkering procedures than the STS bunkering are not stated nor the common distribution of responsibilities for each step of the bunkering process are defined;
- Within the general safety principles stated in chapter 4 of the draft ISO bunkering guidelines it is stated that "Safety shall be the primary objective for the planning, design and operation of facilities for the delivery of LNG as marine fuel taking into consideration simultaneous operations and the interaction with third parties." Detailed guidance for bunkering during loading/unloading and passenger embarking/disembarking are not described by the ISO guidelines;
- The ISO guidelines will not define common safety distances during bunkering operations. Only EX-zones will be defined;
- Detailed descriptions of measures to reduce the release of methane are not within the scope of these guidelines;
- Definitions of the gas quality and procedures for the sampling and measurement of gas are not included.

8.2.2 Rules for Bunkering Gas-fuelled Seagoing Vessels

SIGTTO LNG ship to ship transfer guideline

SIGTTO has developed LNG ship to ship (STS) transfer guidelines to offer guidance to the masters and operators of vessels undertaking STS transfers of LNG. These SIGTTO guidelines cover side-by-side STS transfer operations involving commercially trading LNG carriers at anchor, alongside a shore jetty or while underway. The guidance applies to seagoing ships and may also be useful as for reference when establishing rules and procedures for transfer operations between seagoing ships and LNG floating storage and offloading vessels (FSO's) in onshore waters.

The STS transfer guideline gives guidance for

- Safety during cargo transfer and safety equipment
- Communications
- Operational preparations before manoeuvring
- Manoeuvring and mooring
- Procedures alongside
- Unmooring
- Equipment for fenders, cargo transfer, mooring and personnel transfer
- Emergency planning

These LNG ship to ship transfer guidelines are limited to alongside cargo transfer of large scale LNG carrier and are not legally binding. The requirements especially for the mooring of the vessels are not applicable for small vessels due to the big variation of size and different kind of mooring equipment. General safety requirements for the safe transfer and the equipment, manoeuvring, procedures alongside and emergency planning are recommendable for the development of STS bunkering guidelines for bunkering LNG as fuel.

[15] Gaps identified during meeting between ISO group representatives of GL and DNV

International Safety Guide for Oil Tankers & Terminals

It is recommended by the industry that a copy of the International Safety Guide for Oil Tankers & Terminals (ISGOTT) is kept and used on board of every tanker and in every terminal so that there is a consistent approach to operational procedures and shared responsibilities for operations at the ship/shore interface.

OCIMF and SIGTTO give guidance on jetty topsides (operation, inspection and maintenance), marine hoses, Emergency Shut Down , ship manifolds (LNG, LPG and products) and LNG ship-to-ship loading focussing on the transfer of cargo to/from large scale tankers without being legal binding. The general requirements for marine hoses and Emergency Shut Down should be taken into account for the further rule development.

8.2.3 Rules for Bunkering Gas-fuelled Inland Vessels

For the time being the existing LNG bunkering procedures for inland vessels are part of the special dispensation given by the CCNR for a few Dutch vessels. Each procedure was assessed by a risk analysis.

For the further development of bunkering guidelines for Inland vessels the 'International Safety Guide for Inland Navigation Tank-barges and Terminals (ISGINTT)' can be used as guidance. OCIMF together with other stakeholders for the inland waterways, like CCNR, developed this guide for inland tank-barges and terminals.

The CCNR recognises ISGINTT as the principal industry reference manual on the safe operation of tankers and the terminals that serve them.

8.3 National and Port Regulations for Bunkering LNG as Ship Fuel and related Activities

For the time being three European countries have developed and adopted bunkering procedures as port regulations by using special dispensations. A result of further planning and constructions of LNG terminals as local LNG distribution hubs within Europe, a number of ports within three European countries, Belgium, Germany and Sweden, are planning for LNG bunkering within their port areas. The following table gives examples for the activities of selected European ports and their activities in the field of LNG bunkering procedures:

Table 6 – Selection of LNG bunker developments of European ports

Port	Related chapter(s) of this report	Activity
Hamburg	5.4 8.3.5	A Risk Assessment and Navigational Safety Study for the Port of Hamburg were performed. An establishment of a LNG bunker facility is planned
Rotterdam	5.1 8.3.3	A detailed planning regarding the LNG supply chain for the Port of Rotterdam and Risk Assessments during the LESAS project was performed.
Belgian Ports	5.3 8.3.4	A Risk Assessment during the Flemish study was performed. The Port of Antwerp developed bunkering guidelines for bunkering LNG as marine fuel by truck. The TTS bunkering of LNG is allowed within the port area of Antwerp by using these guidelines.
Zeebrugge	5.3 8.3.4	The port of Zeebrugge has collected experience with the construction and operation of the Zeebrugge LNG terminal which is considered in different LNG studies as possible LNG distribution hub in North Europe.
Gothenburg	8.3.2 14.5	The Port of Gothenburg developed a proposed LNG bunkering guidelines and plans the construction and operation of a LNG intermediate storage facility
Stockholm	8.3.2	The Port of Stockholm constructed a LNG bunker facility for the MV VIKING GRACE. The LNG bunker procedures are developed for the specific ship to ship bunkering process for this single bunkering application for the MV VIKING GRACE and have been agreed by the Swedish authorities for this single application.

8.3.1 Belgian Regulations

Regarding the SWA the operator of LNG facilities should have identified and evaluated the dangers and risks attached to storage and transportation of the LNG. The risk and control measures for these risks must be listed and reported. The control measures should constitute an adequately safe and reliable solution in connection with design, construction, operation and maintenance.

For LNG facilities an up-to-date fire safety plan has to be in place. The fire safety plan has to contain at least:

- the company policy on preventing, controlling, limiting, and fighting incidents;
- a quantitative description of one or more typical incident scenarios for each installation unit;
- a general strategy for the repression of the incident scenarios;
- an overview of the necessary facilities, tools, control measures and detection systems to limit, control and fight incidents;
- the persons and/or positions responsible for monitoring the integrity of these facilities, tools and control measures.

For the approval process of gas-fuelled vessels the Interim Guidelines MSC.285(86) are in use but are not transposed in Belgian law. Due to the ongoing developments the Belgian Administration is waiting of the finalised IGF Code before changing the law.

For the approval of Liquefied Gas Carrier the IGC Code was integrated in Belgian law. The counterpart for inland waterway tankers, the ADN, has not been integrated in Belgian Law, yet. Belgium was not a contract party of the ADN before. With the changes of the ADN within 2011 Belgium jointed as a contract party to the ADN and is still working on the implementation in Belgian Law.

There are no LNG bunkering procedures foreseen on national level, because this kind of regulation are organized on port level and the bunkering permissions will be issued by the Harbour Master.

8.3.2 French Regulations

Division 221 is the French regulatory text that describes the requirements for cargo and passenger of a gross tonnage greater than or equal to 500 UMS (Unattended machinery space). This text is a transcription of the SOLAS Convention to which is added the rules specific to French flag.

The French authorities allow the use of fuel with a low flash point in their regulations by incorporation of a footnote referring to the resolutions MSC.285 (86) in the article page 221-II-1/26. Until the IGF Code comes into force, the provisions of resolution MSC.285 (86) will be used.

8.3.3 German Regulations

Port of Hamburg

No specific guidelines for bunkering LNG or HFO are included in the port regulations of the port of Hamburg. The handling of LNG is defined as cargo handling in the by-laws for dangerous cargo of the federal state of Hamburg. The transfer of LNG as cargo is only allowed in tanker designated harbours. Bunkering LNG as fuel is possible with special permission from the Harbour Master. In the following the current state of the regulatory framework is stated, based on the Port of Hamburg and exemplary for all German ports:

Approach, manoeuvring within the Port and Cargo operations of LNG tanker and LNG bunker vessels

The approach into the port by a LNG tanker is regulated by German law in the 'Schiffssicherheitsgesetz (SchSG). Requirements for the navigation on the waterways are covered by the 'Seeschifffahrtsstrassenordnung (SeeSchStrO)'. The obligation to report the transport of dangerous cargos and the port international traffic of LNG tanker and LNG bunker vessels are regulated by the by-law for dangerous cargo of the federal state of Hamburg (Landesgefahrgutverordnung – LGGVHH). Berthing of LNG tanker and LNG bunker vessels as well the transfer of LNG, e.g. by Ship to Ship transfer, is only possible in harbours designated for LNG tankers.

Approach, operation and bunkering of gas-fuelled vessels

The Interim Guideline MSC 285.(86) was integrated into the German Ship Safety Law (SchSG) which enables the operation of Natural Gas-fuelled vessels on German waterways. The transfer of LNG as fuel at each harbour in the Port of Hamburg is not regulated yet.

Due to the integration of the MSC.285 (86) into the German Ship Safety Law, operation of gas-fuelled vessels in German waterways is already possible. The handling of LNG as cargo is also regulated in German law including requirements for the handling of LNG as cargo. These requirements have been implemented in the Port

Regulations for handling dangerous cargos of all German seaports. The following items have been identified for the approval of LNG bunker processes of gas-fuelled vessels:

- The requirements for the cargo transfer of liquefied gas have to be adjusted to the requirements for the handling of liquefied natural gas as cargo
- The results of the ISO TC 67 WG 10 should be considered for the definition of requirements for bunkering gas as fuel

From the authorities point of view the regulatory framework is sufficient. The LNG bunkering process is not covered but is possible due to special permissions from the authority and the general requirements known from the procedures for the LNG cargo handling. For the first LNG bunkering applications the Hamburg Port Authority will work with special permissions. After a suitable time of operation and an extension of the LNG bunkering activities within the port area the authority will carry out a revision of the Harbour Regulations. In that case the authority prefers to address the requirements for bunkering LNG within their port regulations to a common international guideline, if available.

Safety concept for LNG bunkering within ports

In the absence of existing LNG bunkering rules, a consortium of Germanischer Lloyd, Meyer Yard and TGE carried out a feasibility study for bunkering liquefied gases within German ports for the German Ministry of Transport, Building and Urban Development. An outcome of the study is a draft safety concept for LNG bunkering within ports. This draft of a high-level guideline includes general requirements for the bunkering procedure as well as a bunker checklist and is a standalone annex of the final report of the feasibility study. The concept covers

- Properties of liquefied gas
- Safety philosophy
- Port specific requirements
- Technical and organisational requirements for the bunkering
- Bunker procedures
- Check lists

This guideline has no binding authority but could be used as input for the development of a high-level LNG bunkering guideline. The safety concept for LNG bunkering is appended to this report.

8.3.4 Norwegian Regulations

Norwegian authorities have lasting the past 12 years gained experience with regulations related to bunkering of gas-fuelled ships.

When it comes to bunkering from permanent onshore installations or from tank-vehicle, the responsible national authority is the Norwegian Directorate for Civil Protection (DSB) is the responsible national authority.

Bunkering of LNG from permanent onshore installations and from tank-vehicle is regulated by "the Fire and Explosion Protection Act" of the 14th of June 2002, the regulation of 8th of June 2009 relating to the "handling of flammable, reactive and pressurized substances" and the "Major-Accident Hazards Regulation" of 17th of June 2005 (if the installation contains 50 tones of LNG or more)

Until 8th of June 2009, bunkering of LNG from permanent onshore installations and tank-vehicle were dependent on permission from DSB. Bunkering LNG with passengers onboard, entering or leaving the ship, was never permitted.

Since the 8th of June 2009, as a main rule, bunkering is no longer subject to permissions from DSB. However, DSBs consent is needed if the installation contains 50 tones of LNG or more, or DSB decides so.

The DSB *"Guidance for transferral of dangerous substances"* and established practice imply that bunkering of LNG in Norway shall be done only when there are no passengers onboard, entering or leaving the ship. Until now, Norwegian passenger ships operating with LNG as fuel have been bunkered at night when the ships stay in port, without any passengers onboard. The request to use LNG as engine fuel on ferries etc. that do not stay in ports at nights, and are at all times are carrying passengers onboard, are challenging this established practice.

At the moment, DSB is considering if bunkering of LNG from all permanent onshore installations and from tank-vehicle shall be subject for consent from DSB before bunkering like it was previous to the 8th of June 2009. DSB is also considering if bunkering in the future may be done when there are passengers on board, entering or leaving the ship in the future.

Due to the fact that bunkering of LNG, as distinct to transfer of LNG, may involve the presence of numerous third persons close to the bunkering facility, DSB is paying the bunkering operation special attention. Technical and Organisational measures to prevent spill, and adequate safety distances to where the public is located in case of spill, is of great importance.

In addition, to the regulations by DSB the Norwegian Maritime Authority (NMA) regulation No.1218 from the 9th of September 2005 for passenger ships and the regulation No.644 for cargo ship both have provisions for bunkering safety. For the time being the NMA also accepts that new LNG fuelled ships are build in accordance with the Interim Guideline MSC.285(86).

For ship (barge) to ship bunkering the regulations from NMA will be applied in addition to local port regulations with defined requirements for such operations. Today, there is not any such bunkering arrangement in operation in Norway. It is expected that LNG bunker ships or barges will be built in the near future. The actual regulation for such ships or barges would be the IMO IGC –Code and in addition to regulations for the maneuvering, the mooring between vessels and any system for release and sail away in case of accident.

An unsolved question on ship to ship bunkering operations is however the fact that an vessel build according to the IGC Code has areas in which an explosive gas atmosphere is or may be expected to be present (EX-safety zones), in which there might be a release of methane vapor etc. In contrast to this the Norwegian regulations for LNG fuelled ships, the Interim Guidelines MSC.285(86) and the draft IGF Code do not have a general requirement for EX-safety zones. This means that a ship constructed according the IGF Code with possible igniting sources may enter into the EX-zone of the IGC bunkering vessel with a risk of fire. A solution to the challenge can be a defined requirement for an EX-safety zone on IGF-ships to enable the safe connection to an IGC bunkering vessel.

8.3.5 Swedish Regulations

LNG bunkering procedure of the Swedish Maritime Technology Forum

Within a Swedish joint venture project a ‘LNG ship to ship bunkering procedure’ has been developed. The project has been carried out by the Swedish Marine Technology Forum (SMTF), FKAB Marine Design, Linde Cryo AB, Det Norske Veritas AS (DNV), LNG GOT and White Smoke AB.

The document is a procedural description for bunkering LNG between two ships in port with demands for short operation time. The procedure has been worked out to handle the specific details of this operation in a safe way manner taking into account simultaneous bunkering, cargo and passenger handling. The project has developed a LNG bunkering concept that encompasses both the operational bunkering process and technical solutions needed for ship to ship bunkering of LNG.

In this study the following national rules and guidelines have been used:

- Port Regulations for the Port of Gothenburg
- Sea Regulations from the Swedish Transport Agency, Maritime Department
- Land Regulations from the Swedish Civil Contingencies Agency (MSB)

The following International Rules and Guidelines have been used:

- IMO IGC Code – (International Gas Code), Rules for the bunker ship
- IMO IGF Interim guidelines – (International Gas Fuel), Rules for the receiving ship
- IMO STCW
- IMO Standard Marine Communication Phrases
- Ship-to-Ship Transfer Guide (Liquefied Gases) ICS / OCIMF / SIGTTO
- Ship-to-Ship Transfer Guide (Petroleum) ICS / OCIMF
- ESD arrangements & linked ship/shore systems for liquefied gas carriers SIGTTO

The procedure has no legally or binding status and has the following limitations:

- Only focuses on LNG ship to ship transfer
- Only describes requirements for transfer hoses
- Tank systems described is limited to Type C tanks

These guidelines are limited to a special STS LNG bunkering scenario but could give input for part of a completed LNG bunkering procedure consisting of requirements for all possible bunkering activities.

LNG bunkering procedure Port of Gothenburg

The Port of Gothenburg developed a draft of a LNG bunkering guideline due to its planning of the construction of a LNG intermediate storage for the supply of LNG fuelled vessels operating between the Swedish and Danish coast and within the North Sea. The “proposed LNG bunkering operating regulations including LNG bunkering” is a specific guideline for the port of Gothenburg taking into account national legislation (see in Annex 14.5).

8.3.6 Dutch Regulations

Port of Rotterdam

Based on the Rotterdam Port Bye-laws, the Port Rules on dangerous substances contain additional, specific regulations for ships carrying dangerous cargoes in the port.

The Rotterdam Port Authority is responsible for:

- The nautical management in the Rotterdam harbour and area.
- For the handling of smooth, safe, clean and secure shipping traffic.
- Incident management
- Inspection of safety of dangerous goods
- Mooring aspects

The applicable regulations are:

- Shipping Traffic Act
- Inland Navigation Police Regulations (BPR)
- Shipping Regulations for Territorial Waters (STZ)
- Regulation for the Prevention of Pollution from Ships
- Regulation on the Transportation of Dangerous Substances, 2007
- Port Bye-laws Rotterdam
- Port Bye-laws Schiedam and Vlaardingen
- Port Security Law (ISPS)

The National Inspectorate (IVW) is responsible for the inspection of ships flying the Dutch flag, Flag state and Port state control in accordance to the Paris Memorandum of Understanding on Port State Control (PMoU). Inspections are focussing on certificates, equipment and MARPOL aspects.

The Municipal Executive of Rotterdam enacted the Rotterdam Port Management Bye-Laws to ensure safety and the environment in the port and its surroundings and the quality of the services in the port. With the new LNG

import terminal large scale LNG operations and LNG carriers are incorporated into the Rotterdam Port Management Bye-law rules.

Rotterdam Port Management Bye-law

Article 6.5 LNG tankers outside LNG harbours

1. It is prohibited to occupy a berth with a LNG tanker outside an LNG harbour.

2. The Municipal Executive may grant exemption from the prohibition set forth in the first paragraph.

Article 6.6 Ships allowed in LNG harbours

1. It is prohibited to be in an LNG harbour with a ship, unless:

   a. it is a LNG tanker that is using, has used or will be using port facilities for loading, unloading or bunkering;

   b. the presence of this ship in the harbour is necessary in connection with the arrival, stay or departure of an LNG tanker for reasons of the operation of the shipping company;

   c. it concerns a ship of the Harbour Master Division of Port of Rotterdam Authority and no loading or unloading of LNG is taking place;

   d. it concerns a ship of the Seaport Police of the Rotterdam-Rijnmond police region and no loading or unloading of LNG is taking place;

   e. it concerns a service vessel that is providing services upon the request of the captain of an LNG carrier and no loading or unloading of LNG is taking place.

The Port of Rotterdam also developed a Port Information Guide which gives guidance for Port operations and an overview of the existing regulations:

- Each ship is to have an independent Emergency Shut-Down system.
- Guidelines for handling and emergency situations need to be in place
- Communication and emergency operations according IMO rules.

