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FLEMISH DEPARTMENT OF MOBILITY AND PUBLIC WORKS

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REPORT

Modalities for the provisioning of LNG as shipping fuel in Flemish ports:

PART II:
Legal & Regulatory

REPORT NO./DNV REG NO.: / 13YB7C6-3
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MANAGING RISK

Modalities for the provisioning of LNG as shipping fuel in Flemish ports

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1	01/07/2012	Final report			
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List of Abbreviations

AEO	Annual Energy Outlook
ADN	International Carriage of Dangerous Goods by Inland Waterways
ADR	International Carriage of Dangerous Goods by Road
API	American Petroleum Institute
BTU	British Thermal Unit
CCNR	Central Commission for the Navigation on the Rhine
CEN	European Committee for Standardisation
CFR	Code of Federal Regulations
CPS	Current policies scenario
DECC	Department of Energy and Climate Change
ECA	Emission Control Area
ECE	Economic Commission for Europe
EIA	Energy Information Administration
EU	European Union
FERC	Federal Energy Regulatory Commission
FSO	Floating Storage and Offloading vessels
GIIGNL	International Group of Liquefied Natural Gas (LNG) Importers
HAZID	Hazard Identification
HFO	Heavy Fuel Oil
HOP	High oil prices
IAPH	International Association of Ports and Harbours
ICS	Institute of Chartered Shipbrokers
IEA	International Energy Agency
IGC	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IGF	International Code of Safety for ships using gas or other low flash-point fuels
IGU	International Gas Union
IMDG	International Maritime Dangerous Goods (code)
IMO	International Maritime Organisation
ISGOTT	International Safety Guide for Oil Tankers & Terminals
ISO	International Organization for Standardization
LNG	Liquefied Natural Gas
LNGRV	LNG Regasification Vessels
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
Mtpa	million tons per annum
NBP	National Balancing Point
NFPA	National Fire Protection Association
NYMEX	New York Mercantile Exchange
OCIMF	Oil Companies International Marine Forum
OECD	Organisation for Economic Co-operation and Development
PHMSA	Pipeline and Hazardous Materials Safety Administration
RVIR	Rhine Vessel Inspection Regulations
SIGTTO	Society of International Gas Tanker and Terminal Operators
SOLAS	International Convention for the Safety of Life at Sea
SWA	Samenwerkingsakkoord
UNECE	United Nations Economic Commission for Europe
VLAREM	Vlaams Reglement betreffende de Milieuvergunning
WEO	World Energy Outlook

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1 EXECUTIVE SUMMARY

More stringent air emission requirements for seagoing vessels are introducing a new challenge for maritime administrations and services. These challenges are all the more daunting in the IMO (International Maritime Organisation) Emission Control Areas (ECAs).

One of the possible solutions to compliance is the use of LNG as propulsion fuel for shipping, next to the use of low sulfur (LS) fuels and the installation of exhaust gas scrubbers.

According to data from engine manufacturer Rolls-Royce, relative emissions for these various compliance options can be compared as follows, clearly demonstrating the LNG propulsion option as the overall environmental winner:

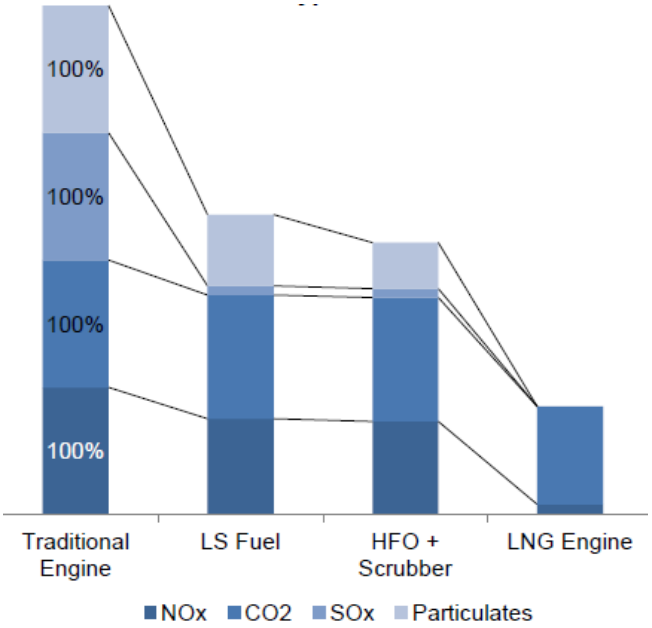


Figure 1 Relative emissions for different ship propulsion systems (source: Rolls Royce)

The lack of adequate bunker facilities for LNG appears to be one of the obstacles for an effective breakthrough of this alternative fuel.

Therefore a study to evaluate the possibilities and options for the organisation and facilitation of bunkering of LNG in Flemish ports has been instigated. The Flemish Government and the port authorities of Antwerp, Zeebrugge and Ghent, in cooperation with Fluxys LNG (operator of the LNG terminal at Zeebrugge) are the initiators and stakeholders of this study.

In this report, the results of this study are presented.

The aim of this study was to identify the necessary regulations concerning bunkering of LNG and ultimately to create possibilities for efficient and safe LNG bunkering in these ports in the near future. The study will therefore cover the following key elements: a market survey, the risk and safety analysis, the legal and regulatory framework and the logistical organisation.

The segment ‘risk and safety’ is not included within this study but was conducted separately by M-Tech. The results of this separate study will be used in this study.

This report is the result of the work undertaken during a six-month project. It documents the main findings from the Market Research & Forecasting study, the Legal & Regulatory study and the Logistical Modeling performed to assess the feasibility of the supply of LNG as shipping fuel in 3 Flemish seaports: port of Antwerp, port of Ghent, port of Zeebrugge.

As requested the report is issued in three distinct parts, namely the Market Research & Forecasting study report, the Legal & Regulatory study report and the Logistical Modeling report.

The Market Research & Forecasting study resulted in demand projections for possible future demand for LNG as shipping fuel in the three ports concerned, for three time horizons 2015, 2020, 2025. This work was framed in a general forecasting study commenting on future energy, natural gas, LNG, and maritime fuels markets & prices.

The Legal & Regulatory study resulted in an overview of currently applicable rules & regulations governing the maritime LNG supply chain, a gap analysis identifying the gaps in the current regulatory framework in order to make LNG bunkering feasible in the ports concerned, and a set of recommendations addressing the gaps identified.

The Logistical Modeling work resulted in an excel model + manual and a report discussing on example supply chain scenarios as defined in workshops with the three ports held in the course of the project.

The remainder of this report is the Legal & Regulatory study.

2 LEGAL & REGULATORY STUDY

In this chapter an identification of applicable and relevant regulations is made with regard to the proposed LNG supply process.

Relevant regulatory levels include:

- International
- European
- National (incl. flag state)
- Regional (i.c. Flemish)
- Local (Municipalities, Provinces)
- Port authorities

The chapter is organized as follows: in section 2.1 the regulations for onshore activities are summarized, followed by an overview of the port state regulations in section 2.2. In section 2.3 the regulations for LNG transfer activities are reviewed. To conclude the LNG value chain, in sections 2.4 and 2.5 the regulations applicable for LNG handling on ships is covered, for maritime vessels and inland vessels respectively.

The chapter concludes by zooming in on some specific regulations for the Belgian waterways in section 2.6 and touching on the issue of the unbundling of the energy market in section 2.7. Finally a summary of the recommendations is given in section 2.8.

2.1 Regulations for onshore activities

In this section we will give an overview or relevant applicable legislation for the following onshore activities: LNG onshore handling & storage, gas liquefaction, LNG transport by truck or pipeline.

It is worth mentioning that at the time of the construction of the Fluxys LNG terminal in Zeebrugge, the below-mentioned legislations for land-based installations did not exist yet. The terminal was thus built under a different regulatory framework:

For the initial construction of the LNG Terminal Zeebrugge, a set of dedicated safety measures were developed by a so-called 'Interministerial Working Group Safety Principles LNG Terminal Zeebrugge', and included in the initial operating permit of the terminal (Royal Decree of 07/08/1981). In case of important modifications (new technical installations or deviations from this RD 1981), positive advice is needed from this Interministerial Working Group, and are formally approved through the Gas Transport Permit.

2.1.1 Seveso II directive / SWA 2006

The so-called Seveso II Directive (*Council Directive 96/82/EC on the control of major-accident hazards*) was converted in Belgian Law in the so-called Samenwerkingsakkoord (SWA) 2006 (Cooperation agreement). The Flemish region has agreed to this SWA 2006 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 agreeing on this SWA 2006 was published in "Belgisch Staatsblad", concluding the legal conversion of Seveso directives into Belgian law. Samenwerkingsakkoord (SWA) 2006 is fully applicable since 06/05/2007.

The Seveso II Directive/SWA 2006 applies to industrial establishments (pipelines are not in 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 tons (low tier) / 200 tons (high tier) respectively. Storage facilities, as well as production installations such as liquefaction plants with permit capacities exceeding these thresholds thus have to comply with SWA 2006.

In the Table below a general overview of the requirements is given for high tier and low tier facilities respectively:

Table 1 Overview of requirements for low tier and high tier Seveso facilities in Flanders

	A low tier facility has to:	A high tier facility has to:
Preventive measures	• Demonstrate "general care" • Submit a notification • Have a policy for the prevention of major accidents with hazardous substances:	
	• Have a document describing the policy for prevention of major accidents with hazardous substances	• Have a safety management system ensuring adequate execution of the policy for prevention of major accidents with hazardous substances • Submit a safety report (SWA-VR*)
Consequence-mitigating measures	• Have an internal emergency plan • Define actions following a severe accident	
		• The internal emergency plan has to comply with specific demands and be linked to the external emergency plan

*: SWA-VR: With this type of safety report, the facility operator must be able to indicate that he knows & manages the hazards and risks linked to the presence of hazardous substances. The SWA-VR also needs to contain adequate information to allow for emergency response planning by the responsible authorities. The SWA-VR is a dynamic document that must be in accordance with the company's current situation. This is why it must be reviewed periodically, at least every five years.

Examining the articles of the SWA 2006 in more detail leads to the following:
Art. 3 §1 states that: "This agreement is applicable to establishments where dangerous substances are present in quantities equal to or greater than those listed in Annex I, Parts 1 and 2, column 3 amount. [...] " ("*Dit samenwerkingsakkoord is van toepassing op inrichtingen waar gevaarlijke stoffen aanwezig zijn in hoeveelheden die gelijk zijn aan of groter zijn dan de in bijlage I, delen 1 en 2, kolom 3, vermelde hoeveelheid. […])* Thus determining the scope of applicability of this legislation to all establishments where dangerous substances are present in quantities exceeding the thresholds in the directive (for LNG 50 resp. 200 tons).

However, in Art. 6 the exceptions to the general applicability of this legislation are stated: "This agreement does not apply to: [...] 3 ° the transport of dangerous substances and

intermediate temporary storage by road, rail, inland waterways, sea or air including loading and unloading and transport to another mode of transport at docks, wharves or marshaling yards outside the establishments covered by this agreement, [...] ″ (*"Dit samenwerkingsakkoord is niet van toepassing op: […] 3° het vervoer van gevaarlijke stoffen en tijdelijke opslag tijdens het vervoer over de weg, per spoor, over binnenwateren of zeewateren of door de lucht, met inbegrip van laden en lossen en de overbrenging naar een andere tak van vervoer in havens, op kaden of in spoorwegemplacementen, buiten de door dit samenwerkingsakkoord bestreken inrichtingen; […]")*

Hence temporary storage of hazardous goods (typical duration less than 24 hours) including transfer of goods to other modalities in for example ports is excluded as long as it does not comprise activities within Seveso locations.

The scope of the Seveso II directive was extended/amended by 2003/105/EC, to cover risks from storage and processing in mining and from pyrotechnic and explosive substances. On the 21th of December 2010, the European Commission adopted a proposal for a new Directive (Seveso III) that would replace Seveso II; The main aim of the proposal is to address the changes from EU CLP (Classification, Labeling and Packaging of chemical substances and mixtures)-legislation. Official publication is expected soon. The amendment nor the proposal of Seveso III will impose important extra requirements with regard to the LNG supply chain.

2.1.2 VLAREM legislation

The regulatory body for environmental affairs in this case is the Flemish government, as all the seaports in Belgium are on Flemish territory. The governing legislation for environmental affairs is the Vlarem legislation: Title I & Title II of Vlarem. This legislation is applicable to onshore activities only.

Establishments that could cause potential nuisance or hold a certain risk to humans and the environment, have to obtain an environmental permit to operate from the Department Environment, Nature & Energy (Leefmilieu, Natuur en Energie) of the Flemish Government:

- All companies with a potential impact on the environment have to apply for an environmental permit (milieuvergunning).
- All companies with a potential major impact on the environment have to apply for an environmental permit and must add an environmental impact assessment (milieu-effectenrapport).

In Vlarem II, storage or transfer facilities for natural gas with a capacity exceeding 10.000 m³ are determined as class 1 facilities (most stringent class). The environmental permits for class 1 facilities are treated by the Provincial Commission for Environmental Permitting. This Commission will further ask relevant regional, provincial and federal official agencies for advice.

The application form for an environmental permit for a class 1 (application is at provincial level; "bestendige deputatie van de provincieraad") or class 2 facility (application is at municipal level; "college van burgemeester en schepenen") can be found on

http://www.lne.be/themas/vergunningen/bestand/regelgeving/titel-i-van-het-vlarem-bijlage-4-modelformulier-voor-aanvraag-pdf/

For facilities where there are risks of major accidents with hazardous substances the application for an environmental permit has to include an external safety report (omgevingsveiligheidsrapport). In practice this is only applicable to the so-called high tier Seveso companies. This type of safety report analyses and evaluates the risks for the surroundings of the facility.

Appendix I of Vlarem I (art. 4.3.2, §2 and §3) lists companies/projects which are obliged to submit an environmental impact assessment. Of relevance for LNG handling is that this list includes:

- energy companies
- above-ground storage facilities of natural gas with a capacity exceeding100.000 m³

Such an environmental impact assessment describes, estimates and reports the direct effects of the project on humans and the environment, of all business activities and proposes possible measures that limit the environmental effects to an acceptable level.

The complete process flow for conducting an EIA is published (in Dutch), on http://www.lne.be/themas/milieueffectrapportage/over-milieueffectrapportage/project-milieueffectrapportage/1processchema-project-mer.pdf

However, Appendix 2 of the environmental impact assessment Act (MER-besluit (2004); Besluit van de Vlaamse Regering van 10 december 2004 houdende vaststelling van de categorieën van projecten onderworpen aan milieueffectrapportage) states the categories of projects for which the project owner can submit a duly motivated request to be relieved of EIA obligation; category 3c are the above-ground storage facilities of natural gas with a capacity exceeding100.000 m³.

Appendix I of Vlarem I describes the list of establishments and activities that are to be classified as potential nuisance or hold a certain risk to humans and the environment. In category 48 of this Appendix, the seaports & ports are listed.