- The international regulations, e. g. IMO, SOLAS convention and EU recommendations, are in force. The Harbour Master can grant exemption for specific regulations or specific activities.
- For any (bunker) operation in the port it is necessary to have the approval of the Harbour Master.

For the Rotterdam LNG terminal extensive nautical studies have been performed and mooring simulations have taken place. For small scale applications and LNG fuelled ship movements there is little experience and guidelines for the port authorities.

The Port Management Bye-law will have to be amended to allow new activities in relation to small scale LNG operations and LNG powered inland ships and bunker barges.

Environmental Management Act (Wm-regime)

Dutch businesses must comply with specific environmental regulations, which are based on the Environmental Management Act (Wet Milieubeheer, Wm) and incorporated within general environmental rules such as the General Rules for Establishments, Environmental Management Decree (Besluit algemene regels voor inrichtingen milieubeheer), the Environmental Activities Decree or environmental licensing (All-in-one Permit for Physical Aspects, omgevingsvergunning).

Statutory regulations apply to, for instance, noise and vibration, energy waste materials, odour, air emissions, discharging liquids, transport management, soil protection and hazardous substances.

The Dutch government, provinces and local districts established a management plans to shape the Netherlands now and in the future. The Spatial Planning Act regulates how these plans are produced and amended.

Companies with LNG terminal(s), LNG storage, LNG fuelling stations and the related LNG operations have to comply with the Environmental Management Act and require a (all-in-one) permit. With the all in one permit companies are also able to incorporate also the construction and operational permits in one permitting process.

Environmental Management Decree (Activities decree)

The Environmental Management Decree forms the basis for the environmental regulations. Many companies (inrichtingen) have to comply with the Environmental Management Decree. Depending on the activities, the company (inrichting) will be classified in one of three categories pursuant with the Activities Decree.

- Type A: No environmental management notification, no environmental permit;
- Type B: Environmental management notification;
- Type C: Environmental permit.

LNG stations and terminals are classified Type C.

Best practice guidelines

The Activities Decree refers to PGS guidelines as the best available techniques (BAT). The Dutch government issued so-called regulatory guidelines (PGS) and standards which are referred to in relation to the permit e.g. the safe storage of hazardous substances. These regulatory guidelines are considered to represent the best available techniques (BAT).

To prevent accidents with hazardous substances, the PGS Guidelines, 'Publicatiereeks Gevaarlijke Stoffen (PGS) have been formulated to provide design requirements for a safe installation. These regulatory guidelines are used by the authorities and industry and in principle every applicable installation shall comply with these guidelines.

These PGS documents are called guidelines because they are not regulations, but one can prove conformity to the regulations by complying with the requirements of the PGS.

Guideline for LNG filling stations

For LNG filling stations a guideline PGS 33 is under development by local and/or regional authorities, including the city council for the building and environmental permit aspects; station owners, advisory bodies and the fire brigades.

The scope of the PGS 33 is to develop a consistent and transparent regulatory framework for LNG filling stations for automotive and maritime applications. The guideline will include harmonised risk analysis procedures for the siting of LNG bunker stations.

According to the timeframe this PGS guideline will be published in early 2013. It is expected that most of the small scale LNG filling stations will be covered by this PGS 33. Like most of the PGS guidelines, PGS 33 will also refer to Best Available Techniques (BAT) as specified in multiple recognised national and international standards, codes and guidelines.

Bunkering procedures Port of Rotterdam

During the LESAS project, the current framework of regulation, codes and standards for the establishment of a small scale LNG fuel supply chain for shipping and vehicles in the Netherlands has been investigated for various bunkering operations:

- From small or large scale terminals via piping and loading arms
- From an onshore LNG fuelling station (from shore to ship)
- From truck to ship at a harbour berth
- From ship to ship
- Large bunker barges to large ships (deep sea and short sea ship)
- Small bunker barges to small ship (inland ships, port vessels, e.g.)
- Usage of LNG hoses for transfer

The regulatory framework consists of national regulations for the shipside as well as port regulations and national regulations for the port side. Local authorities and the responsible port need to permit LNG bunkering at the chosen location.

No requirements for bunkering LNG are included in the Rotterdam Port Management Bye-laws. In the current version bunkering is described as the transfer of fuel oil or lubricants from a bunkering vessel to a seagoing vessel.

In some cases LNG bunkering operations are done in parallel with cargo operations or fuelling diesel oil from one ship to another. Therefore SIGTTO and OCIMF guidelines were taken into account before, during and after an LNG bunkering operation. These guidelines are mainly the Ship to Ship transfer guidelines, the “ESD arrangements & linked ship/Shore systems for liquefied gas carrier” and “LNG operations in port areas”. Furthermore parallel bunkering and cargo transfer could interfere with Dutch environmental permits.

If the bunker operation takes place in a harbour area, a special permit from most of the harbour authorities will be needed before any bunker operation can commence.

Bunkering from a LNG terminal

Bunkering from LNG terminals will take place via piping and loading arms. Large scale LNG terminals can be used for bunkering large or coastal ships and both large and small bunker barges.

For bunkering (fuelling) smaller inland ships from an LNG filling station and/or small LNG terminal, the Environmental Management Act will apply and from a regulatory point of view the requirements of the PGS 33 regime can be used to prove compliance with the legislation.

Bunkering from a pontoon

Inland bunkering (of smaller inland ships, port vessels, for example.), could also take place via an onshore LNG fuel station with pontoon-based LNG dispensers. This configuration is used for small scale inland bunkering stations. The Environmental Management Act applies for this kind of configuration.

If a bunker operator (company) would like to enlarge their existing bunker stations (where petrol and diesel is supplied) for LNG fuelling, a new or revised permit for the entire facility will be needed. One of the major aspects in relation to a new permit is related to the safety of the facilities and the surroundings. For Inland Shipping Decree, as for the Environmental Management Act, the external safety aspects are to be analysed (impact assessment). The authorised regulatory body is the local authority. When available, the PGS 33 document will be used to prove compliance with the legislation.

Ship to ship bunkering

Bunkering of LNG for small (inland) ships is expected to be done by truck or directly from a bunkering facility onshore. For larger ships, ship to ship bunkering seems to be the most economical.

During ship to ship bunkering certain regulations are to be considered. Local authorities and the responsible port need to permit LNG bunkering at the chosen location.

The Rotterdam Port Management Bye-law does not include bunkering of LNG yet.

Truck loading

The bunkering operation from a truck to the ship is under the Environmental Management act and the ADN regulations. There is no regulatory barrier for bunkering from a truck to a ship as long as the international standards and procedures are used and the operations are performed within the requirements of local regulations. The competent authority (DCMR in Rotterdam) can set further requirements for this procedure.

One can expect that written procedures have to be in place, including an ADN safety checklist. Such procedures will include an agreement between the ship's crew and the staff on the quay in line with loading/un-loading of any other commodity with regard to aspects such as technical operation details.

8.3.7 Comparison of different national approaches

In the following Table 7 the different national approaches regarding the approval of gas-fuelled ships and LNG bunkering procedures are summarised:

Table 7 – Comparison of different national approaches for the approval of bunkering LNG

No	Country	Regulation of gas-fuelled ships	Regulation of bunkering LNG	Comment
1	Belgium	Interim Guidelines MSC.285(86): **NOT** transposed in Belgian law.	**NO** regulation on national level: **Ports are responsible**	MSC.285(86) was not implemented in Belgian law. The final IGF Code will be implemented.
2	France	MSC.285 (86**) is implemented** in national law.	**NOT regulated**	-
3	Germany	MSC.285 (86**) is implemented** in national law.	**NOT regulated**. Possible based on special permission and cargo handling procedures	Based on the GL study "Bunkering of liquefied gases within German ports" further rule development activities are expected.
4	Norway	National approval procedure based on MSC.285(86)	National **approval procedures available**	-
5	Sweden	National approval procedure based on MSC.285(86)	**NO** regulation on national level: Several **port specific procedures available.**	Existing bunker guidelines on port level (Port of Gothenburg and Port of Stockholm) are available.
6	The Netherlands	National approval procedure based on MSC.285(86)	National approval guidelines are **under development**	-

8.4 Training

Training requirements for bunkering LNG will be covered by the ISO TC 67 WG 10 LNG bunkering guidelines. Within these guidelines generic training requirements, as well as the use of bunker equipment and port specific operations, will be enlisted. The qualification requirements for the ship's crew will be in accordance with the IGF Code and aligned with STCW. This implies that all crew will have basic safety training, and deck-officers and engineers directly involved in the bunkering will have dedicated training as outlined above. The qualification requirements for the shore personnel will be regulated by the national/ port authorities (EN1473).

9 Identified regulatory Gaps relating to Bunkering LNG as Ship Fuel (Task 2)

9.1 Gaps in the on-going Developments at international Level

The main gap for bunkering LNG as maritime fuel is the missing recognition and regulation of LNG as a fuel itself. Until the publication of the first regulation (as interim guidelines in fact) for the use of natural gas as fuel for ships, the MSC.285(86) in 2009, gas as fuel for ship was not recognized and there was no need for rules and standards for related processes like the bunkering of LNG.

Although the transfer of LNG as **cargo** (as well as boil-off vapours which are utilized as fuel for shipboard) is regulated by the IGC Code for seagoing vessels and a number of guidelines for the transport and transfer of LNG as **cargo** have been published by the International Maritime Organisation and Associations such as the SIGTTO and OCIMF, for the time being the bunkering of LNG as a **fuel** for ships is not regulated. Within the current development of the International Code of Safety for Ships using Gases or other Low Flashpoint Fuels (IGF Code) only the requirements for the receiving vessel will be addressed. Requirements for the whole LNG bunkering process and specific procedural requirements for different bunkering procedures are missing. The IMO's responsibilities regarding the IGF Code are limited to the development of requirements for the receiving vessel (construction and operations) and its crew. That means that only the gas-fuelled vessel itself including the bunker station will be covered. The absence of an adequate IMO regulatory framework for bunkering can be regarded as an important gap and as a driver behind the various on-going initiatives that focus on drafting guidelines and standards for LNG bunkering. The first identified gap therefore is:

► Gap 1 - The entire use of LNG as marine fuel and LNG bunkering procedures are not regulated by IMO requirements and standards as LNG is formally not fully recognised as fuel for the time being.

This main gap has already been identified and the ISO TC 67 Working Group 10 was established in 2011 to develop guidelines for bunkering of gas-fuelled vessels focusing on the technical, operational and safety aspects of the bunkering process itself. The ISO TC 67 WG 10 has decided to develop a Technical Report as a high-level document. At the moment from the ISO point of view, the development of a legally binding standard is not possible due to the lack of experience with bunkering LNG as fuel by different types of bunker operations and for all kind of vessel types. As a consequence the Technical Report will not have the same status as an International Standard but can, of course, be used as a reference document. The work of the ISO TC 67 WG 10 will result in a Technical Report guideline and not in an International Standard. Therefore the Technical Report is not a legally binding document and will have to be referred to in another International Standard or should be developed further to an International Standard after an adequate period of successful use. To set up a common standard for

bunkering LNG, the results of the ISO TC 67 WG 10 should be developed further to an International Standard or these guidelines should be referenced in another common Standard, regulatory instrument or legal text.

► Gap 2 - The future status of the ISO Technical Report on LNG bunkering within the international rule framework will have to be reinforced through references in other common Standards and/or legal texts

In relation to the current draft of the ISO bunkering guideline, it can be noted that the details of the bunkering process in terms of the 'starting' and the 'ending' of procedures will not be defined in the Technical Report of the ISO TC 67 WG 10 or in the IGF Code and remains, for the time being, as an unsolved item. For all possible LNG bunkering procedures as illustrated in Figure 3, the beginning and the end should ideally be defined. This kind of definition is necessary to define responsibilities for each step of the related procedure and the start of specific safety measures before bunkering. Regarding the current draft of the IGF Code the responsibilities are with the Master of the receiving vessel and the Master of the bunker vessel not taking into account further bunkering processes than the STS bunkering. It is also important to define the scope of the risk assessment for each of the possible bunker procedures which will be used for approval and accreditation processes. The risk assessment of the LNG bunkering process is necessary for the verification of safe bunkering at each possible bunker location (see Chapter 8.5).

► Gap 3 - The definition of the bunkering process and the division of responsibilities for bunkering LNG as fuel is not covered by the Technical Report of the ISO TC 67 WG 10. Responsibilities mentioned in the current Draft IGF Code are limited to the Ship to Ship transfer.

The bunkering of LNG as fuel for ships is described as 'bunkering' or 'transfer' of LNG. To distinguish between the bunkering of LNG as fuel for ships and the transfer of LNG as cargo the bunkering of LNG as fuel should be defined as 'bunkering' and not as transfer. The conceptual delineation is necessary to distinguish by definition between the transfer of LNG as cargo and the bunkering of LNG as fuel. This could be important for port authorities to have a binding definition for the approval process of cargo transfer or bunker operation. Such delineation should also be established for the description of different bunkering procedures e.g. STS bunkering instead of STS transfer in case of Ship to Ship LNG bunkering as fuel.

► Gap 4 - A conceptual delineation between transfer of LNG as cargo and bunkering of LNG as fuel is missing

9.2 The Use of portable LNG Tanks

The use of portable LNG tanks (containers) consists of the transport, loading and unloading process from shore to ship and ship to shore and the connection and disconnection process on board the gas-fuelled vessel. The use of portable LNG tank containers avoids refuelling on board of the receiving vessel from an onshore terminal or bunker vessel. Emptied portable tanks will be replaced by filled tanks. During the current work of the ISO TC 67 WG 10 the use of portable LNG tank systems for bunkering was separated in the two processes:

- The transport and loading / unloading of portable LNG tank systems as part of cargo handling and
- The connection / disconnection of theses portable tanks as part of the operational process on board of the gas-fuelled vessel.

The transport of dangerous goods, or the **cargo handling** part - in this case of LNG portable tanks - is regulated by the IMDG code which covers the transport on the receiving vessel and the discharge from the gas-fuelled ship. The requirements for the connection and disconnection procedures to the ship's system (the **operational process**) are not regulated by the current draft of the IGF Code. The relevant requirements for the ship system using portable LNG fuel tanks and additional requirements for the portable tanks were discussed at BLG 17 in February 2013. These are mainly aspects regarding the use of one single main fuel line and one single vent line when several portable tanks are connected to the ship system and additional requirements for the fixation of portable fuel tanks in opposition to cargo container. These items will be discussed further. Guidance for the operational process means for the safe connection and disconnection of portable tanks are still missing. Until the IGF Code is finalised and adopted, the use of portable LNG tank containers is not regulated. It is only possible with special permission of each flag state (and port rules), and thus has to be considered as a gap.

► Gap 5 - The connection and disconnection process of portable LNG fuel tanks is not defined in the current draft of the IGF Code and the Technical Report of the ISO TC 67 WG 10

9.3 Transport of LNG as Cargo by Inland Vessels

LNG as dangerous goods in **packed form** is allowed to be carried by inland waterways according to the European ADN Agreement (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways). Contrary, LNG is not listed in the ADN as dangerous cargo wherefore the transport of LNG in inland **gas tankers** is prohibited within all Member States of the EU. This prohibition also leads to limitations in terms of the development of LNG bunkering possibilities. Currently, planned LNG bunkering concepts using the supply of gas-fuelled vessels via STS transfer can only be done through seagoing bunker vessels which have

been built according to the IGC Code. At the moment a STS transfer via an inland bunker barge is not possible due to the lack of construction regulations. As the ADN does not regulate any transport of liquefied gases, further safety requirements for the transport of LNG have to be developed. For the **technical requirements** regarding the design of piping for cryogenic use, tank design, safety valve design etc. the requirements for Liquefied Ethylene Gas (LEG) already defined within the ADN can be used as guidance. **Operational** aspects like the transfer of cargo and sampling can be adopted in principle from the ISGINTT. The Dutch delegation initiated the establishment of a Working Group 'LNG as cargo' to change the cargo list within the ADN.

To further enhance different models of LNG bunkering and notably for STS bunkering by using an inland vessel (barge), the activities of the Central Commission for the Navigation of the Rhine regarding the approval of the transport of LNG as cargo should be pursued.

► Gap 6 - The absence of appropriate rules relating to the transportation of LNG on European inland waterways affects the lack of construction requirements for LNG inland tankers, bunker barges and gas-fuelled inland waterway vessels.

9.4 The Use of Gas as Fuel for Inland Vessels

European inland waterway shipping plays an important role for the European domestic trade. However according to Article 8.01 (3) of the Rhine Vessel Inspection Regulations, the use of fuels with a flash point that is less than 55°C is prohibited. Accordingly, LNG propulsion systems are not permitted at present. Currently there are some Dutch inland waterway vessels in operation with LNG as fuel. These exceptions have been allowed by the Central Commission of the Navigation of the Rhine for experimental purposes. The number of such application is limited and the CCNR demands the operational results related to the safe operation of the vessel before moving ahead. Additionally, the Swiss delegation of the inspection regulations working group of the Central Commission of the Navigation of the Rhine suggested an 'addition on the Rhine Vessel Inspection Regulation (RVIR) of regulations for the operation of inland vessels with liquefied natural gas' which is still under discussion. To bridge this gap and to enable the use of a LNG as fuel for inland vessels, related regulations of the Central Commission for the Navigation of the Rhine are missing. Recently started activities regarding the approval of the use of LNG as fuel for inland vessels should be reinforced. Therefore this item remains as the sixth gap:

► Gap 7 - The use of LNG as fuel is not permitted on inland waterway vessels in general and is only possible by exemptions given by the CCNR, which consequently does not stimulate the creation of a larger LNG demand

9.5 Construction and Approval of small Scale Onshore LNG Bunker Facilities

The approval process for LNG production and storage facilities is based on Council Directive 96/82/EC (the SEVESO II Directive) which has been integrated into national laws of the Member States of the EU. By agreement the European Economic Area countries (Iceland, Liechtenstein and **Norway)** also enact EU environmental legislation including the Seveso II Directive. The approval process for small scale bunker facilities of the authorities is based on these laws and additional guidelines which defines the state of the technology and safety measures. At the moment the Netherlands (PGS 33) and Norway are developing their own guidelines for the approval processes because for small scale LNG bunkering stations no guidelines or best practice guidance are available, which complicates the process. For the time being the following gaps for the onshore approval process have been identified:

► **Gap 8 – Despite the large range of national legislation, further guidance or Standards for small scale LNG bunkering stations could be developed using current best practices**

9.6 Port Regulations: Common Approach for Approval of LNG Bunker Procedures

Based on the current international maritime rule framework most of the port regulations only address the **transport and transfer of LNG as cargo**. Bunkering of LNG as fuel for ships is not defined in most of the ports. In Norway, the bunkering procedures for gas-fuelled vessels have been designed individually. No common procedure is available or has been implemented within Norwegian port regulations. The International Association of Ports and Harbours (IAPH) established a LNG Working Group dealing with the development of common LNG bunkering procedures and checklists. As these documents do not have any international legally binding status, IAPH plans to hand the results to SIGTTO and IMO for possible implementation in future International Standards or guidelines. LNG bunkering guidelines only exist in Scandinavian ports based on best practices and mainly the Ship to Ship transfer guidelines and the “ESD arrangements & linked ship/Shore systems for liquefied gas carrier” from SIGTTO and OCIMF. Further IMO regulations e.g. the IGC Code the MSC.285(86) and the STCW 78/95 were used Based on the developments within the IAPH, the Port of Gothenburg has developed port specific proposed LNG operating regulations including LNG bunkering. Within the LESAS project the Port of Rotterdam started its own development of LNG bunker regulations. Also the Port of Antwerp issued a tender for the development of their own LNG bunkering procedures and is now in the selection phase before placing the order. In summary different activities have been started but a common solution is not yet available. A further variation in this is also possible when comparing bunkering from a permanent onshore installation or tank-vehicle and from a bunker vessel, especially since it is likely that these vessels will be regulated by IGC code.