Title I & Title II of Vlarem in more detail:

- Title I: The Decision of the Flemish Government of 6 February 1991 fixing the Flemish regulations on environmental permitting. This Decision governs the various procedures and the division of authorities. Annex I to this Decision contains a list with facilities and activities that are classified as a nuisance. Operation of an establishment included in this list may not be operated by anyone without an acknowledgment or an environmental permit. *(Het besluit van de Vlaamse Regering van 6 februari 1991 houdende vaststelling van het Vlaams reglement betreffende de milieuvergunning (afgekort als titel I van het VLAREM). Dit besluit regelt o.a. de verschillende procedures en de bevoegdheidsverdeling daarin. Bijlage I van dit besluit bevat de lijst met inrichtingen en activiteiten die als hinderlijk zijn ingedeeld. Niemand mag een inrichting opgenomen in deze indelingslijst uitbaten zonder over een milieuvergunning of aktename te beschikken.)*

- Title II: The following decree, the decision of the Flemish Government of 1 June 1995 concerning general and sectoral provisions on environmental hygiene, combines the ecological conditions under which such a system may be operated (*Het volgende uitvoeringsbesluit, het besluit van de Vlaamse Regering van 1 juni 1995 houdende algemene en sectorale bepalingen inzake milieuhygiëne (afgekort als titel II van het VLAREM), bundelde o.a. de milieuvoorwaarden onder dewelke een inrichting mag worden geëxploiteerd).*

Summarizing, onshore installations (the legislation does not make this distinction between process or storage installations) with a permit capacity exceeding the threshold of 50 resp. 200 tons have to comply with SWA2006 (decree of 10/12/20006) and to Vlarem II. Onshore installations with a permit capacity lower than this threshold have to comply with the Vlarem II legislation. This legislation is applicable for LNG terminals, liquefaction plants and small scale bunkering installations.

So, in principle, all onshore activity (excluding transport) is covered in the current Flemish regulatory framework. However, since LNG (as fuel) is not explicitly mentioned in Chapter 5.16 of Vlarem II, no predefined frame exists. This would mean that –even though legislation is fully applicable– the permit requirements & conditions are to be established on a case-by-case basis between the permitting authorities and the permit requester; which is likely to complicate and delay the permitting process. It is therefore recommended to develop an approach similar to what exists for LPG installations for LPG as fuel (Titel II van het Vlarem, subafdeling 5.16.4.4), prescribing e.g. safety distances, fire protection measures, requirements for surrounding installations, filling operation instructions. Having a similar section (subafdeling) for LNG bunkering installations would benefit a uniform approach and a smooth permitting trajectory.

⇒ **Recommendation A1**: LNG is not mentioned explicitly in Vlarem II as shipping fuel. It is recommended to start the process of incorporating the necessary requirements in Vlarem II; for example as an extra "subafdeling" under 5.16.4. Necessary requirements would for instance be fixed safety distances, technical requirements for materials & installations, fire fighting requirements, permits & legal compliance checks. This legislation has to be prepared on a regional level and more explicitly by the Flemish Government Department of Environment, Nature and Energy, division Environmental Permitting.

⇒ **Recommendation A2**: Ensure alignment with international standards available (and under development) when developing the regulations under Rec A1. Reference can be made to the Dutch PGS 33[1] (publicatiereeks gevaarlijk stoffen).

[1] The draft of PGS (Publicatiereeks gevaarlijke stoffen: publication series dangerous substances) 33 Natural Gas – delivery facilities for liquefied natural gas (LNG) for motorized verhicles ("PGS 33 Aardgas – afleverinstallaties van vloeibaar aardgas (LNG) voor motorvoertuigen") is published and available for public consultation through
http://content.publicatiereeksgevaarlijkestoffen.nl/documents/other/PGS33_Concept_v0.1_web.pdf
It is expected that the final guideline will be published by the end of 2012.

The permitting process is a rather slow process involving a lot of stakeholders. In order to have as little delay as possible in the permitting process, early cooperation between and involvement of relevant parties is recommended.

⇒ **Recommendation A3**: Initiate a process to ensure early involvement and cooperation between local and regional authorities, port authorities, fire brigades and other stakeholders to get an idea on the suitability of locations for onshore LNG bunkering facilities and to guarantee a smooth permitting process.

Even though the LNG industry (fixed installations and shipping) has excellent accident statistics, experience has shown that the public is not very keen on having LNG terminals and Small Scale LNG plants in the vicinity. Next to the general public, it is also important to inform target stakeholder groups such as dockers and port personnel timely and comprehensively about the presence and handling of LNG in the ports.

⇒ **Recommendation A4:** Consider starting a public engagement process to inform the public and promote the (environmental) benefits of LNG compared to conventional fuels and to demonstrate that risks of LNG are well controlled. Also consider an approach to inform target stakeholder groups such as dockers and port personnel timely and comprehensively about the presence and handling of LNG in the ports. This can be a joint effort of federal, regional, local authorities and the harbors.

2.1.3 Building permit (and joint applications)

For the construction of all land based installations, a building permit (stedenbouwkundige vergunning) has to be obtained. Although strictly speaking, this procedure is separate from the environmental procedure, the Flemish government has decided that as from January 1, 2010, all municipalities should have a joint bureau (uniek loket) where all applications for building permits and environmental permits are jointly treated, ensuring the alignment of both procedures in terms of timing, and the possibility to have joint public investigations (gezamenlijk openbaar onderzoek) linked to the applications. In the application procedures, there is, dependent on the nature of the application, a standard set of requirements to fulfill. However, with each permit application, the permit issuing government (the municipality, the province or eventually the Flemish region) always has the liberty to impose extra requirements.

Other than that, the building permit procedures don't contain requirements that are of specific relevance for LNG installations, and hence will not be further discussed in this report.

2.1.4 Transportation by road

The transport of hazardous materials 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*

par Route"). The ADR is subjected to most of the 56 members of the United Nations 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 labeling; 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 construction of the LNG tank and labeling/indication of hazardous materials on tank) 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. fuel tank of the truck).

For trucks that want to load LNG at the Fluxys terminal, Fluxys imposes extra criteria, described in their LNG truck approval procedure, which can be obtained from Fluxys on demand. Via this procedure, minimum technical requirements are set for the truck/trailer combination and also minimum requirements (experience, training, language) for the truckers. Moreover, an impact analysis calculation based on finite elements analysis is required for LNG trailers or ISO-containers.

⇒ **Recommendation A5:** Even though the activities of LNG transportation by truck are fully covered by the existing ADR framework, Fluxys' practice to impose extra requirements + the truck approval procedure could serve as example for procedures/requirements the ports could impose on future LNG bunkering trucks, to guarantee safe operations as well as full compatibility between the truck/trailer systems and the receiving infrastructure.

2.1.5 Transportation by pipelines

The main regulation for transportation of gaseous products through pipelines is the Gaslaw 1965 concerning the transport of gaseous products by means of pipelines, and its modifications. ("Gaswet 1965 betreffende het vervoer van gasachtige produkten en andere door middel van leidingen").

We mention also the Royal Decree of 11 March 1966 concerning the safety measures to be foreseen during construction and exploitation of gas transport by means of pipelines.

It is interpreted that art. 1, 8° and art. 2, § 1 of this "Gaswet 1965" limit the scope of these regulations to "vervoersinstallaties" (transportation installations) and as such do not include the LNG pipelines linked to local LNG bunkering installations as foreseen in the ports. Those will be covered under the abovementioned Seveso and Vlarem regulations for onshore facilities.

2.1.6 International standards and best practices relevant for onshore handling of LNG

With industry interaction and in light of international industry best practices, the industry also creates its own codes, rules, regulations and environmental standards. In this way, policies and regulation for LNG safety and security can reflect state-of-the-art technologies and operational practices based on performance history and extensive research and development, design and testing.

The below-mentioned series of standards and best practices is meant to give a general overview. The standards mentioned are not always mandatory or legally binding; they can however be regarded as a collection of industry best practices and as such serve as starting point or as inspiration for further regulatory & standardization developments.

2.1.6.1 European committee for standardization (CEN)

Most of the standards for the construction of land-based constructions in Europe are determined by the European Committee for Standardization (CEN). Some of the standards are voluntary, whereas other standards such as harmonized standards have been made effectively mandatory under EU law. CEN is officially recognized as a European standards body by the European Union. The following CEN standards are applicable for LNG facilities:

- EN1473 – Installation and equipment for Liquefied Natural Gas – Design of onshore installations;
- EN1160 – Installation and equipment for Liquefied Natural Gas – General Characteristics of Liquefied Natural Gas;
- EN1474 – Installations and equipment for Liquefied Natural Gas – Design and testing of marine transfer systems;
- 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 and -165 °C;
- EN12308 – Installation and equipment for liquefied Natural Gas – Suitability testing of gaskets designed for flanged joints used on LNG piping;
- EEMUA 147 – Recommendations for the design and construction of refrigerated liquefied gas storage tanks.

The worldwide LNG value chain could not develop without the evolution of international standards that can apply to LNG operations wherever they are located. Countries that rely extensively on natural gas (NG) to meet their energy needs; such as Japan, South Korea or countries that have extensive LNG production such as Australia have made considerable investments in the creation of a set of policies and regulations that support a safe and secure LNG industry. Worldwide codes are provided by the ISO. In the U.S., federal regulations are provided in the Code of Federal Regulations (CFR). Other U.S. standards are the National Fire Protection Association (NFPA) and the American Petroleum Institute (API). All four

organizations and their applicable codes and standards with respect to LNG will be addressed below:

2.1.6.2 The international organization for standardization (ISO)

The International Organization for Standardization (ISO) is standard-setting body on an international level composed of representatives from various national standardization organizations. While ISO defines itself as a non-governmental organization its ability to set standards that often become law, either through treaties or national standards, makes it far more influential than most non-governmental organizations. In practice, ISO acts as a consortium with strong links to governments. ISO's main products are the International Standards, but it also publishes Technical Reports, Technical Specifications, Publicly Available Specifications, Technical Corrigenda and Guides. For activities related to LNG the ISO published the following standards:

- Installation and Equipment for Liquefied Natural Gas – Ship to shore interface and Port Operations (ISO 28460:2010)

  ISO 28460:2010 specifies 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. It 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 unberthing 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 OPS (cold ironing), where applicable;
  - the liquid nitrogen connection (where fitted);
  - ballast water considerations.

  ISO 28460:2010 applies only to conventional onshore LNG terminals and to the handling of LNGC's in international trade. However, it can provide guidance for offshore and coastal operations.
- Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries (ISO 13709:2003)

Currently a working group (ISO TC67/WG10) is developing a guideline for systems and installations for the use (and supply) of LNG as fuel to ships (see also section §2.3.5). The

focus of the new ISO standard is to standardize the interface between the ship and the fuel supply facilities, to ensure the possibility of refueling an LNG fuelled ship in any port with LNG fuel supply facilities.

The purpose of this new guideline will be:

- Establish operational and control procedures to ensure safe, practical and aligned operations in different ports;
- Meet safety requirements specified by authorities (National and Port). Reference to Guidelines for Risk Assessment;
- Identify requirements to components (Storage tanks, piping, hoses, loading arms, connectors etc.) to ensure equipment compliance;

2.1.6.3 The code of federal regulations (CFR)

Code of Federal Regulations (CFR) standards are produced by different American societies; the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Coast Guard, Department of Homeland Security. Each of the societies separately produces standards that concern different activities in the LNG value chain. The CFR standards that are applicable to LNG operations are:

- 49 CFR Part 193: Liquefied Natural Gas Facilities
- 18 CFR Part 153: Applications for authorization to construct, operate, or modify facilities used for the export or import of natural gas
- 33 CFR Part 127: Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas
- 46 CFR Part 154: Safety Standards for Self-Propelled Vessels Carrying Bulk Liquefied Gases

2.1.6.4 The national fire protection association (NFPA)

The National Fire Protection Association (NFPA) is the world´s leading advocate of fire prevention and an authoritative source on public safety. The organization develops, publishes and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. The following NFPA standards are applicable on LNG facilities:

- NFPA 59A: Production, Storage and Handling of Liquefied Natural Gas
- NFPA 30: Flammable and Combustible Liquids Code

2.1.6.5 The American petroleum institute (API)

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. The following API could be applicable on LNG facilities:

- API RP 521: Guide for Pressure-Relieving and Depressuring Systems
- API Std 2510: Design and Construction of Liquefied Petroleum Gas (LPG) Installations
- API Std 617: Axial and Centrifugal Compressors and Expander Compressors for Petroleum, Chemical and Gas Industry Services.
- API Std 620: Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks

2.2 Port State regulations

Specific regulations exist for the Flemish seaports. There are the port by-laws or codices describing the handling of dangerous goods in the ports on the one hand, and the general or municipal police decrees valid for the port on the other hand. The description underneath will be focused on and limited to relevance for LNG bulk transport of LNG as shipping fuel.

2.2.1 General or municipal police decrees for the ports

2.2.1.1 Port of Zeebrugge

In the '*Verordening voor de Haven van Zeebrugge, het Zeekanaal en de Dokken van Brugge',* general port rules are mentioned, but no specific rules for handling and transportation of dangerous goods are made. The only article that specifically mentions hazardous substances is art. 53, stating that without explicit permission of the harbour master, it is strictly prohibited to load or store resin type or highly flammable products in the port.

2.2.1.2 Port of Ghent

For the port of Ghent, the '*Algemene politieverordening van de Haven van Gent'* applies.
Art. 9 defines that with bunkering is meant the intake of bunker oil or lubricants. No reference to other bunker products is made.
Chapter 3.6 stipulates requirements for safe bunkering (art. 85 → 90). All these requirements relate to oil bunkering and are as such not usable/applicable for the bunkering of LNG.
Art. 10 defines the scope of what are to be considered hazardous substances: all substances mentioned as such in IMDG, IBC, IGC, ADN and all other substance appointed as such by the harbor master or the regulatory body.
Chapter 5.2 (art. 117 → 120) is concerned with dangerous or polluting substances. The articles relate in general to dangerous substances shipped as cargo not as fuel. Dangerous substances can only be handled in the port if the 'General prescriptions and specific requirements for the handling of dangerous substances in the harbor of Ghent' are precisely complied with.

2.2.1.3 Port of Antwerp

The *'Gemeentelijke havenpolitieverordening'* of the port of Antwerp contains an extensive list of specific rules for vessels carrying dangerous goods. The requirements relate to dangerous substances as cargo and not to dangerous substances as fuel.

Chapter 5 contains rules concerning hazardous cargo (as defined by IMDG, IMO, IGC, IBC) and activities that can be potentially dangerous. Apart from stating that dangerous goods can be handled only when following all regulatory and general requirements, some specific rules are mentioned in this chapter, such as that

- no maintenance or repair work is allowed on board of a tanker vessel during its stay in the port unless certificate of safe conditions,
- for bunker vessels mooring is only possible at the designated petroleum docks unless permission of harbor master,
- no visits are allowed on a vessel during loading/unloading,
- no handling of packed goods in the same time as the loading/unloading of bulk cargo,
- the prohibition of direct ship to ship transfer of the dangerous goods unless explicit permission and conditions,
- the obligation of use of tugboats for transferring the tanker to the dock,
- the routing that has to be followed.
- …

Furthermore, tankers carrying dangerous goods have to supply specific information concerning their freight before entering locks, such as the type and amount of the dangerous good. Article 85 of this regulation contains a specific rule for tankers holding liquid fuels to supply other vessels, stating that these vessels are only allowed into the docks when they have permission in advance.

Chapter 5 sections D & E contain specific regulations for the Marshall dock and other docks where hazardous liquids or gases are stored or treated, or where vessels are de-gassed and cleaned. In these designated areas other vessels are prohibited, unless specific permission and the compliance to strict rules (no mooring next to the vessels containing the hazardous cargo, keeping a distance of at least 25m, no fire or open light or activities that can cause sparks).

2.2.2 Port by-laws (codices for the handling of dangerous goods)

2.2.2.1 Port of Zeebrugge

In the by-law for handling dangerous goods (*Codex voor de behandeling van gevaarlijke goederen*) from the Port of Zeebrugge, the following topics are of interest:

Chap IV: the notification of Dangerous Goods needs to be performed twice, at arrival and when leaving the port via Internal Forwarding and Transport Dangerous Goods Notification-document.
Section VII mentions special provisions for dealing with methane *(Bijzondere voorschriften voor het behandelen van methaan) (IMO 2.1 UN 1972)* and is more specifically applicable to

vessels carrying methane (e.g. LNG tankers mooring at the LNG terminal). This chapter contains specific requirements with regard to the operations of LNG carriers in the port of Zeebrugge. It relates to the need for permission of Harbor Master before entering the port, precautions to be taken at Fluxys Terminal, the non acceptance of common presence with a ship carrying munition, general mooring arrangements, … Specific rules are set up for barges coming alongside LNG vessels for bunkering purposes.