► Gap 9 – Despite various industry driven initiatives common guidelines for port rules on LNG bunkering procedures are not yet available

More precisely some further, more detailed gaps can also be identified in relation to the absence of common port rules for LNG bunker procedures.

9.6.1 Common Risk Assessment Approach and Risk Acceptance Criteria

For the assessment of additional risks relating to the bunkering of LNG within the port, no procedures and risk acceptance criteria are available. This requires each port to develop its own standards with potential differences between ports as a result. Therefore guidelines for harmonised Quantitative Risk Assessment (QRA) methods for the small scale LNG bunkering process should be developed. During the development of guidelines for the bunkering of LNG as ship fuel at the ISO TC 67 WG 10, risk assessment procedures have been planned and might be suitable for a common approach.

► Gap 9.1 – A common risk assessment approach and risk acceptance criteria for LNG bunker procedures are missing which requires each port to develop its own standards with potential differences as a result.

9.6.2 Simultaneous Activities with Bunkering LNG

To ensure a competitive fuel supply, LNG bunkering must be possible for each type of gas-fuelled vessel under the same conditions as bunkering Heavy Fuel Oil (HFO). This includes the safe bunkering of LNG during cargo loading and unloading, as well as during passenger embarking and disembarking operations. Within the general safety principles stated in chapter 4 of the current draft ISO “Guidelines for systems and installations for supply of LNG as fuel to ships” it is stated that “Safety shall be the primary objective for the planning, design and operation of facilities for the delivery of LNG as marine fuel taking into consideration simultaneous operations and the interaction with third parties.” Due to missing experience with the use of gas as fuel detailed guidance for bunkering during loading/unloading and passenger embarking/disembarking and therefore special requirements for the ship design and bunker station of cargo and passenger are not described. For the time being, these items will be handled within the risk assessments to be carried out for the gas-fuelled vessels (according to the Interim Guidelines MSC.285(86) and later within the IGF Code) and the LNG bunker procedure (later in the ISO “Guidelines for systems and installations for supply of LNG as fuel to ships”).

► Gap 9.2 – Despite various applications of gas-fuelled cargo and passenger vessels the definition of detailed safety requirements for simultaneous LNG bunkering and loading / unloading or passenger embarking / disembarking processes are missing.

9.6.3 Common Safety Distances to other Vehicles and Buildings during Bunkering LNG

In addition to the risk assessment approach itself commonly defined safety distances are also missing. The IMO IMDG Code contains requirements for safety distances for seagoing ships carrying dangerous goods which are not applicable for LNG bunkering as the IMDG Code is only applicable for dangerous goods in packed form. Similarly for inland vessels, the ADN contains safety distances for inland vessels carrying dangerous goods in packed form and dangerous cargo which are not applicable for bunkering LNG as fuel. Belgium and Dutch ports have set safety distances for vessels passing LNG bunker operations to 25m. This proposal as well as the identification of an ongoing LNG bunkering process, is currently under discussion at the WPCI because LNG bunkering rules in other ports have different approaches and different understanding of failure frequencies.

Within ISO 28640 no common safety distance is defined. Regarding this ISO Standard safety distances should be a result of risk assessment taking into account the local circumstances within the port area and different types of ships involved in the process. In the same way for bunkering LNG as ship fuel a common safety distance should take into account different types of vessels, bunkering procedures and local circumstances within the port area. Instead of individual risk assessments a set of safety distances for different port cluster, bunkering operations and types of vessels could be appropriate. An exemplary definition of types of Gas zones depending on type of vessel and bunkering procedure is included in the draft 'LNG operating regulations including LNG bunkering' of the Port of Gothenburg which is attached in Annex 15.5 to this report.

► Gap 9.3 – Indicators for determining common safety distances and identification of LNG bunkering processes are currently missing

9.6.4 Common Accreditation Criteria for LNG Bunker Companies

To ensure safe bunkering of LNG, the supply companies should demonstrate the use of suitable equipment, bunkering procedures, trained personal, sufficient fuel quality and documentation process. This requires each port to develop its own standards with potential differences between the ports as a result. Common criteria for this are missing and this can be identified as a gap.

► Gap 9.4 - Common safety accreditation criteria for LNG bunker companies are missing

9.6.5 Additional Measures for LNG Bunker Operations within Emergency Plans

In general responsibilities of authorities, fire brigades etc. for the operation inside the ports and harbours are regulated according to different regulations and requirements. Additional hazards resulting from the LNG bunkering process, in comparison to the handling of LNG as cargo, should be addressed in the production of regulations, requirements and emergency plans. In addition a model contract for bunkering could be considered in order to have a common approach for the safety aspect.

► Gap 9.5 – Additional measures for LNG bunker operations within emergency plans should be considered

9.7 Crew Training

The minimum training requirements for crews of seagoing gas tankers carrying LNG as cargo are stated in the IGC Code which addressed specific qualification and training requirements to the 'International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW)'. To achieve the training requirements, gas tanker model courses have been developed by the IMO sub-committee on Standards of Training and Watch keeping (STW). Similarly to the IGC Code minimum qualification and training requirements are stated in the current draft of the IGF Code. Specific qualification and training requirements have been addressed by the STW during the meeting on the IGF Code at BLG 16. During the STW 43 meeting in June 2012 the STW noted, that due to the short time period between BLG 16 and BLG 17, it had not been possible for Member Governments to consider this request and submit comments and proposals within the deadline for submission of documents for STW 43. Accordingly, the STW invited Member Governments to consider the matter in detail and submit comments and proposals to STW 44 which will take place from 29th of April to 3rd of May 2013.

At the same time SIGTTO is developing proposals for training and specification requirements in a sub-working group of their LNG Ship Fuel Safety Advisory Group, which will deal with training and specification requirements for crews of gas-fuelled vessels. These requirements will be based on the requirements of gas tanker crews stated in the STCW. A finalised proposal is expected in early 2013.

Following the identified prohibition relating to the transport of LNG as cargo and the use of LNG as fuel on inland vessels, and consequently the identified gaps, no specific training requirements are being developed for inland vessels. This may have a specific impact on LNG bunker barges in ports as these could potentially be developed as inland vessels and not as sea going vessel. This may have to be addressed.

► Gap 10 – Crew training requirements for LNG carrying or fuelled inland vessels and barges do not exist and have to be developed especially with a view on using inland barges as bunker barges

9.8 Minimum Requirements for the Gas Quality

For the use of gas as bunker fuel, there are no regulations regarding the minimum requirements for the composition of the gas. For the time being the gas specification is demanded by the engine suppliers including minimum requirements for the methane number and the minimum content of methane. The composition of LNG is important for the functionality of the engines and for economic aspects and should be defined. Also for the safe operation of gas-fuelled vessels minimum requirements for the fuel gas quality are necessary. Low methane number and low content of methane causes knocking within gas and dual fuel engines which increases maintenance costs and might lead to failure of the engine.

Within the current draft of the IGF code general definitions of gases and its conditions are defined. However, neither in the IGF Code nor in the related Interim Guideline MSC.285(86), minimum requirements for the gas quality are regulated. Within the current draft guideline of the ISO TC 67 Working Group 10 'the specification of LNG as bunker fuel' reference is made to the requirements of the ISO TC 28 / SC 4 Working Group 6.

The scope of the ISO Technical Committee 'TC 28 Petroleum products and lubricants' is the Standardisation of terminology, classification, methods of sampling, measurements, analysis and testing for

- Petroleum
- Petroleum products
- Petroleum based lubricants and hydraulic fluids
- Non-petroleum based liquid fuels
- Non-petroleum based lubricants and hydraulic fluids

The subcommittee 'SC4 Classifications and specifications' is separated in several Working Groups. The Working Group 'WG 6 Classification and specification of marine fuels', as referenced from the Draft IGF Code, is responsible for the development and modification of the International Standards 'ISO 8216 [16] Classification of marine fuels' and the 'ISO 8217 Specifications of marine fuels'. For the time being the scope of work of the Working Group 6 is petroleum based fuels. The extension of the scope regarding the classification and specification of this Working Group can be changed by proposals which have to be submitted by the National

[16] http://www.bunkerworld.com/forum/blogs/18/94412/Wanda-Fabriek/ISO-8216-1-and-ISO-8217-standards-15-June-2010

representatives. The current absence of an International Standard for the specification of LNG as fuel for ships can be identified as a gap.

► Gap 11 - No International Standards for the specification of LNG as marine fuel are available

9.9 Minimum Requirements for the Sulphur Content of LNG

The general requirements within Emission Control Areas regarding the sulphur content of fuel oil as regulated in MARPOL Annex VI Chapter 3 Regulation 14 'Sulphur Oxides (SOx) and Particulate Matter' must also be observed as well as when using gas as fuel. This results in an obligation for the **documentation** of the sulphur content of the LNG as regulated in MARPOL Annex VI Chapter 3 Regulation 18 'Fuel Oil Quality', even if the sulphur content does not exceed 10 ppm.

The current draft IGF Code makes reference to the MARPOL Annex VI (version 2009) that 'the sulphur content of gas fuels loaded shall be maintained on board as required by MARPOL Annex VI'. Within the current MARPOL Annex VI Regulation 18 version 2012 it is stated that 'this regulation does not apply to gas fuels such as liquefied natural gas, compressed natural gas or liquefied petroleum gas.' It is stated within this regulation that 'the sulphur content of gas fuels delivered to a ship specifically for combustion purposes on board that ship shall be documented by the supplier'. This results in the need for the documentation of the sulphur content of Natural Gas as ship fuel.

However, in the current IGF Code no further guidelines are provided on how to deal with these MARPOL Annex VI requirements. The ISO TC 67 WG 10 on LNG bunkering guidelines should be considered to extent chapter 10 'delivery notification of LNG Quantity and Quality' of the current draft to include the documentation of the sulphur content of the LNG as demanded by the current draft of the IGF Code and the development of requirements for the measurement of the sulphur content.

► Gap 12 – No requirements and guidelines are available for the measurement of the sulphur content of LNG as fuel.

9.10 Procedures and Equipment for Gas Sampling

Within the current draft of the IGF Code Chapter 19 'operational requirements (bunkering operations and/or other operations)' subchapter '19.2 'Functional requirements' states that 'the ship shall be provided with a suitably detailed fuel transfer manual, approved by the Administration […] This manual shall be a controlled document under the ISM Code. The contents of the manual shall include but is not limited to:

1. Overall operation of the ship from dry-dock to dry-dock, including procedures for system cooling down and warm-up, bunker loading and, where appropriate, discharging, sampling, inerting and gas freeing'

The ISO TC 67 Draft Guideline describes in Chapter '10. Delivery notification of LNG Quantity and Quality' the need for the documentation of the quantity and quality of LNG fuel transferred. 'Such documentation shall include the;

- method used to determine the quantity and quality of the LNG transferred; and
- certification associated with the measurement equipment or methodology used to determine transfer quantity and LNG quality'

ISO 28460 references within Chapter 16 to ISO 10976 and the 'LNG custody transfer handbook' of the GIIGNL.

Other existing and potentially relevant guidelines are:

- ISO 8943 'Refrigerated light hydrocarbon fluids – sampling of Liquefied Natural Gas – continuous and intermittent method (published by ISO TC 28 SC5)
- ISO 10715 'Natural gas – Sampling guidelines'
- EN 12838 ' Suitability testing of LNG sampling systems' prepared by CEN/TC 282
- ISGOTT / ISGINTT Chapter '11.8 Cargo Measurement, Ullaging, Dipping and Sampling'

However, suitable sampling procedures are not described within the IGF Code or in the ISO TC 67 bunker guidelines. For that reason, the absence of sampling procedures is identified as a gap.

► Gap 13 - A Standard for the safe sampling of LNG as fuel is missing

9.11 Link between delivering Facility and receiving Vessel

The equipment for the connection of communication devices and process monitoring including Emergency Shut Down (ESD) between the LNG delivering facility and the receiving gas-fuelled vessel should be standardized. The safety philosophy could be taken from SIGTTO 'ESD Arrangements & Linked Ship / Shore Systems for Liquefied Gas Carriers'. This guideline is only valid for links between fixed installations and LNG gas carriers.

In order to assure a common safety level, the link should preferably be standardized for all kind of possible LNG delivering facilities and receiving vessels, therefore this item has been identified as fourteenth gap:

► Gap 14 – No Standard is available for the Standardisation of the equipment for the connection of communication devices and process monitoring including Emergency Shut Down (ESD) between the LNG delivering facility and the receiving gas-fuelled vessel.

9.12 Quantity measuring Equipment of the LNG transferred

A method used to determine the quantity of the LNG transferred as well as certification associated with the measurement equipment or methodology used to determine transfer quantity and LNG quality is missing. Issues like return vapour, vapour generated from piping cool down and tank liquid level measurement will have an impact on determining the quantity and value of fuel delivered. At the moment no requirements for the safe measurement of the amount of LNG are stated. Common procedures are used regarding the transfer of LNG as cargo as mentioned in the GIIGNL Custody Transfer Handbook and might serve for the bunkering of LNG as fuel. Further input can give ISO 10976:2012 “Refrigerated light hydrocarbon fluids, Measurement of cargoes on board LNG carriers”.

There is a need for specific standards, practices and procedures for the bunkering of LNG. This gap is considered as a commercial aspect and not as a safety or environmental issue. Therefore the requirements for the quantity measurement equipment will not be addressed in the regulatory instrument proposed within this study.

► Gap 15 - Procedures and equipment for gas measurement are missing

9.13 Environmental Aspects

Within the draft ISO bunkering guidelines measures to minimise a possible methane release during bunkering operation for gas as fuel are under discussion but it is not foreseeable how detailed the recommended measures will be. The scope for such measures should cover the whole LNG bunker supply chain. Therefore coherent guidelines for operational measures to reduce the methane release related to all elements of the LNG supply chain could be developed

► Gap 16 – Operational guidelines need to be developed to reduce the potential negative environmental impacts related to the possible release of methane

10 Summary of identified Gaps

The gaps identified gaps have been summarized in the list below.

1. The entire use of LNG as marine fuel and LNG bunkering procedures are not regulated by IMO requirements and standards as LNG is formally not fully recognised as fuel for the time being;

2. The future status of the ISO Technical Report on LNG bunkering within the international rule framework will have to be reinforced through references in other common Standards and/or legal texts;

3. The definition of the bunkering process and the division of responsibilities for bunkering LNG as fuel is not covered by the Technical Report of the ISO TC 67 WG 10. Responsibilities mentioned in the current Draft IGF Code are limited to the Ship to Ship transfer;

4. A conceptual delineation between transfer of LNG as cargo and bunkering of LNG as fuel is missing;

5. The connection and disconnection process of portable LNG fuel tanks is not defined in the current draft of the IGF Code and the Technical Report of the ISO TC 67 WG 10;

6. The absence of appropriate rules relating to the transportation of LNG on European inland waterways affects the lack of construction requirements for LNG inland tankers, bunker barges and gas-fuelled inland waterway vessels;

7. The use of LNG as fuel is not permitted on inland waterway vessels in general and is only possible by exemptions by the CCNR, which consequently does not stimulate the creation of larger LNG demand;

8. Despite the large range of national legislation, further guidance or Standards for small scale LNG bunkering stations could be developed using current best practices;

9. Despite various industry driven initiatives common guidelines for port rules on LNG bunkering procedures are not yet available;

    9.1 A common risk assessment approach and risk acceptance criteria for LNG bunker procedures are missing, which requires each port to develop its own standards with potential differences as a result;

9.2 Despite various applications of gas-fuelled cargo and passenger vessels the definition of detailed safety requirements for simultaneous LNG bunkering and loading / unloading or passenger embarking / disembarking processes are missing;

9.3 Indicators for determining common safety distances and identification of LNG bunkering processes are currently missing;

9.4 Common safety accreditation criteria for LNG bunker companies are missing;

9.5 Additional measures for LNG bunker operations within emergency plans should be considered;

10. Crew training requirements for LNG carrying or fuelled inland vessels and barges not exist and have to be developed especially with a view on using inland barges as bunker barges;

11. No International Standards for the specification of LNG as marine fuel are available;

12. No requirements and guidelines are available for the measurement of the sulphur content of LNG as fuel;

13. A Standard for the safe sampling of LNG as fuel is missing;

14. No Standard is available for the Standardisation of the equipment for the connection of communication devices and process monitoring including Emergency Shut Down (ESD) between the LNG delivering facility and the receiving gas-fuelled vessel;

15. Procedures and equipment for gas measurement are missing;

16. Operational guidelines need to be developed to reduce potential negative environmental impacts related to the possible release of methane.

All the above identified gaps could be further addressed in a common EU wide regulatory instrument, starting from the definition of the bunkering process from an EU point of view and the consequent responsibilities. From there further guidance can be given in relation to the identified gaps at port level, notably taking into account the various on-going initiatives in ports. Finally the more operational aspects of the bunkering between the bunkering installation and the receiving vessel could be addressed at EU level. An overview of the regulatory framework and the identified gaps is summarised in Table 10 in Annex 15.1 of this report.