Reference is also made to the 'General nautical regulations with procedures for LNG traffic' with more detailed information on position indication of the ship, nautical requirements when mooring or unmooring (e.g. number of tugs). Distinction is made between small carriers (<200m) and large carriers (>200m).

2.2.2.2 Port of Antwerp

In the code for handling dangerous goods (*Codex voor gevaarlijke goederen*) of the Port of Antwerp the main requirement with regard to LNG is that before handling approval of the harbor master is needed.

2.2.2.3 Port of Ghent

In the regulations for handling dangerous and harmful goods (*Reglement gevaarlijke en/of schadelijke stoffen van de Haven van Gent*) of the Port of Ghent the following articles are applicable on the storage and handling of LNG (LNG is considered in the category of flammable liquids with a flame point lower than 21°C):

Chapter I art 24:

- Dangerous and/or hazardous goods cannot be handled in case the meteorological situation leads to a hazardous situation.

Chapter I art 30:

- §5 LNG (Methane is described as a category A product in appendix VII) cannot be transferred from sea tanker ship to another tanker ship.
- §8 During transfer of LNG (Methane is described as a category A product in appendix VII) from sea tanker ship to onshore installation, no ship can be docked next to the sea tanker ship.
- §13 LNG (Methane is described as a category A product in appendix VII) cannot be transferred between two inland tanker vessels (binnentankschip).

A ship-shore safety checklist exists for liquefied gases in bulk.

2.2.3 Recommendations for port activities (excluding bunkering)

During the analysis of the port by-laws, codices and the general or municipal police decrees, it is noted that the requirements enforced to ensure the safe handling of hazardous substances always relate to hazardous substances as cargo. Considering the future use of LNG as a propulsion fuel, the question arises whether or not (partial) distinction needs to be made between vessels that carry LNG as bulk cargo in cargo tanks (LNG carriers and LNG feeder & bunker vessels), and vessels that carry LNG merely as fuel, in fuel tanks.

2.2.3.1 Port activities with vessels holding LNG as cargo

Looking at the situation of LNG as cargo, one of the recommendations (no. 11) from the report of the North European LNG Infrastructure Project is to consider the LNG bunker vessel traffic similar to other dangerous cargo vessel traffic and avoid introduction of special requirements specific for the LNG bunker vessel traffic. The rationale for this is that stringent international codes and national regulations for ship design and traffic with hazardous cargo including liquid flammable gases are already well established and are generally and internationally considered to ensure an adequate safety level for sea transportation of most types of dangerous cargo and hazardous materials. LNG is one of the substances listed and considered in these regulatory frameworks and it is therefore not considered necessary to introduce special requirements or procedures for traffic with LNG feeder vessels and LNG bunker boats only because they are carrying LNG. Depending on the port specific conditions and traffic situation it may, however, still be important to review and assess the feasibility and potential risks associated with the projected LNG bunker vessel traffic and to compare it with the present bunker vessel traffic in the port.

⇒ **Recommendation D1:** It is recommended to consider the LNG on board LNG bunker vessels navigating in the port generally in a similar way as other hazardous cargo transported in the port. In this way all regulations applicable to the transport of hazardous cargo in the ports will be applicable to these bunker vessels.

But, next to this *general* policy, the ports should consider which *specific* aspects to address in the by-laws, such as the routing, the use of tug boats (type of tug, number of tug, specifications for tug cables, specifications for fire-fighting equipment on board of tugs, …), designated places to anchor/moor, distances to other vessels when moored, distances for crossing other vessels when sailing in the ports, requirements for entering locks and so on. Zeebrugge's General Nautical Regulations – Procedures LNG-traffic can serve as a starting point for the development of these port specific regulations on top of the general rules for the handling of hazardous cargo as they exist already in the port by-laws today.

⇒ **Recommendation D2**: Port authorities need to update their port by-laws, codices and general or municipal police decrees with specific aspects for LNG cargo vessels.

For the three ports concerned, this means concretely:

Port of Ghent:

Algemene Politieverordening van de Haven van Gent:

- Examine to which extent Art. 64 & 65 need to be revised for LNG carriers. Possible adaptations:
    - enforce the use of tug boats for LNG carriers, possibly dependent on the size of the LNG carrier.
    - Specify type of tug, number of tug, specifications for tug cables, specifications for fire-fighting equipment on board of tugs assisting LNG carriers.
- Examine to which extent Art. 73 needs to be revised. Possible adaptation is to enforce minimum distances between moored vessels in case one of the vessels is an LNG carrier.

Reglement gevaarlijke en/of schadelijke stoffen van de Haven van Gent:

- Remove methane (LNG) in "Bijlage VII (version 30-03-2009) on p 139", in order to allow the ship-to-ship transfer of LNG in the Port of Ghent.

Port of Antwerp:

Gemeentelijke havenpolitieverordening:

- Examine to which extent Chapter 5, section 2A needs to be revised to include LNG carriers. The requirements stated here are formulated in a general way, no reference is made that excludes LNG, so no real void in regulations was detected. However, possible adaptations could be considered for e.g. Art. 73 describing the need for a vapor return and Art. 74 describing the connection between ship side pipelines and port side pipelines.
- Examine to which extent Art. 80 and Art. 9 need to be revised, regarding the requirements for tug boats & crew.
- Examine to which extent Chapter 5, section 2D needs to be adapted. Possible adaptation is to enforce minimum distances between moored vessels in case one of the vessels is an LNG carrier.

Port of Zeebrugge:

Verordening voor de Haven van Zeebrugge, het Zeekanaaal en de dokken van Brugge:

No specific suggestions, since the port of Zeebrugge already has its general nautical regulations with procedures for LNG traffic, though legislation needs to be extended for ships not mooring at the LNG terminal.

2.2.3.2 Other port activities

Floating installations containing LNG (e.g. a local storage facility) are, very strictly speaking, not covered. However, there are precedents where floating but stationary installations are considered as fixed installations, equivalent with onshore installations, and are treated accordingly. The department Milieuvergunningen has internal guidelines stating a clear position to consider floating but stationary installations as fixed.

⇒ **Recommendation D3**: Consider to explicitly describe the case of floating installations in Vlarem instead of only having it as an internal guideline. This has to be done on a regional level and more explicitly by the Flemish Government Department of Environment, Nature and Energy, division Environmental Permitting.

2.3 Shore-to-ship, ship-to-shore or ship-to-ship transfer standards

The regulatory framework for seagoing vessels that is covered by the International Maritime Organization does not include the transfer of materials from one vessel to another. Advice and support of the transfer operations are captured in standards and best practices of societies like SIGTTO and OCIMF. These two societies and their applicable standards and best practices that can be useful for LNG are given below:

2.3.1 The society of international gas tanker & terminal operators (SIGTTO)

The Society of International Gas Tanker & Terminal operators is an organization formed to promote high operating standards and best practices in gas tankers and terminals throughout the world. It provides technical advice and support to its members and represents their collective interests in technical and operational matters. The SIGTTO guidelines are focused on large scale LNG transfer from LNG carriers, both for transfer to terminal and for Ship to Ship LNG transfer. Some of the guidelines designed for large scale LNG operations, can be used for bunkering of LNG as well. SIGTTO publishes guidelines and “white papers” with the purpose of sharing expertise and best practices.

The two most important guidelines that are applicable for the ship to ship bunkering of LNG are:

- Ship to Ship Transfer Guide (Liquefied Gases) - 2nd edition (OCIMF/SIGTTO)

The “ship to ship transfer guide Liquefied Gases” covers the ship to ship transfer of liquefied gases at sea. The guideline is originally written for the transfer of LPG but may be used for LNG as well. The guide will be of use in the event of emergency lightning operations, providing checklists for each stage of the operation. This guide aims to familiarize ship's Masters, ship and barge operators and charterers/traders with the general principles of liquefied gas transfer operations.

- LNG Ship to Ship Transfer Guidelines

The "LNG Ship to Ship Transfer Guidelines" differ from the "ship to ship transfer guide Liquefied Gases". The former guideline, which was published in 2001, covers the transfer of LNG from LNG carriers at anchor, alongside a shore jetty or while underway. They are also useful for reference when establishing rules and procedures for transfer operations between seagoing ships and LNG regasification vessels (LNGRV) or LNG floating storage and offloading vessels (FSOs) in inshore waters. The guideline is applicable on the transfer of large amounts of LNG from ship to ship. It does not cover the bunkering process. However it can be used as a starting point for the development of LNG bunkering guidelines.

Relevant publications for ship to shore transfer are e.g.:

- Safety in Liquefied Gas Marine Transportation and Terminal Operations
- Ship/Shore Interface - Safe Working Practice for LPG & Liquefied Chemical Gas Cargoes
- LNG Operations in Port Areas

  "This document draws on the collective experience of the gas industry members in setting out guidance to best practice for managing gas shipping operations within ports. It also illuminates the profile of risks attaching to gas operations, for the information of those who administer ports and provide essential services in ports areas. This document is essential guidance to best practice for those involved with the design and operation of new LNG terminals and for existing terminals who wish to re-assess risk due to the dynamic nature of operating environments"
- ESD Arrangements & Linked Ship / Shore Systems for Liquefied Gas Carriers:

  "This SIGTTO guidance note has been produced due to members' concerns about the different interpretations of the functional requirements for ESD systems, particularly those differences between the needs of the LNG industry and those of the LPG industry and how these may interact with linked ship/shore shutdown systems"

2.3.2 The oil companies international marine forum (OCIMF)

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 to take care of a safe and environmentally responsible operation of oil tankers, terminals and offshore support vessels by promoting continuous improvement in standards of design and operation. The most important rules and regulations that can be applicable on LNG operations are:

- *ISGOTT*

The International Safety Guide for Oil Tankers & Terminals (ISGOTT) is devolved for the safe carriage and handling of crude oil and petroleum products on tankers and at terminals. To ensure that the ISGOTT reflects the current best practice and legislation the guideline is reviewed by the ICS and OCIMF, together with the International Association of Ports and Harbours (IAPH). 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 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.

- *Ship to Ship Transfer Guide (petroleum)*

The ship to ship transfer guide will primarily cover the transfer of crude oil and petroleum products between seagoing vessels. The guide is aimed at providing advice for masters, marine superintendents and others responsible for planning Ship-to-Ship transfer operations. Although the guide is written for the transfer of crude oil and petroleum products between seagoing vessels the principle can be used for LNG applications as well.

2.3.3 Swedish marine technology forum

An LNG ship to ship bunkering procedure has recently been issued by The Swedish Marine Technology Forum: FKAB Marine Design, Linde Cryo AB, Det Norske Veritas AS (DNV), LNG GOT and White Smoke AB.

The document is a procedural description of how LNG (liquid natural gas) bunkering between two ships should be done according to the Forum's experts. The document is the result of the joint venture project "LNG bunkering Ship to Ship", a technology development project carried out by the Forum.
LNG bunkering ship to ship in port with demands for short operation time have not been performed before and this procedure has been worked out to handle the specific details of this operation in a safe way. The procedure is made for ship to ship bunkering of LNG in a port environment, with a dedicated bunker ship rapidly delivering the fuel to client ships while cargo and passenger handling is still in progress. 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.

The concept is accepted and approved in principle by DNV. The procedure has no legal or binding status.

2.3.4 International Safety Guide for Inland Tank-barges and Terminals

The Oil Companies International Marine Forum (OCIMF) together with other stakeholders for inland waterways, like the CCNR developed the International Safety Guide for Inland Tank-barges and Terminals (ISGINTT). The International Safety Guide for Inland Tank-barges and Terminals is not intended to replace or to amend current legislation as ADN and RVIR, but to provide additional recommendations. The CCNR supports the Guide as the principal industry reference manual on the safe operation of tankers and terminals that serve them.

The ISGINTT does not give restrictions on fuel properties that can or cannot be used for the propulsion of inland ships. The link with LNG can be found in the hazards that arise for liquids with a flashpoint below 60°C. The ISGINTT does distinguish between volatile and

non-volatile liquids based on their flashpoints. However, this link is purely based on hazard identification and not on shipping fuel related activities.

2.3.5 Recommendations for bunkering

The class rules do not give all safety information that is needed for the bunkering process of LNG. For example the safety distances that are given in the rules are applicable around the fuel tank when there is no bunkering of LNG. Currently there are no safety perimeters available for the bunkering of LNG as a fuel.

The IMO / IGF / IGC regulations cover the technical requirements for safe bunkering at the ship's side.

No existing regulation or standardization is directly applicable, but there is some practical experience and there is ongoing standardization work.

Practical experience for LNG transfer:

- large scale LNG transfer through fixed loading arms, typically at high throughput rates (order of magnitude 10 000 m^3/hour), limited relevance towards small scale LNG bunkering practices
- Ships in operation in Norway: transfer of LNG through cryogenic hoses, low capacities of about 70 m^3/hour. Most of these projects have developed their own dedicated LNG supply system, so limited generic experience is accumulated so far.

There are some on-going projects that may give some guidance on LNG bunkering in the near future:

- The current Interim Guidelines of IGF contains some issues related to ship to ship bunkering:
  - Final version of IGF code will come in 2014
  - The fact that it is currently "interim guidelines" simply means that it may be updated more frequently
  - Flag states can still adopt the interim guidelines for the code (Norwegian Maritime Directorate has rules)
  - Note that a formal safety assessment (FSA) is required for each individual ship
- The SIGTTO document Guidelines on Ship to Ship bunkering covers most of the issues including pre-notification and safety zones. These guidelines are not yet generally valid, though the intent of the guidelines is for authorities and other organizations to use them as input to regulation and guideline work concerning LNG bunkering;
- The Gothenburg Ship to Ship bunkering procedure project;
- The on-going ISO project for the development of guidance for systems and installations for the supply of LNG as a fuel in the shipping industry;
- Bungas project in the port of Hamburg;
- Local projects by (Port) authorities.

DNV proposed the topic to ISO TC67/WG10 (ISO workgroup for the LNG industry). The objective of this workgroup is to develop standards for LNG bunkering equipment and procedures; 20 companies and individuals are participating, representing the following countries:

- Norway
- Belgium
- Brazil
- Canada
- China
- France
- Germany
- Italy
- UK

The scope for the Project Team is to provide guidance on how to

- Meet safety requirements specified by authorities (National and Port) with reference to Guidelines for Risk Assessment.
- Establish operational and control procedures to ensure safe, practical and aligned operations in different ports.
- Identify requirements to components (Storage tanks, piping, hoses, loading arms, connectors etc) to ensure equipment compliance.
- other factors as agreed by the PT such as:
    - Requirements for maintenance
    - Training and qualification schemes
    - Emergency preparedness

The Project Team shall collect, evaluate and distill experiences and practices developed in the North Sea area. The focus shall be to standardize the interface between the ship and the fuel supply facilities, to ensure that a LNG fuelled ship can refuel in any port with LNG fuel supply facilities.

The most recent meeting of the committee took place 26-27th June 2012, in Washigton D.C. with participation of the US coast Guard. A draft guideline will be provided later this year and information will be given to EMSA and IGF-Code Correspondence Group at the end of the summer.
The ambition is to publish draft “guidelines for systems and installations for supply of LNG as fuel for ships” by the end of 2012. The guidelines should cover all safety relevant items and set the baseline of all functional requirements necessary for safe bunkering operations.

A tentative table of content for the guideline is proposed as follows:

Summarizing, despite several ongoing initiatives, there is currently no comprehensive (international) legislation available for the bunkering of LNG as a fuel. In order to allow safe bunkering operations, there is a need for (standardized) technical requirements for the equipment and for operational procedures (e.g. with regard to safeguards and safety distances).