11 Recommendations and Drafting of a possible common EU wide LNG bunkering standard (Task 3)

Several identified gaps summarized in Chapter 9 of this report are already being addressed within the current rule development or initiatives have been started to modify existing rules or standards to regulate these gaps. A detailed description of these items for which international rule development has already started within a possible common EU wide regulatory instrument is not necessary, nonetheless these international rules, standards and guidelines should be mentioned and referred to in a specific EU document in order to have a uniform application in all Member States. Some gaps could be closed by enforcing current developments or the extension of the scope of already established working groups.

11.1 Gaps foreseeable closed within existing Standardisation Projects

A common EU guideline / standards regarding the bunkering of LNG for ships should cover procedures for seagoing and inland vessels. For the time being the transport of LNG on European inland waterways (Gap 6) and the use of LNG as fuel is not permitted on inland waterway vessels (Gap 7). As a consequence no construction requirements for LNG inland tanker and no crew training requirements for inland vessels and barges carrying or fuelled by LNG (Gap 10) exist.

To enable the use of gas as ship fuel on inland vessels and the transport of LNG by inland tankers and barges, the current intentions of the Central Commission of the Navigation of the Rhine in establishing two Working Groups should be followed up. The work will result in modification of the 'European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)' and the 'Rhine Vessel Inspection Regulation (RVIR)'.

11.2 Recommended Extension of the Scope of existing Standardisation Projects

The drafts of the relevant International Standards and rules regarding the use of gas as ship fuel and the bunkering of LNG do not contain detailed specification of LNG as fuel for ships (Gap 11). At least the minimum requirements for the composition of the main compounds and the methane number should be defined. These requirements should be addressed to the International Standards 'ISO 8216 Classification of marine fuels' and the 'ISO 8217 Specifications of marine fuels'. As the scope of the responsible Working Group 'WG 6 Classification and specification of marine fuels' of the ISO TC 28 SC4 'Classifications and specifications' is limited to petroleum based fuels, the scope should be extended to LNG as fuel by a corresponding proposal to the TC28.

Lack of Standardisation of the equipment for the connection of communication devices and process monitoring (Gap 14) should be considered by the LNG bunkering guidelines currently under development by the ISO TC 67 Working Group 10. In addition to the functional requirements already considered, more detailed design requirements should also be addressed.

Despite the large range of national legislation, further guidance or Standards for small scale LNG bunkering stations could be developed using current best practices (Gap 8). The extension of existing International Standards such as EN ISO 28460 'Petroleum and natural gas industries - Installation and equipment for liquefied natural gas - Ship-to-shore interface and port operations, 2010' the European Standard 'EN1473 – Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations' or the European Standard 'EN 13645 Installations and equipment for liquefied natural gas – Design of onshore installations with a storage capacity between 5 t and 200 t' should be considered.

11.3 Possible Need for the Development of further Guidelines

Five gaps identified within this study deal with missing handling and measurement procedures which could go beyond the scope of a common Standard for bunkering LNG. Similar to the general approach of existing Standards, it is appropriate to mention minimum requirements but a detailed description of these procedures should be included in further guidelines, which could then be used as reference. This approach is recommended for the

- Gap 5 'Connection and disconnection process of portable LNG fuel tanks'
- Gap 12 'Measurement of the sulphur content of LNG as fuel'
- Gap 13 'Safe sampling of LNG as fuel'
- Gap 15 'Procedures and equipment for gas measurement'
- Gap 16 'Reduction of potential negative environmental impact related to possible methane spills'

11.4 Draft of a possible common EU guideline/ standard for bunkering Gas-fuelled Ships

As described in Gap 1 and 2, no standards for the bunkering of gas-fuelled ships are in force due to the fact, that LNG is formally not recognised as maritime fuel and first interim regulations for the use of gas as fuel were only recently published. To enforce the existing standards and guidelines under development, a high level European guideline or standard could provide the regulatory framework and provide a more harmonized character.

This guideline / standard should provide a definition of the bunkering process (Gap 3) and the conceptual delineation between transfer of LNG as cargo and bunkering of LNG as fuel (Gap 4).

To harmonize the requirements for approval processes, the following gaps should be addressed within a possible guideline / standard:

- Common risk assessment approach and risk acceptance criteria for LNG bunker procedures (Gap 9.1);
- Common safety requirements for simultaneous LNG bunkering and loading / unloading and passenger embarking / disembarking (Gap 9.2)
- Common safety distances for the bunkering process (Gap 9.3);
- Common safety accreditation criteria for LNG bunker companies (Gap 9.4);
- Additional measures relating to LNG bunker operations within emergency plans (Gap 9.5).

Based on the findings of this study, in the following recommendations for EU standards for the bunkering of gas-fuelled ships are made. To ensure a minimum of safety for the bunkering of gas-fuelled ships in Europe, it is advisable to make standards on bunkering of LNG legally binding.

“Comments” are used to underline, that the development of further guidelines are missing or aspects used within the proposed text are for the time being not finally discussed or regulated.

1 Introduction

This draft Standard should be applicable to European countries and shall serve national and local authorities with guidance for the assessment of the bunkering operations of liquefied natural gas in ports or on all kind of European waterways. The Standard shall help to define the necessary safety requirements for the bunkering process and therefore help to ease the approval process for the bunkering of gas-fuelled ships.

The reasons for the creation of this Standard are to:

- achieve a unified approval procedure including a common risk assessment approach and common risk acceptance criteria for the bunkering of gas as fuel in the respective European countries and their ports
- inform about the relevant hazards related to the handling of liquefied natural gas as bunker fuel
- consider all relevant safety requirements regarding the bunkering of liquefied natural gas
- distinguish more strictly between responsibilities of different land and sea side authorities regarding the bunkering of liquefied natural gas
- create a clear delineation between bunkering LNG as fuel and transfer of LNG as cargo

2 Scope

This Standard provides safety requirements to ensure safe LNG bunkering of gas-fuelled seagoing and inland waterway vessels taking into account all kind of possible bunkering procedures, bunkering facilities and simultaneous activities during bunkering.

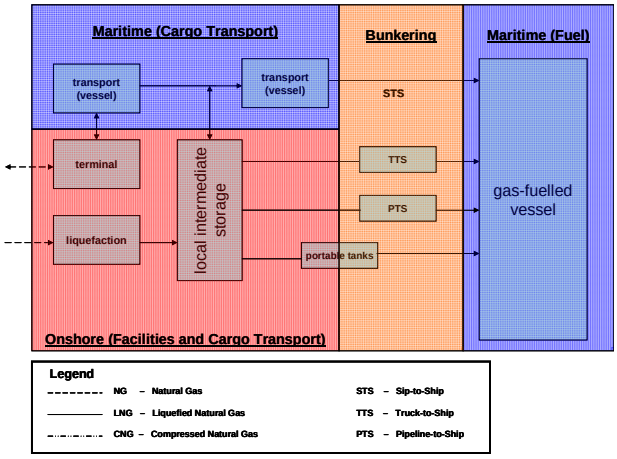

Figure 9 – (Possible) Scope of the (recommendation of a possible EU) bunkering standard

3 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

- ISO TC 67 WG 10 Draft, Guidelines for systems and installations for supply of LNG as fuel to ship (as far as available)
- IMO MSC.285(86), Interim Guideline on safety for natural gas-fuelled engine installations in ships, adopted 1 June 2009 (will be replaced by IMO IGF-Code)
- IMO IGF Code Draft ,International Code of Safety for Ships using Gases or other low Flashpoint Fuels' (as far as available)
- IMO IGC-Code ,International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
- MARPOL Annex VI Chapter 3 regulation 14 and regulation 18
- ISO 8216 Classification of marine fuels
- ISO 8217 Specifications of marine fuels
- ISO 28460 Installation and equipment for liquefied natural gas – Ship-to-shore interface and port operations

Further related Standards and guidelines can be used as a reference as far as applicable and are mentioned in the relevant chapters of this Standard.

4 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1 LNG

Liquid Natural Gas (LNG)

The gas composition can vary depending on the source of natural gas and the processing of the gas. A typical composition in volume % is:

Methane	94.0 %
Ethane	4.7 %
Propane	0.8 %
Butane	0.2 %
Nitrogen	0.3 %

The *sulphur content of LNG* is not expected to exceed 5 ppm. However, the sulphur content must be documented in line with the requirements and procedures as stated in the relevant chapters within MARPOL Annex VI.

4.2 LNG as Fuel

The characteristics and specification regarding the requirements of the composition and minimum contents of compounds for LNG as marine fuel are defined in ISO 8216, Classification of marine fuels' and ISO 8217 ,Specifications of marine fuels'

Comment: *For the time being it is not finally decided if, where and how LNG as marine fuel might be specified. ISO TC 67 WG 10 proposed to ISO 8216 and ISO 8217 to look into this issue. The exact scope of this ISO 8216 and ISO 8217 is under consideration.*

4.3 LNG Bunkering

LNG bunkering means the transfer of LNG from land based or floating facilities into a ship's permanent fuel tanks or the connection of portable tanks to the ship's fuel supply system (refer IGC Code chapter 2.2 Definitions).

4.4 LNG Transfer

LNG transfer means the transfer of LNG from land based or floating facilities into a ships permanent cargo tanks or other LNG cargo containment systems and vice versa.

4.5 Begin and End of the LNG bunkering Process

Defining the start of the bunkering process should coincide with the first handling procedure related to bunkering LNG as fuel. This could be defined by the interaction of the defined safety zone around the receiving vessel. On the sea side this will be the safety distance for passing vessels. On the landside this will be the Explosion Zone around the bunker station. For the different bunker procedures the following definitions could be made

- Ship to Ship LNG bunkering:
    - Begin: Interaction of the safety distance zone of the receiving vessel with a bunker vessel or bunker barge
    - End: Leaving of the bunker vessel or bunker barge out of the safety distance zone
- Truck to Ship LNG bunkering:
    - Begin: Interaction of the defined Explosion Zone around the bunker station of the receiving vessel with the LNG bunker hose
    - End: Removal of the bunker hose from the Explosion Zone of the receiving vessel
- Terminal to Ship LNG bunkering:
    - Begin: Interaction of the defined Explosion zone around the bunker station of the receiving vessel with the LNG bunker hose / pipe
    - End: Removal of the bunker hose / pipe from the Explosion Zone of the receiving vessel
- Portable tanks
    - Begin: Fixation of the portable tank to the ships structure; here fore special requirements regarding the IGF Code are required and differ from the fixation of cargo container. Therefore the fixation is the begin of the bunkering procedure
    - End: After disconnection of the portable tank fixation to the ships' structure.

Comment: *Special requirements for the fixation of portable fuel tanks were agreed during the BLG 17 meeting due to the development of the IGF Code. Details about the requirements of the fixation are still under discussion due to the ongoing development of the IGF Code.*

For the above mentioned bunker procedures the relevant port authority and maritime administration is assumed as responsible authorities. However, it should be kept into mind that during other possible bunker modes e.g. bunkering at sea or bunkering while sailing other authorities might be involved.

4.6 Responsibilities

4.6.1 Ship to Ship bunkering

The responsibility of the bunkering process is with the Master of the receiving vessels and the Master of the bunker vessel (refer chapter 19.3 of the IGF Code).

4.6.2 Truck to Ship bunkering

The responsibility of the bunkering process is with the Master of the receiving vessels and the operator of the LNG truck.

4.6.3 Terminal to Ship bunkering

The responsibility of the bunkering process is with the Master of the receiving vessels and the operator of terminals' jetty.

4.6.4 Portable tanks

The responsibility of the bunkering process is with the Master of the receiving vessels.

Comment: *The above mentioned definitions of responsibilities refer to the definition of responsibilities in Chapter 19.3 of the current draft of the IGF Code as reflected in 4.6.1. As the IGF code is not finalised it is not foreseen if there are any amendments or additional definitions regarding responsibilities for the bunkering process as well for other than the ship to ship bunkering will be done. The same applies for possible definitions regarding bunkering responsibilities due to the ongoing development of the ISO TC 67 WG 10 bunkering guidelines.*

4.7 Rapid Phase Transition (RPT)

The explosive change from liquid to vapour phase when LNG is released into water

4.8 Emergency Shut-Down (ESD)

Emergency Shut Down means the controlled determination of the bunkering process as a result of an unsafe condition being detected. The bunkering process will be stopped immediately and no fuel will be transferred. The gas system of the bunker facility as well as of the receiving vessel will be transferred to a safe condition.

4.9 Emergency Release Coupling (ERC)

An automatic disconnection device located within the transfer system that allows rapid disengagement when the limits of safe operation of the transfer system are reached. The disconnection can also be carried out manually. Usually a dry break coupling will be used for this purpose so that no media can escape. The disconnection of the coupling will be executed in such a way, that one part of the valve closes the bunker line of the bunker facility and the other part of the valve stays on the receiving vessel and closes the bunker line respectively.

4.10 Quick Connect / Disconnect Coupler (QC / DC)

The QC / DC Coupling system is foreseen for a fast and safe assembly of the pipe connections. The QC/DC can be achieved hydraulically as well as mechanically.

5 Properties of liquefied Gases

LNG has the following properties:

- Boiling point LNG -163 °C
- Density LNG appr. 450 kg/m³
- LNG evaporates if heated with a volume expansion factor of about 600 (methane)
- LNG is colourless and odourless
- LNG is non toxic
- Natural gas generates an ignitable atmosphere (5% to 15% by volume natural gas in air at 20 °C)

The following hazards can occur in case of a LNG spill:

- Embrittlement and structural collapse of materials exposed to LNG (e.g. steel)
- Formation of explosive atmosphere
- Fire and Explosion
- Rapid Phase Transition (RPT) if released into water
- Frost bites and injuries
- Asphyxiation in confined spaces (according to volume expansion caused by evaporation)

6 Safety Philosophy

This Standard aims of ensuring the safety of the crew of the receiving vessel as well as the safety of the personnel of the bunker facility, to avoid damage to the environment and to avoid any damage of possible effected surrounding infrastructure and any other people not directly involved in the bunker process.

The bunker procedure shall be analysed systematically for possible hazards by a common risk assessment procedure and be in line with the risk acceptance criteria according to the ISO “Guidelines for systems and installations for supply of LNG as fuel to ships” for the safe construction and operation for the bunker facilities. By means of this risk assessment the approval and accreditation process for the bunkering of LNG will be carried out by the authorities. The scope of the risk assessment should be at least:

- The assessment of additional collision risks which might occur due to the traffic of bunker vessels, barges and trucks within the bunker areas (navigational and traffic safety analysis);
- The assessment of additional risks to the surrounding infrastructure which might result from a failure during the bunkering process (Risk assessment of the bunker procedure);
- The assessment of additional risks which might occur from external processes such as cargo handling in the surrounding area (external risk analysis);
- The assessment should pay special attention to cargo vessels bunkering LNG during cargo loading and unloading processes and passenger vessels bunkering LNG during the embarking and disembarking of passengers.

Further requirements are stated in Chapter 7.1 “Accreditation criteria”.

Additionally, prior the start of each LNG bunkering process a suitable check-list based on the list as shown in Annex 10.2 shall be followed.

Furthermore it is a requirement that all parts of the system will be checked regularly and their functionality, as well as the operational readiness of the safety relevant systems, shall be tested.

Despite all preventive actions, the particular harbour shall be prepared for a possible incident, with an alarm and emergency prevention plan which is coordinated with all relevant authorities.

Comment: *A risk assessment procedure and risk acceptance criteria are foreseen in the LNG bunker guidelines of the ISO TC 67 WG 10. It should be checked if these procedures and especially the risk acceptance criteria are of a sufficient minimum level for the EU.*

7 Port specific Requirements

7.1 Accreditation criteria

The responsible Harbour Authority or Maritime Administration for the intended bunker location shall check the qualification of the bunker company before the first bunkering (first accreditation) and on a regular basis (general accreditation). Depending on the intended bunker supply facility:

7.1.1 Supply by seagoing bunker vessels

.a General

Seagoing LNG bunker vessels must:

- be built according to IGC-code
- be inspected (SIRE or similar) at least twice every year
- hold relevant vetting certificate for IGC tankers
- hold proof of adequate training and certification according to international standards
- comply with technical standard ISO TC 67 or similar

Comment: *These criteria are stated within the proposed LNG bunkering regulations of the Port of Gothenburg (see Annex 14.5 of this report)*

.b First accreditation

The supplier must prove that,

- The LNG bunker vessels and their equipments to be used for the bunker supply are build and regular tested due to international standards by means of vessel certificates and test plans. At least the requirements as stated in the IGC Code, IGF Code and the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships" must be fulfilled;

- The crews responsible for the LNG bunker supply are qualified and regular trained due to the requirements of the STCW and proven by STCW certificates;

- A Risk Assessment following the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships " was carried out prior the first bunkering within the intended bunkering area taking into account local vessel traffic, cargo operations and other local circumstances and the bunkering equipment intended to be used for the supply of LNG. The Risk Assessment should be revised in case of any relevant changing of equipment and the operation area;

- Specific bunker procedures including the used equipment, responsibilities of all crew members and bunker checklist are available onboard of each bunker vessel;

- Specific sampling procedures including the used equipment and responsibilities of all crew members are available onboard of each bunker vessel;

- Specific procedures for the measurement of the transferred amount of LNG including the used equipment and responsibilities of all crew members are available onboard of each bunker vessel;

- Suitable and proven Personal Protective Equipment (PPE) for all kind of LNG bunker related activities are available and the use of these PPE is trained.

Comment: *Requirements for the equipment and training requirements for crews within the IGF Code and the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships " are still under development. International standards for the procedures of sampling and measurement of LNG as fuel are not available, yet.*

7.1.2 Supply by inland waterway tanker

.a General

- be built according to ADN
- be regular inspected regarding ADN requirements
- hold relevant vetting certificate for inland tankers
- hold proof of adequate training and certification according to international standards
- comply with technical standard ISO TC 67 or similar

Comment: *These criteria based on requirements stated within the proposed LNG bunkering regulations of the Port of Gothenburg (see Annex 14.5 of this report). The requirements regarding the ADN for inland waterway tanker are not developed, yet.*

.b First accreditation

The supplier must prove that,

- The LNG Inland waterway vessels (barges) and their equipments to be used for the bunker supply are build and regular tested due to international standards by means of vessel certificates and test plans. At least the requirements as stated in the ADN and RVIR must be fulfilled;
- The crews responsible for the LNG bunker supply are qualified and regular trained due to the requirements of the ADN;
- A Risk Assessment regarding the ISO “Guidelines for systems and installations for supply of LNG as fuel to ships “ was carried out prior the first bunkering within the intended bunkering area taking into account local vessel traffic, cargo operations and other local circumstances and the bunkering equipment intended to be used for the supply of LNG. The Risk Assessment should be revised in case of any relevant changing of equipment and the operation area;
- Specific bunker procedures including the used equipment, responsibilities of all crew members and bunker checklist are available onboard of each bunker barge;
- Specific sampling procedures including the used equipment and responsibilities of all crew members are available onboard of each bunker barge;

- Specific procedures for the measurement of the transferred amount of LNG including the used equipment and responsibilities of all crew members are available onboard of each bunker barge;

- Suitable and proven Personal Protective Equipment (PPE) for all kind of LNG bunker related activities are available and the use of these PPE is trained.