⇒ **Recommendation F1**: Develop regulations/procedures for truck to ship (TTS) bunkering.

⇒ **Recommendation F2**: Develop regulations/procedures for ship to ship (STS) bunkering.

⇒ **Recommendation F3**: Develop regulations/procedures for small scale LNG station to ship bunkering (ITPS: intermediary storage to ship via LNG pipeline).

Furthermore, in order to be time-efficient, the possible concurrency of LNG bunkering with cargo handling and passenger embarking or debarking is a point of interest. This possibility is also being addressed a.o.t. in the ISO TC67/WG10. For the time being, the workgroup has not issued any written guidelines addressing this issue, not even in draft form, but the point is certainly on the table and the intention of the forthcoming guideline is to address and make possible these concurrent operations.

Looking at the positions of other stakeholders / other countries in this matter, the current situation is as follows:

Norway: There are no general regulations / conditions under which LNG bunkering together with passenger movement is allowed in Norway. DNV has conducted a risk assessment for this combined operation (bunkering while passengers are brought on or off board) but the Authorities have not yet allowed this to happen. They have, however, initiated a new second risk assessment which may give complementary points of views, giving more confidence in this. Concretely, the "Department for fire & explosion safety" have received a request to allow this for the upcoming Fjordlines ferries which may bunker in Stavanger (Risavika).

Other Baltic countries: an active stakeholder in the debate is Viking Line, a ferry line operating ferry services between Sweden, Finland and Estonia. The new Viking Line vessel can run on both LNG and traditional fuels. The new vessel will replace M/S Isabella on the Stockholm-Åland-Turku route and will operate from the western Stadsgården/Masthamnen quay. The M/S Viking Grace will begin to call at Stadsgården from the beginning of 2013.

To adapt the Viking Terminal for the new Viking Line vessel M/S Viking Grace Ports of Stockholm is performing construction work at Stadsgården. This work will be ongoing throughout 2012.

The work performed by Ports of Stockholm will include reconstructing and adapting car lanes, constructing a goods vehicle ramp and a side ramp for cars, adapting the quayside and laying new conduits for fresh water and waste water.

AGA Gas AB will deliver the liquefied natural gas from its LNG terminal in Nynäshamn, which was inaugurated in 2011. The planning, pre-construction engineering and permitting process for bunkering of the vessel at Stadsgården in the port of Stockholm is under way.

Figure 2 Viking Line ferry routes

Germany: currently, there are no regulations in force in Germany. The German Ministry of Transportation (BMVBS) have issued a study (with GL) that, amongst other things, covers concurrent bunkering/cargo operations. The study is finished but not yet published.

⇒ **Recommendation F4**: Develop regulations/procedures for simultaneous bunkering & cargo handling.

⇒ **Recommendation F5**: Develop regulations/procedures for simultaneous bunkering & passenger embarking/debarking.

Concretely guiding the development of bunkering procedures is out of the scope of this study, but it can be stated that the bunker procedures to be developed should cover the whole sequence of bunkering, i.e.

- Communication aspects in ports between all parties involved (receiving vessels, bunker vessels or trucks, harbor master service, fire & rescue brigades,…)
- Navigation aspects of bunker vessels in ports
- Technical and safety requirements for bunkering facilities (= bunker vessels or trucks + small scale bunkering infrastructure, including associated containment systems)
- Requirements covering the operational and safety aspects of the bunkering operation, referencing both the vessel's rules and the port's rules where applicable. The bunkering operation can be considered as a sequence of phases:
    - GENERAL (notification, communication, …)
    - PRE-FILLING
    - FILLING
    - POST-FILLING
- The need and the way to perform safety assessments
- Training and qualification schemes of all personnel involved in the abovementioned sequence, where the depth of training should be commensurate on the roles and responsibilities of the personnel and the complexity of the operation and facilities.

  Bunkering personnel need to know:
    - Generics
        - Basics of LNG Handling
        - LNG metering (Mass/volume/calorific value/composition)
        - Hazards and properties of LNG and Natural gas, and inerting gases
        - Use of PPE equipment
        - Safety and firefighting
    - Use of Equipment
        - Hoses
        - Connectors
        - Valves
        - Pumps

- ESD
- Instrumentation controls
- Safety devices
- Handling equipment

- Port Specific Operations
  - Operations
  - Organisation/communication
  - Emergency preparedness

Looking into what is currently prescribed in the port by-laws, codices and the general or municipal police decrees, the following concrete suggestions can be made:

Port of Ghent:

Algemene Politieverordening van de Haven van Gent:

- Adaptation of art. 9 definition of bunkering
- Adaptation of chapter 3.6 on bunkering

Reglement gevaarlijke en/of schadelijke stoffen van de Haven van Gent:

- Adaptation of bunker checklist
- Adaptation of ship/shore checklist
- Adaptation of guidelines for the filling out of the terminal safety checklist

Port of Antwerp:

Gemeentelijke havenpolitieverordening: -

Codex voor gevaarlijke goederen: -

No specific problems are discovered with respect to the possibility to allow LNG bunkering, although given the specific properties of LNG it might be sensible to make the requirements more specific.

Port of Zeebrugge:

Verordening voor de Haven van Zeebrugge, het Zeekanaaal en de dokken van Brugge: -

Codex voor de Behandeling van Gevaarlijke Goederen in de Haven van Zeebrugge/Brugge:

- Adaptation of Section 6, art. 24
- Review of Section 7 , extend the scope beyond unloading at the Fluxys terminal
- Adaptation of Section 8.5, art. 2

Next to the technical and safety aspects when bunkering LNG, also standards will be needed for metering & measurement, sampling, quality control.

⇒ **Recommendation F6**: Develop standards (NBN) and procedures (or amend current standards and procedures) for metering, measurement, fuel sampling & quality control.

With regard to recommendation F6, it has to be mentioned that currently the port of Antwerp is developing a procedure for the recognition (erkenning) of bunker companies (which, once established, will also be valid in the other Flemish seaports), following the conditions set in annex VI (Reg. 18) of the MARPOL convention 73/78**.** The draft procedure indeed mentions, amongst other requirements, the necessity to have a yearly calibration of all metering equipment used by the bunkerers. The scope of this current recognition scheme is traditional oil bunkering. It is advisable to start, in parallel, a similar process for the recognition/accreditation of LNG bunkering companies.

⇒ **Recommendation F7**: Initiate the process for accreditation/recognition of LNG bunkering companies valid in the Flemish seaports. Such an accreditation procedure should establish minimum safety and quality levels for the bunkering companies, and establish that non-compliance to the rules implies the loss of the accreditation and subsequently the denial of access to the ports.

It is of course also essential to establish procedures allowing the safe sampling of these gaseous fuels. To this purpose there are already reference standards available, e.g. “BS EN ISO 4257:2001 Liquefied petroleum gases – Method of sampling”.

2.3.6 Mobile tanks

Another way of bringing LNG as shipping fuel on board a vessel, is via mobile tanks, e.g. ISO containers, which are hoisted or rolled on board to serve as fuel tanks after being connected to the engine system. In general, in class rules as well as in the IGF code, it is stated that such “mobile” gas tank systems should, in terms of safety, be equivalent to fixed/permanent gas fuel tanks.

Mobile or portable tank systems are an integral part of the scope of the certification/classification of a ship and as such are to be considered as fuel tanks and not as cargo tanks, as soon as they are received on board a vessel, even if they are not connected. The procedure for connecting/disconnecting these mobile or portable fuel tanks is subject to approval by the class society, as are the bunkering procedures for vessels with fixed tanks.

2.4 Ship based activities (maritime based) – international regulations

2.4.1 The international convention for the safety of life at sea (SOLAS)

The International Convention for the Safety of Life at Sea (SOLAS), 1974, is an international maritime safety treaty. The SOLAS Convention in its successive form is generally regarded as the most important of all international treaties concerning the safety of (merchant) ships.
The SOLAS requires flag states to ensure that their ships comply with minimum safety standards in construction, equipment and operation. It includes articles setting out general obligations, followed by an annex divided into twelve chapters:

Chapter I – General Provisions

Includes regulations concerning the survey of the various types of ships and the issuing of documents signifying that the ship meets the requirements of the Convention.