Comment: *Requirements for the equipment and training requirements for crews are not defined, yet. It is not foreseeable which requirements will be added to the ADN or RVIR or if some of the requirements will be handled by further regulations. International standards for the procedures of sampling and measurement of LNG as fuel are not available, yet.*

7.1.3 Supply by Port bunker barge

Port bunker barge means a bunker supply vessel, which is only operating within port areas. The port authority is responsible for the accreditation of such a barge for local use. General accreditation requirements as well requirements for the first accreditation of port bunker barges should be in accordance to the requirements as stated in chapter 1.1.2 as for inland waterway barges. Any deviations from these requirements should be documented and in case of safety relevant aspects a risk assessment should be performed to prove an equivalent level of safety.

7.1.4 Supply by terminal

.a General

LNG bunker terminals must:

- be built and inspected according to EN 1473 or EN 13645 and EN ISO 28460,
- hold relevant certificate for terminal
- hold proof of adequate training and certification according to international standards
- comply with technical standard ISO TC 67 or similar

Comment: *Specific requirements for LNG bunker terminals are not defined, yet.*

.b First accreditation

The supplier must prove that,

- The LNG bunker terminals and their equipments to be used for the bunker supply are build and regular tested due to international standards by means of certificates and test plans. At least the requirements as stated in the EN 1473 or EN 13645, EN ISO 28460 and the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships" must be fulfilled;

- The personnel responsible for the LNG bunker supply are qualified and regular trained due to the requirements of the EN 1473 or EN 13645 and proven by certificates;

- A Risk Assessment according to ISO 16901 for the siting of the LNG terminal and Pier, the approach of the LNG supply vessel, the approach of receiving vessels and safety distance as required in ISO 28460 was carried out prior the first bunkering taking into account local vessel traffic, cargo operations and other local circumstances and the bunkering equipment intended to be used for the supply of LNG. The Risk Assessment should be revised in case of any relevant changing of equipment and the use of surrounding areas;

- Specific bunker procedures including the used equipment, responsibilities of all personnel involved and bunker checklist are available;

- Specific sampling procedures including the used equipment and responsibilities of all personnel involved are available;

- Specific procedures for the measurement of the transferred amount of LNG including the used equipment and responsibilities of all personnel involved are available;

- Suitable and proven Personal Protective Equipment (PPE) for all kind of LNG bunker related activities are available and the use of these PPE is trained.

Comment: *Specific requirements for LNG bunker supply facilities are not in place, yet. Please refer to chapter 6.3 of the "study on standards and rules for bunkering of gas-fuelled ships".*

7.1.5 Supply by Truck

.a General

LNG bunker supply trucks must:

- be built and inspected both according to the ADR
- hold relevant certificate for LNG supply trucks
- hold proof of adequate training and certification according to international standards
- comply with technical standard ISO TC 67 or similar

Comment: *These requirements are already defined within the ADR.*

.b First accreditation

The supplier must prove that,

- The truck and their equipments to be used for the transport, reception and supply of LNG are build and regular tested due to international standards by means of certificates and test plans. At least the requirements as stated in the ADR and the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships" must be fulfilled.
- The truck driver is qualified and regular trained due to the requirements of the international standards;
- A Risk Assessment for the LNG bunkering process was carried out prior the first bunkering taking into account local traffic, cargo operations and other local circumstances and the bunkering equipment intended to be used for the supply of LNG. The Risk Assessment should be revised in case of any relevant changing of the bunker location;
- Specific bunker procedures including the used equipment, responsibilities of all personnel involved and bunker checklist are available;
- Specific sampling procedures including the used equipment and responsibilities of all personnel involved are available;
- Specific procedures for the measurement of the transferred amount of LNG including the used equipment and responsibilities of all personnel involved are available;

- Suitable and proven Personal Protective Equipment (PPE) for all kind of LNG bunker related activities are available and the use of these PPE is trained.

Comment: *The minimum requirements for the transport, reception and supply of LNG are stated in the both standards as mentioned. Additional requirements maybe required by terminals regarding detailed risk assessment for the compatibility between truck and terminal (refer to the Fluxy's "Terminalling Code Version 3.1 – For the Zeebrugge LNG terminal, Appendix M: LNG Truck Approval Procedure" available at http://www.fluxys.com/belgium/en/Services/LNGTerminalling/TerminallingModel/TerminallingModel).*

7.1.6 Supply by portable tanks

.a General

Portable tanks must:

- be built and inspected both according to the IGF-code
- hold relevant certificate for portable tanks
- hold proof of adequate training and certification according to international standards
- comply with technical standard ISO TC 67 or similar
- comply with relevant standards for the sea, road and rail transport (Depending on transport mode before us as fuel tank)

Comment: *These criteria are not finally defined within international standards, yet. There are as well requirements for the fuel gas supply system onboard of the receiving vessels. These requirements are proofed by the class approval of the vessel and therefore are not relevant for the accreditation process.*

.b First accreditation

The supplier must prove that,

- The portable tanks and their equipments to be used for the fuel supply onboard of vessels are build and regular tested due to international standards by means of certificates and test plans. At least the requirements as stated in the IGF Code, the ISO "Guidelines for systems and installations for supply of

LNG as fuel to ships" must be fulfilled. Additional requirements for the transport on sea, road and rail regarding the IGC Code, IMDG Code, ADN and ADR must be fulfilled;

- The personnel responsible for the transport and transfer of the portable tanks to and onboard of the receiving vessel are qualified and regular trained due to the requirements of the international standards;

- Suitable and proven Personal Protective Equipment (PPE) for all kind of LNG bunker related activities are available and the use of these PPE is trained.

Comment: *The supply of portable tanks is defined as cargo transport. The supplier must fulfil already existing standards for the transport and handling of dangerous cargos on sea, road and rail. Additional requirements for the fuel gas supply system onboard of the receiving vessel are proofed by the class approval of the vessel and therefore are not relevant for the accreditation process.*

7.2 Emergency Management

7.2.1 The emergency plans for all bunker locations within Harbours or any other waterways shall include additional requirements for the handling of hazards and emergency situation regarding the bunkering of LNG.

7.2.2 Terminals where LNG bunkering could be carried out shall have a local emergency plan.

7.2.3 Emergency plans should include at least the procedures and responsibilities to handle the following possible scenarios:

- Release of LNG and NG, Fire and explosion during Ship to Ship LNG bunkering of seagoing and inland vessels
- Release of LNG and NG, Fire and explosion due to collision with bunker vessels or gas-fuelled ships
- Release of LNG and NG, Fire and explosion during Terminal to Ship LNG bunkering of seagoing and inland vessels
- Release of LNG and NG, Fire and explosion during the Truck to ship bunkering of seagoing and inland vessels

At least the following procedure should be taken into account:

- Fire fighting service for all kind of gas-fuelled ships, bunker facilities and surrounding infrastructure
- Assessment of scenarios for the dispersion of Natural Gas clouds
- Installation of exclusion zones in case of collision with bunker vessels or gas-fuelled ships

7.3 Registration

7.3.1 The Harbour Authority and the Maritime Administration shall be sufficiently informed about a voyage of a LNG bunker vessel within the harbour and the intended bunker operation (compare reporting data for the transport of dangerous goods).

7.3.2 The respective terminal has to be informed about the intended LNG bunkering.

7.4 Emergencies

Incidents and unintended gas releases shall be immediately reported to the harbour authorities.

7.5 Restriction of Fairway and Safety Distances

7.5.1 A restriction of the fairway should be avoided during bunkering as far as possible.

7.5.2 Bunkering within bends or junctions of the fairway should be avoided.

7.5.3 Effects on the surrounding area caused by LNG bunkering should be minimized as far as possible (e.g. effects on the terminal).

7.5.4 After the bunker vessel has cast off, it should leave the fairway as fast as possible.

7.5.5 Safety distances to the outside boundaries of the bunker facility and the receiving vessel should be at least 25 meters for passing vessels, road traffic and all kind of non-bunkering relevant activities. In principle, safety distance should be a result of Risk Assessment as stated in ISO 28460. A categorisation depending of the kind of use of adjacent areas should be considered.

Comment: *The minimum requirements of 25 m are based on a Risk Assessment carried out for the Truck to Ship transfer during the Flemish LNG study. A modification of this minimum requirement should be considered regarding to the following statement under item 7.6.6. The categorisation in different areas with different sizes of safety distances is shown in the LNG operation*

guidelines of the port of Gothenburg in Annex 15.5 of the "study on standards and rules for bunkering gas-fuelled ships.

7.5.6 Safety distances to surrounding industries and public buildings should be calculated in respect to the maximum storage capacity of the bunker facility

7.6 Mooring

The harbour authorities and the Maritime Administration should provide suitable berthing areas, which allow tank operations such as gas freeing of tanks and inerting on board the gas-fuelled vessel before and after maintenance or yard operations.

7.7 Interruption of Bunkering

Under extreme weather conditions (e.g. thunderstorms, gale force winds, high waves, strong current, ice or poor visibility) which could affect the safety of the bunkering process, it is necessary to stop the bunkering immediately. Deviations from this procedure have to be approved by the respective Harbour Authority and the Maritime Administration in all cases.

8 Technical and organisational Requirements for the Bunkering

8.1 General Requirements

8.1.1 General Safety Strategy

8.1.1.1 To fulfil the above mentioned safety goal for bunkering it is required that a leakage of LNG or gas is avoided as far as possible by reasonable technical or organisational measures.

8.1.1.2 The intended bunker procedure of the bunker vessel should be clearly defined and checked by a general safety analysis. A suitable document has to be provided. The bunker procedure should include, as a minimum, the topics mentioned in Annex A of this document. A suitable bunker check list is required. A suitable document has to be provided. The bunker check list should include as a minimum the topics mentioned in Annex B of this document.

8.1.1.3 Parallel bunkering of liquefied gases with HFO/MDO/MGO is generally possible. It has to be proven by a suitable safety analysis according to ISO “Guidelines for systems and installations for supply of LNG as fuel to ships” that no intolerable risk will occur.

8.1.1.4 Parallel bunkering of LNG with cargo loading and unloading processes are in general possible. It has to be proven by a suitable safety analysis and risk acceptance criteria according to the ISO “Guidelines for systems and installations for supply of LNG as fuel to ships” that no intolerable risk will occur.

8.1.1.5 Parallel bunkering of LNG with passenger embarking and disembarking processes are in general possible. It has to be proven by a suitable safety analysis and risk acceptance criteria according to the ISO “Guidelines for systems and installations for supply of LNG as fuel to ships” that no intolerable risk will occur. Suitable measures to close and label areas not to be entered by unauthorized people during bunkering LNG and measures to avoid passengers entering these areas without authority should be taken.

8.1.1.6 Sampling of the gas has to be carried out in a safe manner and in accordance with international standards and guidelines.

Comment: *Standards for the approval of sampling equipments are still available. Handling procedures and guidelines for the safe sampling of gas as ship fuel are not available, yet*.

8.2 Organisational Requirements

8.2.1 Communication

8.2.1.1 Clear communication between the bunker facility and the receiving ship is required. A check list is to be prepared. The checklist is to contain at least the points listed under Annex B.

8.2.1.2 Bunkering is only to be performed after mutual agreement between bunker facility and receiving vessel.

8.2.2 Watch during Bunkering

There is to be a bunker watch on the bunker facility and the receiving ship during bunker operations. The bunker watch must not perform other duties during bunkering.

8.3 Technical Requirements

8.3.1 General requirements

8.3.1.1 Requirements for the receiving Vessel

The bunker station of the receiving ship has to fulfil the requirements of the IGF-Code. Special consideration is to be given to:

- Collecting of leaking LNG;
- Suitable and approved gas measuring devices are to be employed;
- During bunkering, all openings to endangered areas are to be closed.

8.3.1.2 Fire and Explosion Protection

- Electrostatic charging caused by fuel transfer is to be avoided;
- Ship's antennas are to be suitably grounded. Radar equipment is to be switched-off during fuel transfer;
- The bunker connection is to be equipped with potential equalisation.

8.3.1.3 Mooring

- All involved vessels are to be moored to the rules of good seamanship;
- A suitable fender system is to be used between the vessel and bunker facility;
- A safe transfer of personnel between bunker facility and receiving ship is to be provided.

8.3.1.4 LNG Transfer System

- Bunker interfaces should be in accordance with the requirements of the ISO TC 67 Guidelines and ISO 28460;
- A well fasted connection of the bunker line between the bunker facility and the receiving ship is to be provided;
- The connecting lines should follow best available practice (e.g. use of QC/DG connections)
- A safe separation for the bunker line is to be provided at all time. An emergency release coupling (dry-break coupling) is to be installed;
- If vapour return is required, it is to be a closed process (i.e. no emissions);
- Hose connections must not be subjected to stresses and strains resulting from tension, compression and buckling. Hose manufacturer's minimum bending radiuses are to be observed.
- Transfer systems are to be designed in such a way that in failure cases leakages are reduced to minimum.
- Bunker lines are to be equipped with devices that ensure safe release, emptying and purging of the line.

8.3.1.5 Emergency Shut Down

- An automatic emergency shutdown connection is to be installed between the bunker facility and receiving ship in accordance with the requirements of the ISO "Guidelines for systems and installations for supply of LNG as fuel to ships". It must be tested for proper function prior to bunkering.
- Shutdown shall be carried out in two steps according to the requirements of the ESD connection in accordance to ISO "Guidelines for systems and installations for supply of LNG as fuel to ships":
    - ESD 1: Emergency shutdown of bunker activities
    - ESD 2: Emergency release of the bunker connections.
- The emergency shutdown is to be triggered as quickly as technically possible in order to stop the LNG transfer and limit the amount of leakage to a minimum. (e.g. quick closing valves)
- When releasing the ERC the amount of escaping LNG is to be limited to the absolute minimum.

8.3.1.6 Measurement of Amount and Sulphur Content of the bunkered LNG

- The amount of bunkered LNG should be measured using the equipment and procedures as defined in international standards and guidelines;

- The sulphur content is to be measured and documented as required in MARPOL Annex VI and should be undertaken using the equipment and procedures as defined in international standards and guidelines,

Comment: *International standards and guidelines describing the detailed procedures for the measurement of amount of LNG transferred and the sulphur content are not available, yet.*

8.3.2 Specific requirements STS bunkering

8.3.2.1 The bunker vessel is to have suitable manoeuvrability in order to ensure safe passage under all weather conditions.

8.3.2.2. The propulsion plant of the bunker vessel is to be in stand-by at all times such that it can leave the endangered area in emergency situations

8.3.3 Specific requirements PTS bunkering

The bunkering from terminal to ship shall be in accordance the ISO 28460.

Comment: *Please see the amendments to the ISO 28460 as discussed in chapter 6.3 of the "study on standards and rule for bunkering of gas-fuelled ships" also partly based on the Northern European LNG infrastructure study of the Danish Maritime Authority*

8.3.5 Specific requirements use of Portable Tanks

The connection and disconnection process of portable LNG fuel tanks should be in accordance to international standards and guidelines.

Comments: *Guidelines for the connection and disconnection process of portable tanks are not developed, yet.*

9 Environmental Requirements for the bunkering Process

Due to environmental reasons, the possible release of methane should be avoided by technical, operational and organisational measures as defined in the "Guidelines for the establishment of technical, operational and organisational measures for the reduction of possible impacts on the environment during bunkering LNG as fuel".

Comment: *The "Guidelines for the establishment of technical, operational and organisational measures for the reduction of possible impacts on the environment during bunkering LNG as fuel" does not exist nor it is planned in current working programmes of any international, European or national standardisation body.*

10 Annexes

10.1 Annex A – Form sheet Bunker Procedure

Form sheet for the supplier to describe the bunkering process and the used equipment (different sheets for the different bunker supply modes STS, TTS, PTS, Portable tanks).

10.2 Annex B – Check List Form

Form sheets to be used by the supplier containing check lists for prior and after LNG bunkering will be annexed.

Comment: *IAPH is currently developing such check lists. Once finished these IAPH checklists may serve as basis for this annex.*

12 References

[1] Danish Maritime Authority: North European LNG Infrastructure Project, A feasibility study for an LNG filling station infrastructure and test of recommendations, Copenhagen, March 2012

[2] Germanischer Lloyd: Feasibility study for bunkering liquefied gases within German ports, Bericht Nr. RD-ER 2011.125, publication in German, Hamburg, July 2012

[3] Germanischer Lloyd: Feasibility study for bunkering liquefied gases within German ports, Draft of a safety concept for LNG bunkering within ports, Bericht Nr. CL-T-SM 2012.094, Hamburg, June 2012

[4] Central Commission for the Navigation of the Rhine: Empfehlung an die Schiffsuntersuchungskommissionen zur Rheinschiffsuntersuchungsordnung, Empfehlung Nr. 1/2012, Argonon, Straßburg, January 2012

[5] Central Commission for the Navigation for the Rhine: Basic information on the addition to the Rhine Vessel Inspection Regulations (RVIR) of regulations for the operation of inland vessels with liquefied natural gas (LNG), Straßburg, August 2012

[6] Swedish Marine Technology Forum: LNG Ship to Ship Bunkering Procedure, Uddevalla, June 2010

[7] Det Norske Veritas: Report for the Flemish Department of Mobility and Public Works, Modalities for the provisioning of LNG as shipping fuel in Flemish ports, Part II, Legal & Regulatory, Report No. 13YB7C6-3, Brussels, July 2012

[8] Netherlands Standardisation Institute: Creating the LNG small supply chain, Standards and regulations assessment report, LNG LESAS Project, Final Report WP 3, Delft, January 2012

[9] Lloyd's Register: LNG-fuelled deep sea shipping, the outlook for LNG bunker and LNG-fuelled newbuild demand up to 2025, London, August 2012

[10] IMO Subcommittee on Bulk Liquids and Gases: Draft International Code of Safety for ships using gases or other low flashpoint fuels (IGF Code), London, February 2013

[11] ISO Technical Committee 67 WG10: Draft Guidelines for systems and installations for supply of LNG as fuel to ships, Part 1 General Guidlelines, Geneva, October 2012

13 Schedule and Milestones of the Study

The Tender for the "Study on Standards and Rules for bunkering of gas-fuelled Ships" was published on 8th of May 2012. The main objective of the study, as stated within the tender specification, was "to provide EMSA with a detailed analysis of the current applicable standard as well as the on-going regulatory development on LNG bunkering and, following this detailed analysis, to produce a draft set of common EU wide guidelines or standards in this field to assist the Commission in assessing whether the adoption of such standards are justified".

The study was structured into three tasks:

- Task 1: Provide a detailed description of the existing standards/regulations/guidelines related to LNG bunkering and those currently under development;
- Task 2: Provide a gap analysis identifying, documenting and comparing the differences between requirements to current/on-going LNG related rules;
- Task 3: Provide a consolidated version of proposed for common EU-wide guidelines or standards for LNG bunkering;
- Task 4: Present preliminary result of task 1-3 to stakeholders and member states.

The following meetings and deliverables were part of the contract:

- Kick-Off meeting
- 1st interim report
- Draft Final report
- Stakeholder conference
- Final report

The contractor of the study was the Germanischer Lloyd who structured the work approach of the study in the following phases:

1 Preparation phase starting with the Kick-Off meeting

2 In-dept Stakeholder interviews

3 Analysis, Consolidation, Drafting including the 1st interim report and ending with the draft final report

4 Final report and result presentation including stakeholder conference and ending with the final report

After contracting Germanischer Lloyd to carry out this study a **Kick-Off meeting took place at 13th of August 2012** at EMSA premises in Lisbon. The following persons participated on the Kick-Off meeting:

1 Mr. Roel Hoenders, Project Officer for Environmental Protection, EMSA

2 Mr. Carlos Pereira, Project Officer for Environmental Protection, EMSA

3 Ms. Ana Paula Rodrigues, Trainee, EMSA

4 Mr. Harald Seibicke, District Manager Lisbon (Portugal, Spain), Germanischer Lloyd

5 Mr. Henning Pewe, Lead Gas Technology, Germanischer Lloyd

6 Mr. Lars Langfeldt, Senior Project Engineer Gas Technology, Germanischer Lloyd

The **Final meeting took place at 30th of January 2013** at EMSA premises in Lisbon. The following persons participate on the Final meeting:

1 Mr. Georgios Christofi, Head of unit Marine Environment, Training and Statistics, EMSA

2 Mr. Roel Hoenders, Project Officer for Environmental Protection, EMSA

3 Mr. Carlos Pereira, Project Officer for Environmental Protection, EMSA

4 Ms. Janeta Toma, Policy Officer Maritime Transport and Logistics, European Commission

5 Mr. Harald Seibicke, District Manager Lisbon (Portugal, Spain), Germanischer Lloyd

6 Mr. Henning Pewe, Lead Gas Technology, Germanischer Lloyd

7 Mr. Lars Langfeldt, Senior Project Engineer Gas Technology, Germanischer Lloyd

During various stakeholder consultations further meetings took place (please see Chapter 14 of this report). In the following Table 8 the schedule including Milestones, meetings and deliverables for the study on standards and rules of bunkering gas-fuelled ships can be found.

Table 8 – Schedule of the study

	August '12					September '12				October '12				November '12					December '12				January '12					February '12			
	KW 31	KW 32	KW 33	KW 34	KW 35	KW 36	KW 37	KW 38	KW 39	KW 40	KW 41	KW 42	KW 43	KW 44	KW 45	KW 46	KW 47	KW 48	KW 49	KW 50	KW 51	KW 52	KW 1	KW 2	KW 3	KW 4	KW 5	KW 6	KW 7	KW 8	KW 9
Task 1: Preparation																															
Definition of mapping method																															
Exploratory desk research																															
Preparation overview of guidelines and standards																															
Task 2: In-dept stakeholder interviews																															
Design of questionaire / setup related database																															
Organisation of interviews																															
Stakeholder interviews																															
Preparation of results / filling up database																															
Task 3: Analysis, consolidation and drafting																															
Filling of mapping structure and gap analysis																															
Feedback loop with stakeholder																															
Consolidation of previous work steps																															
Preparation draft guidelines																															
Task 4: Result presentation																															
Preparation of conference																															
Stakeholder conference																															
Post-conference consultation																															
Task 5: Project management																															
Implementation of project management tools																															
Team mobilization and internal kick-off meeting																															
Continuously project and quality management																															
Drafting expert list																															
Contacting experts for concluding projekt participation																															
kick-off meeting																															
Interim report with task 1 and 2 results (Draft and final)																															
Interim-meetings																															
Draft final report																															
Final report																															
Final meeting																															

14 Stakeholder consultations during this study

14.1 Overview conferences and meetings

A number of interviews and meetings with experts from the maritime industry, the gas industry, authorities and other relevant stakeholder have been carried out to generate input for this study. In the following the most relevant conferences and meetings are enlisted chronologically.

Expert meetings and Workshops

- EU Technical Workshop "Maritime Safety and LNG as a Marine Fuel, Brussels 2012-09-06, organised by SIGTTO and OCIMF
- Expert exchange meeting "ISO TC 67 WG and BLG IGF Code development – Status and interactions", Hamburg 2012-10-02, organised by GL
- European Community Shipowners' Associations "LNG fuelled ship working group meeting, Brussels 2012-11-12, organised by ECSA
- Expert exchange meeting, Port of Gothenburg 2012-11-21, organised by GL / Port of Gothenburg, with representatives from
    - Port of Gothenburg
    - Port of Stockholm
    - Swedish Transport Agency
    - Norwegian Directorate for Civil Protection and Emergency Planing
    - Norwegian Maritime Authority
    - Germanischer Lloyd

Stakeholder Conference

- EMSA's "Third expert meeting on LNG as bunker fuel in relation to the Sustainable Waterborne Transport Toolbox, Brussels 2012-12-04, organised by EMSA

14.2 Agenda and list of participants of the stakeholder conference

Please find in the following the agenda and list of participants of the ""Third expert meeting of gas-fuelled ships" (stakeholder conference) which took place on 4th of December 2012 in the Berlaymont Building in Brussels.

European Maritime Safety Agency

Draft agenda – 4 December 2012

Third expert meeting on LNG as bunker fuel in relation to the Sustainable Waterborne Transport Toolbox

European Commission
Berlaymont Building
200 Rue de la Loi/Wetstraat
Brussels
Meeting room : Whall

8:45	**Registration**	
9:15	**Opening meeting & Latest developments on the Sustainable Waterborne Transport Toolbox**	**DG MOVE** Magda Kopczynska (Head of Unit D.1)
9:30	**State-of-play of EMSA tender for a study on rules for LNG bunkering since June 2012 (second LNG expert meeting)**	**EMSA** Roel Hoenders
9:45	**Presentation of task 1 of the EMSA tender:** detailed description of existing standards/regulations/guidelines **Presentation of task 2 of the EMSA tender:** gap analysis	**Germanischer Lloyd** Lars Langfeldt, Benjamin Scholz
10:30	**Coffee break**	
11:00	**Discussion regarding task 1 and 2 of the EMSA tender**	
12:00	**Presentation of task 3 of the EMSA tender:** proposal for a consolidated version of a common EU guideline/standard for LNG bunkering	**Germanischer Lloyd** Lars Langfeldt, Benjamin Scholz
12:30	**Lunch**	
13:50	**Views on the presented gap analysis and a possible common EU guideline/standard for LNG bunkering (task 2 and 3)**	**Member State**

14:10	**Views on the presented gap analysis and a possible common EU guideline/standard for LNG bunkering (task 2 and 3) –** port	**Port of Gothenburg** (Capt. Joel Smith)
14:30	**Short presentations (10 min. each) on the presented gap analysis and a possible common EU guideline/standard for LNG bunkering (task 2 and 3)** - View of ship owners - View of ports - View of LNG shipping - View of gas owners	**ECSA** (Ludovic Laffineur) **ESPO/IAPH** (Antonis Michail/Tessa Major) **SIGGTO** (Roger Roue) **NGVA** (John Chamberlaine)
15:30	**Coffee**	
16:00	**Latest developments on the ISO TC 67/WG 10 on LNG Bunkering**	**Chair ISO working group TC 67 Working Group 10** Erik Skramstad, DNV
16:20	**Final discussion on the presented gap analysis and a possible common EU guideline/standard for LNG bunkering (task 2 and 3)**	
16:45	**Summing up and identifying next steps**	**DG MOVE**
17:00	**End of meeting**	

Table 9 – List of participants of the stakeholder conference in Brussels, December 2012

No	Country	Name	FirstName	Organisation
1	Austria	Pontzen	Sabine	Permanent Representation of Austria to the EU
2	Belgium	Costa	Simona	Regione Liguria
3	Belgium	De Witte	Edouard	Delphis
4	Belgium	Mille	Eric Georges	Germanischer Lloyd
5	Belgium	Vankerckhoven	Patrick	European Commission - EACI
6	Belgium	Vopel	Ronald	European Commission
7	Belgium	Loicq	Benoit	ECSA
8	Belgium	Laffineur	Ludovic	Royal Belgian Shipowners Association
9	Belgium	Schroe	Paul	Port of Zeebrugge
10	Belgium	Maes	Florent	CLdN
11	Belgium	Grunert	Astrid Silvia	IACS Ltd.
12	Belgium	Van Buggenhout	Erwin	Fluxys LNG
13	Belgium	Claeyssens	Peter	FPS Mobility & Transport
14	Belgium	Bonne	Pim	Flemish Ministry of Mobility and Public Works
15	Belgium	Kotowski	Jaroslaw	TEN-T EA
16	Belgium	Barrio Alonso	Javier	TEN-T EA
17	Belgium	Ducas	Rhiannon	ADS Insight
18	Belgium	Roos	Johan	INTERFERRY
19	Belgium	Major	Tessa	Port of Antwerp
20	China	Yue	Mengqiang	China Classification Society
21	Denmark	Berg	Søren	Lauritzen Kosan A/S
22	Denmark	Bech	Mogens Schroeder	Danish Maritime Administration
23	Denmark	Kristensen	Palle	Danish Maritime Authority
24	Denmark	Sreekanth	Vemula	DONG Energy
25	Denmark	Larsen	Morten	Fjord Line
26	Estonia	Iling	Raigo	Permanent Representation of Estonia to the EU
27	Finland	Wood	Päivi	Permanent representation of Finland to EU
28	Finland	Sundberg	Sten	Finnish Transport Safety Agency
29	Finland	Mäkinen	Anita	Finnish Transport Safety Agency
30	France	Person	Antoine	Louis Dreyfus Armateurs (shipowner)
31	France	Fusy	Joël	ISO TC67 WG10 PT1 Member - FMC Technologies SA Company
32	France	Khelia	Mikael	French Flag Sate
33	Germany	Toerkel	Bernd	Gerrmanischer Lloyd SE
34	Germany	Scholz	Benjamin	Germanischer Lloyd
35	Germany	Langfeldt	Lars	Germanischer Lloyd
36	Germany	Schnell	Jaana	IHK Nord
37	Germany	Hintzsche	Wolfgang	German Shipowners' Association (VDR)
38	Greece	Mispinas	Ioannis	Permanent Representation of Greece to the E.U.
39	Greece	Michail	Antonis	ESPO
40	Italy	Dogliani	Mario	RINA SPA
41	Japan	Kohno	Jun	Japan Ship Centre (JETRO)
42	Latvia	Anina	Gertrude	Maritime Administration of Latvia
43	Lithuania	Robertinas	Tarasevičius	Lithuanian Maritime Safety Administration
44	Malta	Kerr	David	Permanent Representation of Malta to the EU
45	Norway	Skramstad	Erik	Det Norske Veritas
46	Norway	Sletner	Tor Christian	Norwegian Shipowners Association
47	Norway	Vaagland	Jostein	Norwegian Shipowners Association
48	Norway	Karlsen	Lasse	Norwegien Maritime Authority
49	Norway	Trond	Carlsen	Norwegian Directorate for Civil Protection
50	Norway	Johansen	Heidi Margareth	Norwegian Directorate for Civil Protection
51	Poland	Osadowska	Julita	Maritime Office in Szczecin
52	Poland	Banas	Pawel	Ministry of Transport, Construction and Maritime Economy
53	Poland	Bartnicka	Justyna	Permanent Represenation of Poland to the UE
54	Spain	Chamberlain	John	Gas natural Fenosa
55	Spain	Esteban	Molina	Direción General de Marina Mercante
56	Sweden	Molitor	Edvard	SSPA Sweden AB
57	Sweden	Joel	Smith	Port of Gothenburg
58	Sweden	Ljungmark	Klas	Swedish Transport Agency
59	Sweden	Joslin	Ola	Port of Stockholm
60	The Netherlands	Quaak	Lizet	Permanent Representation of the Netherlands to the EU
61	The Netherlands	Alkema	Peter	Port of Amsterdam
62	The Netherlands	Kager	Piet	NV Nederlandse Gasunie
63	The Netherlands	Försterling	Guido	Germanischer Lloyd
64	The Netherlands	Cees	Boon	Port of Rotterdam
65	The Netherlands	Van de Minkelis	Niels	Royal Association of Netherlands Shipowners
66	United Kingdom	Brown	Chris	Oil Companies International Marine Forum
67	United Kingdom	Paul	Davies	Lloyd's Register
68	United Kingdom	Alderson	Andrew	Shell
69	United Kingdom	Roue	Roger	SIGTTO

14.3 Questionnaire I

At the beginning of this study, in September 2012, the following first Questionnaire was distributed to generate input for the overview of the regulatory rule framework and gap analysis regarding task 1 and 2 of this study.

Questionnaire

Subject Study on standards and rules for bunkering gas fuelled ships - Status and GAPs of the current rule framework
Date 2012-09-19
Distribution Interview partner

The following questions are related to Task 1 and 2 of the "study on standards and rules for bunkering gas fuelled ships" which was ordered by the European Maritime Safety Agency (EMSA). The questionnaire is prepared as guidance through an interview aiming the identification of the existing rule framework for bunkering gas fuelled ships within port areas and the need for further rule development from your point of view.

This study as well the interviews and their results are prepared by Germanischer Lloyd SE who is the contractor of the study. Please feel free to use any free space within the questionnaire for your own remarks.

1 Are you representative of a

1.1 Port authority ☐ _____

1.2 Ship manager ☐ _____

1.3 Company supplying LNG ☐ _____

1.4 Others ☐ _____

2 Which are the international statutory standards and regulations used for your field of application while handling and / or bunkering LNG?

2.1 IGC Code ☐ _____

2.2 MSC.285(86) ☐ _____

2.3 ISM Code ☐ _____

2.4 Other international standards and regulations (e.g. ISO, ANSI, SIGTTO, OCIMF):

_____

_____

_____

3 Which are the European statutory standards and regulations used for your field of application while handling and / or bunkering LNG?

_____

_____

_____

4 Which are the national and / or local statutory standards and regulations used for your field of application while handling and / or bunkering LNG?

_____

_____

_____

5 Which are the open items (GAPs) in the current rule framework from your point of view?

_____

_____

_____

6 Are you aware of the current rule development activities? Which rules and guideline may regulate the GAPs as specified in item 5?

_____

_____

_____

7 Do you see a need for any European rules and guideline to regulate the GAPs and / or a high-level standard regulating bunkering of LNG as ship fuel?

_____

_____

_____

8 Are there any counterproductive developments in the international and / or European rule development regarding bunkering LNG?

_____

_____

_____

LLan
Ref.

Sgd. Lars Langfeldt
Signature

14.4 Questionnaire II

As follow-up of the “Third expert meeting of gas-fuelled ships” the following second Questionnaire was distributed in December 2012 to generate further input for the gap analysis and to identify a possible need for a common LNG bunkering regulation regarding task 1 and 2 of this study.

Questionnaire II – Member states

Subject	Study on standards and rules for bunkering gas fuelled ships – View of the member states	**Date**	2012-12-14
Distribution	Interview partner		

This questionnaire is a follow up of the third expert meeting on LNG as bunker fuel in relation to the Sustainable Waterborne Transport Toolbox on 4th of December in Brussels. The questionnaire's objective is to collect input to the "study on standards and rules for bunkering gas fuelled ships" of the European Maritime Safety Agency (EMSA) regarding the point of views of the national authorities involved in the permission process for bunkering LNG as fuel for ships.

The study as well as the questionnaire are prepared by Germanischer Lloyd SE, who is the contractor of the study.

1 Implementation of relevant regulations into national law

1.1 Where and how has Council directive 96/82/EC (Seveso II directive) been implemented in national law?

_____

1.2 Where and how are the Interim Guidelines MSC.285(86), the IGC code and the ADN addressed in national law?

_____

1.3 Where and how is the IGF code addressed in national law? How much time does an implementation take?

_____

1.4 Are there any (additionally) guidelines for the permission process of LNG bunker stations for gas as ship fuel existing, under development, needed?

_____

Questionnaire II – Member states

2 General bunkering aspects

2.1 Is the conventional bunkering process defined and regulated within the national rule framework. And if so, where and how?

2.2 Which authority is responsible for giving the bunkering permission (who hands out the permit)?

3 Bunkering of LNG

3.1 Are there any LNG bunkering permission processes existing or planed (special permission or own procedures)?

3.2 With respect to the current rule development: Do you see a need for a European guidance regarding bunkering LNG taking into account the unregulated items (Gaps) as identified within Task 2 of this study?

LLan
Ref.

Sgd. Lars Langfeldt
Signature

15 Appendix

15.1 Gap matrix for the regulatory framework of bunkering LNG

Please find in the following Table 10 a summary of the existing regulatory framework related to the LNG bunker supply chain including the gaps identified in Chapter 9 of this study.

Table 10 – Gap matrix LNG bunkering rules and guidelines

Overview and gaps of the regulatory framework for bunkering of gas-fuelled ships

No	Item	Relevant existing Standard, Rule	Current reponsibility	Under development by	Assumed finalising date	Regulated?	Related gap No	Comment
Onshore regulations								
1	LNG cargo **transport, Pipeline**	EN 1474	CEN	CEN / TC 282	-	**YES**	**-**	-
2	LNG cargo **transport, Road**	ADR	UNECE	-	-	**YES**	**-**	-
3	LNG cargo **transport , Rail**	RID	OTIF	-	-	**YES**	**-**	-
4	LNG storage, pressurization, liquefaction (**Terminal**)	EN 1473	CEN	CEN / TC 282	-	**YES**	**-**	-
5	LNG **cargo transfer**	ISO 28460 EN 1474	ISO CEN	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
6	LNG **ship to shore cargo interfaces**	ISO 28460	ISO	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
7	**Back loading** from LNG terminal	EN 1474	CEN	CEN / TC 282	-	**YES**	**-**	-
8	LNG **bunker station**	ISO 28460 EN 1473 EN 13645	ISO CEN	ISO TC 28 CEN / TC 282	-	**NO**	**8**	Resulting from the "Study on Standards and Rules for bunkering gas fuelled ships" an extension of the scope of ISO 28460 could be possible to create a suitable Standard for bunkering LNG as fuel from Shore to ships. Decissions and activities regarding this recommendation have not started yet
9	**Risk analysis procedure** for LNG bunker stations	ISO 31010 ISO 17776	ISO	ISO TC 67	March 2013 (First Draft)	**NO**	**9.1**	The current draft of the ISO TC 67 WG 10 bunker guidelines containing a risk assessment approach and risk acceptance criteria. These Guidelines are still under development For the time being common procedures are missing.
10	LNG cargo **port operations**	ISO 28460	ISO	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
11	**Training onshore personal**	EN 1474	CEN	CEN / TC 282	-	**YES**	**-**	-
Maritime regulations								
12	LNG **cargo transport, Seagoing ship**	IGC Code	IMO	BLG	-	**YES**	**-**	-
13	LNG **cargo transport, Inland vessel**	ADN	UNECE / CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**6**	The transport of LNG by Inland tanker is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
14	**Gas fuelled vessels, Seagoing**	MSC.285(86) IGF Code	IMO	BLG	2015	**YES**	**-**	The Interim Guidelines MSC 285.(86) gives guidance for safety requirements for gas fuelled ships. The IGF Code is still under development but will build a suitable international adopted Code for gas fuelled vessels.

Overview and gaps of the regulatory framework for bunkering of gas-fuelled ships

No	Item	Relevant existing Standard, Rule	Current reponsibility	Under development by	Assumed finalising date	Regulated?	Related gap No	Comment
15	**Gas fuelled vessles, Inland**	RVIR	CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**7**	The use of LNG as fuel for Inland vessels is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
16	LNG **storage onboard Inland vessels, Cargo**	ADN	UNECE / CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**6**	The transport of LNG by Inland tanker is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
17	LNG **storage onboard Inland vessels, Fuel**	RVIR	CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**7**	The use of LNG as fuel for Inland vessels is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
18	LNG **cargo transfer procedures**	ISO 28460 EN 1160 EN 1474	ISO CEN	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
19	LNG **cargo transfer systems**	ISO 28460 EN 1160 EN 1474	ISO CEN	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
20	LNG cargo **sampling**	ISO 8943 EN 12838 ISGOTT ISGINTT	ISO CEN SIGTTO	ISO TC 28 CEN / TC 282 SIGTTO	-	**YES**	**-**	-
21	LNG cargo **measurement**	ISO 10976	ISO	ISO TC 28	-	**YES**	**-**	-
22	**Crew training gas tanker, Seagoing**	IGC Code STCW Code	IMO	BLG STW	-	**YES**	**-**	-
23	**Crew training gas tanker, Inland**	ADN RVIR	CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**10**	The transport of LNG by Inland tanker is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
24	**Crew training gas fuelled vessel, seagoing**	IGF Code STCW Code	IMO SIGTTO	BLG STW SIGTTO WG	-	**NO**	**10**	Within the Draft IGF Code basic requirements are stated. Similar to the IGF Code the training requirements were addressed to STW. The IGF Code is still under development. The scope of STW is still under discussion. The SIGTTO established an own working group dealing with training items for gas-fuelled ships crew. First results are expected in 2013.
25	**Crew training gas fuelled vessel, Inland**	RVIR	CCNR	Working Groups of the CCNR	2014 / 2015	**NO**	**10**	The use of LNG as fuel for Inland vessels is not regulated. First applications and rule development initiatives recently started. Finalising date and content of the amendments are not foreseeable.
Bunkering regulations								
26	**Definition** of the LNG bunkering process	-	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**3, 4**	Guidelines under development Not planned as international standard, yet.

Overview and gaps of the regulatory framework for bunkering of gas-fuelled ships

No	Item	Relevant existing Standard, Rule	Current reponsibility	Under development by	Assumed finalising date	Regulated?	Related gap No	Comment
27	**LNG bunkering procedures, STS**	-	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**1, 2**	Guidelines under development Not planned as international standard, yet.
28	**LNG bunkering procedures, TTS**	-	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**1, 2**	Guidelines under development Not planned as international standard, yet.
29	**LNG bunkering procedures, PTS**	-	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**1, 2**	Guidelines under development Not planned as international standard, yet.
30	**LNG bunkering procedures, Mobile tanks**	IGF Code ISO TC 67 WG 10 Guidelines	IMO ISO	BLG ISO TC 67 WG 10	-	**NO**	**5**	Handling procedures for mobile tanks are not foreseen within the current rule development; neither in the IGF Code nor in the ISO TC 67 WG 10 Guidelines
31	LNG **fuel transfer systems**	ISO 28460 EN 1474	ISO CEN	ISO TC 67 CEN / TC 282	-	**YES**	**-**	-
32	LNG ship to delivering facility **interfaces**	ISO TC 67 WG 10 Guidelines	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**14**	Functional requirements for the bunker interfaces are under development by ISO TC 67 WG 10.Design and operational requirements should be considered.
33	LNG bunker **port operations**	ISO 28460	ISO	ISO TC 67 CEN / TC 282 IAPH	-	**NO**	**9**	Resulting from the "Study on Standards and Rules for bunkering gas fuelled ships" an extension of the scope of ISO 28460 could be possible to create a suitable Standard for bunkering LNG as fuel from Shore to ships. Decissions and activities regarding this recommendation are not started, yet. The International Association of Ports and Harbors established own working groups defining requirements and guidelines for bunkering LNG within port areas. Finalising dates and application to International Standards are not foreseeable.
34	LNG bunkering **safety distances**	ISO TC 67 WG 10 Guidelines	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**9.3**	Common safety distances are not defined. The current Draft of the ISO TC 67 WG 10 Guidelines contain a chapter "Calculation of safety distances". The approach should be cross checked with requirements of ISO 28460.
35	LNG bunkering **risk assessment and risk acceptance criteria**	ISO TC 67 WG 10 Guidelines	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**9.1**	Within the ISO TC 67 WG 10 Guidelines a risk assessment approach and as well acceptance driteria are foreseen. The guidelines are not yet finalized.
36	LNG bunkering during **loading / unloading and passenger embarking / disembarking**	IGF Code SO TC 67 WG 10 Guidelines	IMO ISO	BLG ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**9.2**	Within the ISO TC 67 WG 10 Guidelines loading / unloading and passenger embarking / disembarking processes are adressed to the risk assessment procedure. Detailed design requirements are not defined within the ISO TC 67 WG 10 guidelines and the draft IGF code.
37	LNG bunker related **Emergency Plans**	-	-	-	-	**NO**	**9.5**	Procedures are not defined and not in the scope of the current rule development
38	LNG fuel **sampling**	ISO 8943 EN 12838 ISGOTT ISGINTT	ISO CEN SIGTTO	ISO TC 28 CEN / TC 282 SIGTTO	-	**NO**	**13**	Procedures for sampling gas fuelled ships not defined and not in the scope of the current rule development

Overview and gaps of the regulatory framework for bunkering of gas-fuelled ships

No	Item	Relevant existing Standard, Rule	Current reponsibility	Under development by	Assumed finalising date	Regulated?	Related gap No	Comment
39	LNG fuel **measurement**	ISO 10976	ISO	ISO TC 28	-	**NO**	**15**	Procedures for LNG fuel management are not defined and not in the scope of the current rule development.
40	LNG marine **fuel quality**	ISO 8216 ISO 8217	ISO	ISO TC 28 ISO TC 67	-	**NO**	**11**	The specifications for LNG as fuel are not defined. Currently under discussion during the ISO TC 67 WG 10 work.
41	LNG **suplhur content**	MARPOL Annex VI	IMO	-	-	**NO**	**12**	Procedures for the measurement of the sulphur content of LNG as fuel are not defined and not in the scope of the current rule development
42	**Accreditation criteria** LNG bunker company	-	-	-	-	**NO**	**9.4**	Accrediation criteria for LNG bunker companies are not defined, yet.
43	**Environmental requirements**	ISO TC 67 WG 10 Guidelines	ISO	ISO TC 67 WG 10	March 2013 (First Draft)	**NO**	**16**	Basic statement to avoid the release of methane to atmosphere are stated but no pocedures are defined.

List of abbreviation

ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
BLG	Bulk, Liquids and Gases; sub-committee of the IMO
CCNR	Central Commission for the Navigation on the Rhine
CEN	European Committee for Standardization
EN	European Standard
IAPH	International Association of Ports and Harbors
IGC Code	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (Gas Carrier Code)
IGF Code	International Code of Safety for Ships using Gases or other Low-Flashpoint Fuels
ISGINTT	international Safety Guide for Inland Navigation Tank-barges and Terminals
ISGOTT	International Safety Guide for Oil Tankers & Terminals
ISO	International Organization for Standardization
LNG	Liqufied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MSC	Maritime Safety Committee of the IMO
OTIF	Convention concerning International Carriage by Rail
PTS	Pipeline / Terminal-to-Ship
RID	Regulations concerning the International Carriage of Dangerous Goods by Rail
RVIR	Rhine Vessel Inspection Regulation
SIGTTO	Society of International Gas Tanker and Terminal Operators
STCW	The Seafarers' Training, Certification and Watchkeeping Code of the IMO
STS	Ship-to-Ship
STW	IMO Sub-Committee on Standards of Training and Watchkeeping
TC	Technical Committee
TTS	Truck-to-Ship
UNECE	United Nations Economic Commission for Europe
WG	Working Group

15.2 IMO Interim Guidelines MSC.285(86) – Table of Contents

The first international guidelines of the IMO dealing with natural gas-fuelled ships have been developed to provide an international standard for gas-fuelled ships, other than vessels covered by the IGC Code. The goal of these Interim Guidelines is to provide criteria for the arrangement and installation of machinery for propulsion and auxiliary purposes, using natural gas as fuel. These Interim Guidelines were published within 2009 and are into force since 2010. Please find in the following the table of contents of the Interim Guidelines.

Chapter 4 – Electrical System

4.1 General

4.2 Area classification

4.3 Definition of hazardous area zones

Chapter 5 – Control, Monitoring and Safety Systems

5.1 General

5.2 Gas tank monitoring

5.3 Gas compressor monitoring

5.4 Gas engine monitoring

5.5 Gas detection

5.6 Safety functions of gas supply systems

Chapter 6 – Compressors and Gas Engines

6.1 Gas compressors

6.2 Gas engine design general

6.3 Requirements dual fuel engines

6.4 Requirements gas-only engines

Chapter 7 – Manufacture, Workmanship and Testing

7.1 General

7.2 Gas tanks

7.3 Gas piping systems

7.4 Ducting

7.5 Valves

7.6 Expansion bellows

Chapter 8 – Operational and Training Requirements

8.1 Operational requirements

8.2 Gas-related training

8.3 Maintenance

15.3 Draft IMO IGF Code – Table of Contents

Based on the requirements for gas-fuelled ship installation as defined in the IMO Interim Guidelines MSC 285.(86) the development of the "International Code for Safety for Ships using Gases and other low Flashpoint Fuels (IGF Code) was initiated. The IGF Code is expected to be finalised within 2015. In the following, the table of contents of the latest version of the Draft IGF Code from November 2012 is quoted in extracts. The yellow-marked items are related to the bunkering process.

9 Fuel Supply to Consumers

9.1 Goal

9.2 Functional requirements

9.3 Redundancy of fuel supply

9.4 Safety functions of gas supply system

9.5 Requirements for fuel distribution outside of machinery space

9.6 Requirements for fuel supply to consumers in gas-safe machinery spaces

9.8 Requirements for the design of ventilated duct, outer pipe against inner pipe gas leakage

9.9 Requirements for gas compressors and pumps

10 Power Generation including propulsion and other energy converters

10.1 Goal

10.2 Functional requirements

10.3 Requirements for internal combustion engines of Piston type

10.4 Requirements for boiler main and auxiliary

10.5 Requirements for gas turbines

10.6 Requirements for fuel cells

11 Fire Safety

11.1 Goal

11.2 Functional requirements

11.3 General

11.4 Requirements for fire protection

11.5 Requirements for fire main

11.6 Requirements for water spray system

11.7 Requirements for dry chemical powder fire-extinguishing system

11.8 Requirements for fire detection and alarm system

12 Explosion Protection [Area Classification]

12.1 Goal

12.2 Functional requirements

12.3 General requirements

12.4 Area classification

12.5 Hazardous area zones

Part B

16 Manufacture, workmanship and testing

16.1 General

16.2 Testing

16.3 Gas piping systems

16.4 Welding, post-weld heat treatment and non-destructive testing

16.5 Testing Requirements

16.6 Other test requirements

Part C

17 Training and operational requirements

17.1 Goal of part

17.2 Functional requirements

17.3 Training requirement

17.4 General

17.5 Category A training

17.6 Categories B and C training

17.7 Maintenance

18 Operational requirements (bunkering operations and/or other operations)

18.1 Goal

18.2 Functional requirements

18.3 Requirements for bunkering operations

18.4 Requirements for enclosed space entry

18.5 Requirements for Inerting and purging of fuel systems

18.6 Hot work on or near fuel systems

Part X – Additional Guidance on Documentation

15.4 Draft Bunkering Guideline ISO TC 67 WG 10 – Table of Contents

Together with the development of the IGF Code the most relevant work for bunkering LNG as fuel for ships is carried out by the ISO TC 67 WG 10 developing LNG bunker Guidelines. The first draft of these "Guidelines for systems and installations for supply of LNG as fuel to ships – Part 1 General Guidelines" are expected to be published in March 2013. In the following, the table of content of the latest version of these Guidelines from October 2012 is quoted in extracts.

15.5 Draft LNG bunkering Guideline Port of Gothenburg

Please find in the following the proposed LNG operating regulations including LNG bunkering of the Port of Gothenburg.

PORT OF GOTHENBURG

GOTHENBURG ENERGY PORT

PROPOSED LNG OPERATING REGULATIONS including LNG BUNKERING

Introduction

General

The interest for LNG as a bunker fuel is increasing around the world. Port of Gothenburg will act as a facilitator for an intermediate storage to supply bunker vessels in the area. This publication is a draft regulation and should be considered in combination with existing and future rules. This draft can be used as a guideline when it comes to questions regarding Port of Gothenburg policy concerning LNG handling in the port and adjacent areas. Numerous studies and recommendations has been used to form this draft and before commissioning the intermediate storage, the final version will be published and in force.

Mission and Goal

These draft regulations is a proposal base for nautical and operational regulations LNG tankers and for LNG bunker operations in the Port of Gothenburg. The primary concern of this draft is activities which lie within Port of Gothenburg jurisdiction.

Note

These regulations will be valid in combination with Port of Gothenburg general harbour regulations, national and local regulations, laws and bye-laws. If a conflict between regulations should occur, the most stringent regulation is applicable.

Definitions

Gas zone - risk area in which an explosive gas mixture is expected to occur during normal handling.
Safety zone – area where unauthorized access are prohibited
IGF - IMO International Code of Safety for Gas-Fuelled Ships
IGC - The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
ISO TC 67 WG 10 – Standardization committee responsible for developing technical standards for Liquefied Natural Gas (LNG) installations, handling and equipment

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1. Regulations, general

All regulations remain unaltered whether the LNG bunker tanker is empty or not, if it is partially or fully loaded or approaching or leaving the port.
All LNG tankers >20000 m3 must berth in such a way that they can depart from berth by sailing ahead.
The compatibility study and the final approval for the reception of the LNG bunker vessel at the jetty and its compability for LNG bunkering purposes must be in accordance with LNG Terminal/Port of Gothenburg regulations.
Parties involved in bunkering in Port of Gothenburg area shall as long as reasonably practical apply rules, standards and best practice which are internationally harmonized.

1.2 Basic *assumptions*

-A sailing LNG tanker is a ship with dangerous goods in maritime traffic
-A ship with LNG propulsion is a ship in maritime traffic
-Land based activities on a terminal are subject to an environmental permit, national and Seveso legislation
-The berth at a land based activity must be nautical safe accessible and at a nautical safe location
-Water based activities in the port are subject to the Port bye-laws, Port Regulations and National regulations
-LNG bunkering should be carried out as bunkering operations today, but with minor limitations considering locations and simultaneous activities

2. LNG bunker operation regulations

2.1 General

All bunkering operations in the Port of Gothenburg harbour area are subject to bye-laws and regulations. In order to perform a ship to ship bunkering the following conditions must be met:
-Bunker vessel must have accreditation from Port of Gothenburg (see 2.1.1)
-Receiving vessel must comply with IGF-code and class rules (see 2.1.2)
-Terminal (if applicable) must have approved safety management system and/or routines for allowing bunker operations alongside terminal berths with or without simultaneous cargo operations (see 2.1.3)
-All bunkering operations must be approved by terminal (if alongside) or relevant national authority (if offshore)

2.1.1. Accreditation criteria

Bunker vessel shall:
-be built according to IGC-code
-be inspected (SIRE or similar) at least twice every year
-hold relevant vetting certificate for IGC tankers
-hold proof of adequate training and certification according to international conventions
-comply with technical standard ISO TC 67 or similar

2.1.2 Receiving vessel criteria

Receiving vessel must fully comply with IGF-code and have safe bunkering procedures which are carried out according to approved ISM-manual onboard. Relevant chapter concerning crew training in the IGF-code shall be incorporated in the vessel's ISM code.
Receiving vessel must also comply with technical standard ISO TC 67 or similar.

2.1.3 Terminal criteria
Terminal must have safe bunkering procedures which are carried out according to approved safety manual (by Port of Gothenburg or other dedicated body).

2.2 Applicable regulations

Swedish Transport Agency issue fundamental bunkering regulations applicable.
Where applicable, the following rules, regulations and guidelines must be complied with:
IGF-code
IGC-code
ISO TC 67 WG 10 results
Relevant SIGGTO Publications
Relevant OCIMF Publications
National regulations (Transportstyrelsen, MSB, local authorities)
Operating regulations for the Oil Harbour
General harbour regulations for Port of Gothenburg
Port bye-laws
ADR, IMDG, RID

2.3 Type of Gas zone (Hazardous area zone I)
Category based on type of LNG bunkering and location.[1][2]

Gas Zone: risk area in which an explosive gas mixture is expected to occur during normal handling. Electrical equipment should fill standard Ex II 2G T4. The Gas Zone shall be sealed off to prevent unauthorized persons to enter involuntarily.

Type	Gas Zone, Ship to Ship	Gas Zone, STS in port	Gas Zone, truck to ship
LNG Tankers/Bunker	(1)	(A)	(N/A)
Oil/ChemTankers	(1)	(A)	(N/A)
Ro/Ro vessel	(2)	(C2)	(C)
RoPax, Ferries	(3)	(D3)	(D)
Lo/Lo vessel	(3	(B3)	(B)
Ro/Lo vessel	(3)	(B3, C2/3)	(B, C)
Bulk vessels	(3)	(B3, C3)	(B, C)

(1).The Gas zone to be set 10m horizontally and 10m in vertical of the delivering/receiving vessel.

(2). The receiving vessel's Gas zone to be set to 6m horizontally and the vessel's height vertically from/at all open areas related to LNG bunkering equipment and facilities on the receiving vessel.

(3). The receiving vessel's Gas zone to be set to 6m horizontally and the vessel's height vertically and 6m horizontally inward of vessel from at/all open areas related LNG bunkering equipment and facilities on the receiving vessel.

Skarvikshamnen (Energy Port). This category is only applicable for LNG and oil tankers.
(A).LNG bunker transfer is only allowed by pipe and by LNG bunker vessel. Terminal's Ex/Gas Zone to be applicable 25m horizontally and 25m vertically and including LNG bunker vessel's Gas Zone.

[1] Refer to standards IEC 60079-10-1:2008 Explosive atmospheres – Part 10-1: Classification of areas. Explosive gas atmospheres and guidance and informative examples given in IEC 60092-502:1999, Electrical Installations in Ships – Tankers – Special Features for tankers.
[2] SIGTTO Chapter 4.8

APM Terminals (Container & RoRo port). This category is only applicable for dry cargo vessels.
(B3). Receiving and bunker vessels Ex/Gas Zone shall be applied. If the Ex/Gas Zone is greater on one of the vessel, the greatest should be applied.

(B). LNG truck's Ex/Gas Zone to be set 6m horizontally and 20 m vertical from truck.

Älvsborgshamnen (RoRo port). This category is only applicable for dry cargo vessels.
(C2/3). Receiving and bunker vessels Ex/Gas Zone category shall be applied.
(C). LNG truck's Ex/Gas Zone to be set 6 m horizontally and 10 m vertical from truck.

(Ferry Port). This category is only applicable for RoPax vessels.
(D3). Receiving and bunker vessels Ex/Gas Zone category shall be applied.
(D). LNG truck's Ex/Gas Zone to be set 6m horizontally and vertically, height of receiving ship.

If a conflict between the extents of Gas zones should occur, the largest zone is applicable.

2.4 Weather condition requirements:

No ship to ship bunkering is allowed in Port of Gothenburg when wind force exceeds 20 m/s at applicable wind speed meters. Current wind speed can be obtained from SMHI's ViVa system.

2.5 Safety Zone while moored during LNG ship to ship bunkering operation.

The Safety Zone at the sea side set to 25 meters, no vessel or craft is permitted to come closer except permission has been granted by the Port authorities.

Additionally for Lo/Lo vessels, if any container bay interferes with Safety Zone, the entire bay to be included to the Safety Zone.

The shore side Safety Zone shall be set in a way of that no involuntary mechanical impact which could harm the vessel or trucks integrity during the LNG bunkering operation. Electricity and ignition sources shall be eliminated or switched off.

Additionally for Lo/Lo vessels, if any container bay interferes with Safety Zone, the entire bay to be included to the Safety Zone.

The Safety Zone at anchorage is applicable for all LNG bunkering operations. The Safety Zone is recommended to be set at anchorage to 50 m.

2.6 Firefighting equipment for LNG

A tug equipped with suitable fire-fighting equipment must remain in the vicinity (approx. 20 min) of LNG tanker >20000 m3. All other LNG tankers and LNG driven vessels will rely on own equipment and the terminal equipment.

2.7 Special provisions for bunkering gas and petroleum products

LNG and FO/DO manifold on-board and shore should be separated into independent manifolds and spillage containments for each type of purpose.
-Oil bunkering to LNG driven vessel is allowed simultaneously as LNG bunkering
-Oil bunkering alongside at LNG terminal during cargo transfer operation of LNG is not allowed.

2.8 LNG bunker truck

Bunkering vehicles must strictly comply with the bunkering operating regulations and to fulfil below items:

To operate a LNG bunkering vehicle at Port of Gothenburg, the operator of the vehicle must have an approved and documented ADR education and a theoretical generic knowledge of how the receiving vessel's LNG fuel system is designed and works.

2.9 Bunkering procedures and requirements

The maximum pressure and discharge rate for unloading is based on the terminal, receiving vessel's receiving capacity. These figures should be filed in respective Safety Checklist.

If an emergency arises in the terminal, not affecting the vessels operation, the Terminal will inform the vessels and/or LNG truck over VHF radio or similar of the emergency.

If an emergency arises in the terminal affecting the vessels and LNG truck operations, decision to abandon vessel or leave berth is masters or harbourmaster's authority.

Double banking of LNG bunker vessels alongside of receiving vessel not allowed.

LNG bunkering vessel and receiving vessel which intend to load or bunker shall be aware of the general operating regulations for the respective port.

All terminal lightning and cables, which interferes with the Gas Zone for LNG vessel or LNG truck shall be switched off in a way of that the lights are totally powerless.This is not applicable if equipment is explosion proof.

Objects such as ro-ro ramps, gangways, hydraulic/pneumatic tools/equipment which could cause spark/heat during movements or malfunction. This equipment's are not allowed to be used inside the Safety Zone.

Passenger shall be informed of LNG transfer operations is in progress, in means of warning signs (no smoking, no open lights etc.) and limitation of access to weather decks on the side where the LNG transfer is carried out.

2.10 Checklists

At the Port of Gothenburg, dedicated LNG Bunker Safety checklists is used to follow step by step the operations of the LNG bunkering. The ship specific LNG Bunker Safety checklist for each receiving vessel should be in a way that all risks in their cargo handling including passengers handling has been determined and considered.

3. Distribution of Responsibility

3.1 Vessels

Both parties remain responsible for shutting down operation or preventing incident and accidents unregarded the cause of action.

The ship's master shall remain responsible for the safety and efficient working and safety of the ship during all port operations. He should be well acquainted with all procedures and instructions and ensure that the relevant ship's personnel are trained and prepared for the operation.

The master of the bunkering vessel or the driver of the bunkering vehicle is obliged, within their respective areas of responsibility, to take all necessary precautions to prevent the release of LNG.

The master of the vessel is responsible for all operations controlled and supervised from the vessels and the truck driver is responsible for all operations controlled from truck.

3.2 Terminal

The terminal must have procedures regarding safe bunkering and cargo operations. The terminal representative is responsible to have a developed contingency plan in case of emergency involving LNG. The terminal representative will ensure that no one from shore will violate the set and agreed Gas and Safety Zone at the terminal and sea side. The terminal representative should also ensure that the LNG truck (if applicable) is parked correct and has not been blocked by any vehicle. The LNG truck shall be parked in a way that immediate take off is available, without maneuvering.

The representative from terminal should check that all safety precautions have been made according to terminal regulations.

Annex I

(VAP) Vessel Approval Procedure (VAP) at the Skarvik LNG Terminal Gothenburg, valid for vessels over 20000 m3

This procedure will be amended in the final version.

Annex II

Bunkering checklist developed by IAPH/WPCI will be amended in the final version.

15.6 Shell Shipping LNG bunkering Installation Guidelines – Table of Contents

Shell Shipping LNG bunkering installation guidelines SST02167, April 2012.

15.7 Draft revised IGC Code – Table of Contents

Draft revised International Code for the Construction and equipment of Ships carrying Liquefied Gases in Bulk (IGC Code) – Status: June 2012

15.8 Information on the Addition to the RVIR of Gas-fuelled Inland Vessels

CENTRAL COMMISSION FOR THE NAVIGATION OF THE RHINE

RV/G (12) 74
JWG (12) 75
21st August 2012
Or. de fr/de/nl/en

INSPECTION REGULATIONS WORKING GROUP
JOINT WORKING GROUP

Basic information on the addition to the Rhine Vessel Inspection Regulations (RVIR) of regulations for the operation of inland vessels with liquefied natural gas (LNG)

Communication from the Swiss delegation

In European inland shipping there is a growing interest in the use of alternative fuels such as liquefied natural gas (LNG) or hydrogen for the propulsion system. The main reasons for this are the reduced emission of pollutants and the lower costs compared with the diesel fuel being used at present.

The Central Commission for the Navigation of the Rhine (CCNR) has decided to test the use of LNG as fuel for the propulsion system of Rhine vessels and to develop appropriate regulations. Before LNG can be used, however, it must be guaranteed that it provides the same level of safety as diesel.

According to Article 8.01 (3) of the Rhine Vessel Inspection Regulations, the use of fuels with a flash point that is not higher than 55°C is forbidden. Accordingly, LNG propulsion systems are not permitted at present.

In an endeavour to approve LNG as a fuel and to quickly gain some practical experience, the CCNR, at the request of the Netherlands and following extensive clarifications, has made recommendations for four dangerous goods tankers to use LNG on a trial basis up until 2017. Further applications for the use of LNG as fuel will follow.

The CCNR has decided that the addition of regulations on the approval of LNG as a fuel to the Rhine Vessel Inspection Regulations (RVIR) will be incorporated in its work programme for 2012 / 2013 with priority I (Resolution 2011-II-6, Allowance for new developments, No. 4.5). A brief problem analysis for the Netherlands makes reference to the urgency of the development of LNG regulations for the propulsion of inland vessels (cf. RV/G (11) 92 = RV (11) 72 = JWG (11) 97= MD (11) 23).

Due to the potential risks of LNG, coupled with complex safety questions, it is foreseeable that protracted discussions and clarifications will be required in the bodies of the CCNR and the Joint Working Group with the European Commission (JWG) to establish the regulations.

In a first step, it is proposed to define a concept for the amendment of the Rhine Vessel Inspection Regulations (RVIR).

We suggest incorporating a new Chapter 8b ‘SPECIFIC REQUIREMENTS FOR VESSELS WITH MACHINES OPERATED ON NATURAL GAS’.

The structure of the chapter is based on Chapter 22b ‘SPECIFIC REQUIREMENTS APPLICABLE TO HIGH-SPEED VESSELS’.

The key points of the conceptual proposal are:

- Special requirements for the use of LNG for the propulsion of main and auxiliary machines
- Vessels with machines operated on natural gas must be built and classified under the supervision of a recognized classification society, which has special rules for machines operated on natural gas. The LNG rules of the classification society must be based on the IGF code.
- Only those requirements which are valid independently of the regulations of the recognized classification society are specified in the RVIR.

For purposes of clarifying the proposal for the structure of the regulations, an example is shown in the annex. The content and the formulations of the additions to the RVIR are intended as pointers to possible regulatory areas.

Another option would be to incorporate general regulations for alternative gas fuels (natural gas, hydrogen) in the RVIR. The specific regulations would be listed individually for each of the alternative fuels. This approach would be based on Article 10.03b ‘Permanently installed fire-fighting systems for protecting engine rooms, boiler rooms and pump rooms’.

Moreover, it is also proposed that regulations for bunkering LNG fuel are added to the Police Regulations for the Navigation of the Rhine under Article 15.06 ‘*Duty of care during bunkering*’.

Annex to RVG (12) 74 = JWG (12) 75

Addition to Rhine Vessel Inspection Regulations:

Rhine Vessel Inspection Regulations

PART I

CHAPTER 1

GENERAL

Article 1.01

Definitions:

The following definitions shall apply in this Regulation

[...]

Other definitions

83b. ‘machines operated on natural gas’: propulsion or auxiliary machines that use liquefied natural gas (LNG) as fuel. That also includes propulsion or auxiliary machines that can be operated on diesel and natural gas (LNG) or mixtures of both.

[83c. ‘Alternative fuel’: fuel for operating an internal-combustion engine, if something other than exclusively diesel is used.]

CHAPTER 8

ENGINE DESIGN

Article 8.01

General

[...]

3. [With the exception of machines operated on natural gas as per Chapter 8b] only internal-combustion engines burning fuels having a flashpoint of more than 55 °C may be installed.

[CHAPTER 8b

SPECIAL REQUIREMENTS FOR VESSELS WITH MACHINES OPERATED ON NATURAL GAS

Article 8b.01

General

1. Cabin vessels may not be fitted with machines operated on natural gas.

2. On vessels fitted with machines operated on natural gas, the following equipment is forbidden:
   a) Devices fitted with wick burners according to Article 13.02;
   b) Vaporising oil burner stoves according to Articles 13.03 and 13.04;
   c) Solid fuel heaters according to Article 13.07;
   d) Liquefied gas installations according to Chapter 14.

3. The following documentation must be submitted to the Inspection Body before starting construction:
   a) General plan of all machines operated on natural gas;
   b) Report on the hazard identification study carried out by the recognised classification society (HAZID study);
   c) Risk management and maintenance plans;
   d) Training plan for the entire crew.

   Specific details on the operation and maintenance of the system and in relation to emergencies must be submitted to the Inspection Body after construction is complete.

Article 8b.02

Application of Part I

1. In addition to Article 2.03, vessels fitted with machines operated on natural gas must be built and classified under the supervision of and according to the requirements of a recognised classification society, which has special rules for machines operated on natural gas. The special rules must be based on the 'International code of safety for ships using gas or other low flash point fuels (IGF Code [IMO Resolution MSC.285(86) xx.yy.zzzz])'. The classification must be maintained.

2. By way of derogation from Article 2.06, the maximum validity period of Community Certificates issued in accordance with the provisions of this article is five years.

Article 8b.03

Application of Part II

1. By way of derogation from Article 8.05, fuel tanks, lines and accessories are subject to Article 8b.04.

2. In addition to the requirements of Part II, Articles 8b.01 to 8b.09 are applicable to vessels fitted with machines operated on natural gas.

3. If the regulations of Part II, with the exception of Chapter 8b, are contrary to the special rules of the classification society for machines operated on natural gas, the rules of the classification society take priority.

Article 8b.04

Natural gas fuel tanks, lines, and bunkering facilities

1. The natural gas fuel tanks must comply with the European standard EN 13458-2 : 2002 (Cryogenic Vessels - Static Vacuum Insulated Vessels) [or the European standard EN 13530-2 : 2007 (cryogenic vessels - large transportable vacuum insulated vessels)].

2. Natural gas fuel tanks must be mounted on the vessel in the open air, in such a way that they remain attached to the vessel under all circumstances. It is forbidden to install natural gas fuel tanks below deck.

3. Drip trays which are sufficiently large, made from suitable material, and include an overboard discharge, must be fitted beneath natural gas fuel tanks. No natural gas must escape up to a keeling angle of 30 degrees. The deck and the outer hull of the vessel must not be exposed to impermissible cooling, if natural gas escapes.

4. The natural gas fuel tanks, lines, fittings, ventilation lines and pressure relief valves must be arranged in the safe area in accordance with Article 1.01 (41a).

5. Natural gas fuel lines, along with their connections, gaskets and fittings, must be made from materials which can withstand the expected mechanical, chemical and thermal conditions. Fuel lines must not be exposed to any harmful thermal effects and it must be possible to inspect the entire length of the lines.

6. Natural gas fuel lines must be secured against an escape of fuel during bunkering by means of suitable on-board technical facilities, which must be specified on the Community Certificate (52).

7. Drip trays of adequate size and having an over-board discharge must be placed beneath the bunker connections.

8. The bunkering facilities must be designed in such a way that no natural gas can escape into the open air while the fuel tank is being filled.

9. The operating instructions for the bunkering facilities must be kept on board. They must contain at least the following information:
   a) How to operate the controls;
   b) Actions to be performed before, during and after the filling of the fuel tank;
   c) Maximum permissible filling level;
   d) Maintenance instructions;
   e) Emergency measures.

Article 8b.05

Distance from openings where natural gas could possibly escape to the openings of the accommodation space, wheelhouse and other rooms

Ventilation and pressure discharge openings where natural gas could possibly escape must be at a distance of at least 6 m from openings to the accommodation space, wheelhouse and other rooms. They must be fitted with suitable gas warning devices.

Article 8b.06

Explosion protection

1. In rooms where natural gas can build up, electrical and mechanical devices are only permitted in suitable explosion-proof designs.

2. In open-air areas or half-closed rooms on the deck with a gas hazard, electrical and mechanical devices are only permitted in suitable explosion-proof designs.

Article 8b.07

Safety organisation

1. A safety rota must be present on vessels fitted with machines operated on natural gas. This describes the tasks of the crew in the event of an emergency.

2. The safety rota includes instructions and a safety plan for the ship.
   The safety instructions must include at least the following:
   a) Information about emergency shutdown of the system;
   b) Measures to be taken if liquid or gaseous natural gas escapes;
   c) Measures to be taken in the event of fire;
   d) Measures to be taken if the vessel crashes;
   e) How to use the safety equipment;
   f) Alarm;
   g) Evacuation procedure.

The safety plan must include at least the following:

a) Escape routes, emergency exits, assembly points, gas-tight rooms;
b) Life-saving equipment and dinghies;
c) Fire extinguishers, fire-fighting systems and pressurized water sprinklers;
d) Alarm systems;
e) Operating controls of the emergency shutdown mechanisms;
f) Fire dampers;
g) Fire alarm system;
h) Emergency power system;
i) Operating controls of the ventilation systems;
j) Shore connections;
k) Shut-off mechanisms of the fuel lines.

3. The safety rota must be stamped by the Inspection Body. The safety plan must be hung in a suitable location where it is clearly visible. They are part of the training plan for the crew.

Article 8b.08

Maintenance

1. The system for running machines operated on natural gas must be maintained under the instructions of the recognised classification society and the manufacturer. The instructions must be kept on board. They are part of the training plan for the crew.

2. The systems of the machines operated on natural gas must be inspected annually by the recognised classification society who supervised the construction of the system.

3. Following every significant change or repair job, the system must be inspected by the recognised classification society who supervised the construction of the system before it is commissioned again.

Article 8b.09

Equipping of vessels with regard to the crew

The systems of the operating machines that run on natural gas must be constructed in such a way that they can be operated, inspected and serviced easily and safely by the crew at all times.

The company documents for the crew must be checked by the Inspection Body or its agents and duly stamped. They are part of the training plan for the crew.

Addition to the Police Regulations for the Navigation of the Rhine:

Police Regulations for the Navigation of the Rhine

THIRD PART

ENVIRONMENTAL REQUIREMENTS

CHAPTER 15

WATER PROTECTION AND WASTE DISPOSAL ON VEHICLES

Article 15.06

Duty of care during bunkering

Addition to the existing regulations of requirements for the bunkering of LNG

- Bunkering procedure
- Bunker checklist

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