Chapter II-1 – Construction – Subdivision and stability, machinery and electrical installations

Describes inter alia the subdivision of passenger ships into watertight compartments so that after damage to its hull, a vessel will remain afloat and stable.

Chapter II-2 – Fire protection, fire detection and fire extinction

Describes minimum fire safety provisions for all ships with detailed measures for passenger ships, cargo ships and tankers.

Chapter III – Life-saving appliances and arrangements

Describes minimum requirements for life-saving appliances and arrangements, including requirements for life boats, rescue boats and life jackets according to type of ship.

Chapter IV – Radiocommunications

Incorporates the Global Maritime Distress Safety System (GMDSS), requires passenger and cargo ships on international voyages to carry adequate radio equipment.

Chapter V – Safety of navigation

Requires governments to ensure that all vessels are sufficiently manned from a safety point of view. It is different to the other chapters, which only apply to certain classes of commercial shipping, in that these requirements apply to all vessels and their crews, including yachts and private craft, on all voyages and trips including local ones.

Chapter VI – Carriage of Cargoes

Contains requirements for the stowage and securing of all types of cargo and cargo containers except liquids and gases in bulk.

Chapter VII – Carriage of dangerous goods

Requires the carriage of all kinds of dangerous goods to be in compliance with the International Maritime Dangerous Goods Code (IMDG Code)

Chapter VIII – Nuclear ships

Nuclear powered ships are required, particularly concerning radiation hazards, to conform to the Code of Safety for Nuclear Merchant Ships

Chapter IX – Management for the Safe Operation of Ships

Requires every shipowner and any person or company that has assumed responsibility for a ship to comply with the International Safety Management Code (ISM).

Chapter X – Safety measures for high-speed craft

Makes mandatory the International Code of Safety for High-Speed Craft (HSC Code).

Chapter XI-1 – Special measures to enhance maritime safety

Requirements relating to organisations responsible for carrying out surveys and inspections, enhanced surveys, the ship identification number scheme, and operational requirements.

Chapter XI-2 – Special measures to enhance maritime security

Includes the International Ship and Port Facility Security Code (ISPS Code). Controls the delay, detention, restriction, or expulsion of a ship from a port. Requires that ships must have a ship security alert system, as well as detailing other measures and requirements.

Chapter XII – Additional safety measures for bulk carriers

Specific structural requirements for bulk carriers over 150 metres in length.

Of main relevance for LNG are the following:

Chapter VII – Carriage of dangerous goods

The regulations for Chapter VII - Carriage of dangerous goods are contained in several parts:
Part A - Carriage of dangerous goods in packaged form - includes provisions for the classification, packing, marking, labelling and placarding, documentation and stowage of dangerous goods. Contracting Governments are required to issue instructions at the national level and the Chapter makes mandatory the International Maritime Dangerous Goods (IMDG) Code, developed by IMO, which is constantly updated to accommodate new dangerous goods and to supplement or revise existing provisions.

Part A-1 - Carriage of dangerous goods in solid form in bulk - covers the documentation, stowage and segregation requirements for these goods and requires reporting of incidents involving such goods.

Part B covers Construction and equipment of ships carrying dangerous liquid chemicals in bulk and requires chemical tankers to comply with the International Bulk Chemical Code (IBC Code).

Part C covers Construction and equipment of ships carrying liquefied gases in bulk and gas carriers to comply with the requirements of the International Gas Carrier Code (IGC Code).

Part D includes special requirements for the carriage of packaged irradiated nuclear fuel, plutonium and high-level radioactive wastes on board ships and requires ships carrying such products to comply with the International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships (INF Code).

The chapter requires carriage of dangerous goods to be in compliance with the relevant provisions of the International Maritime Dangerous Goods Code (IMDG Code).

Chapter II-2 – Fire protection, fire detection and fire extinction

Part B - Prevention of fire and explosion

Regulation 4 - Probability of ignition

2. Arrangements for oil fuel, lubrication oil and other flammable oils

2.1 Limitations in the use of oils as fuel

The following limitations shall apply to the use of oil as fuel:

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

2.4.2 The international code for the construction and equipment of ships carrying liquefied gases in bulk (IGC code)

The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) applies to gas carriers constructed on or after 1/7/1986. Gas carriers constructed before that date should comply with the requirements of the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (GC Code) (gas carriers constructed between 31/12/1976 and 1/7/1986) or the Code for Existing Ships Carrying Liquefied Gases in Bulk (gas carriers constructed before 31/12/1976).

The purposes of these codes is to provide an international standard for the safe transport by sea in bulk of liquefied gases and certain other substances, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as 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, updates are expected by 2014.

The IGC Code covers the design of vessels transporting liquefied gases; therefore, it is applicable to LNG feeder ships & bunkering barges.

The IMO IGC Code consists of the following chapters:

1) 1983 IGC Code Preamble
2) General Code
3) Ship survival capability and location of cargo tanks
4) Ship arrangements
5) Cargo containment
6) Process pressure vessels and liquid, vapour and pressure piping systems
7) Materials of construction
8) Cargo pressure/temperature control
9) Cargo tank vent systems
10) Environmental control
11) Electrical installations
12) Fire protection and fire extinction
13) Mechanical ventilation in the cargo area
14) Instrumentation (gauging, gas detection)
15) Personnel protection
16) Filling limits for cargo tanks
17) Use of cargo as fuel
18) Special requirements
19) Operation requirements
20) Summary of minimum requirements

2.4.3 The international code for the construction of gas fuelled ships (IGF code)

Currently, there is no formal IMO rule concerning (L)NG fuelled vessels other than the IGC code that allows LNG carriers to use their boil-of-gas as a fuel. The expected publication of the formal International Code for the construction of gas fuelled ships, IGF code, will be no earlier than 2013-14. To allow vessels to use fuels with a low (i.e. below 60°C) flashpoint an interim guideline was published by the IMO in 2009. This guideline is formally known as Resolution MSC 285(86). MSC 285(86) indicates arrangement and installation of LNG fuelled machinery to achieve an equivalent level of safety, reliability and dependability compared to conventional oil fuelled machinery.

The IGF code is applicable for the receiving vessel, the ship using LNG as bunker fuel. The bunkering of LNG is at this moment not included in the scope of the IGF code.

The goal of the International Code of Safety for Gas-fuelled Ships (IGF Code) is:

- to provide criteria for the arrangement and installation of machinery for propulsion and auxiliary purposes, using various gases as fuel,
- to ensure an equivalent level of integrity in terms of safety, reliability and dependability as that which can be achieved with new and comparable conventional oil fuelled main and auxiliary machinery,
- to facilitate the application to all ship types in a flexible way without inhibiting technical innovation.

The scope of the IGF code

- should provide safety measures for ships using various gases as fuel including liquefied gas tankers,
- is intended to address natural gas fuel and also other gas fuel types, such as butane, hydrogen, propane,
- will cover the energy conversion systems of relevance (low and high pressure ICE, gas turbines, boilers, fuel cells,
- should only address issues not already covered by SOLAS and serve as an addition to SOLAS,
- should revoke the interim guidelines and Chapter 16 of the IGC Code,
- should be set into force with SOLAS 2014.

The provisions of the IGF Code will be developed to the extent possible in a functional manner.

The Interim Guidelines already developed:

- may serve as guidance for the issues to be addressed,
- are not intended to restrict the development of the IGF Code with regard to the scope of application or regulatory style,

Resolution MSC.285(86): Interim Guidelines on Safety for Natural Gas-fuelled Engine Installations in Ships covers:

1) General hazards, applications and survey requirements for gas-fuelled engines
2) Ship arrangements and system design
3) Fire safety
4) Electrical systems and hazard zones
5) Control, monitoring and safety systems
6) Compressors and gas engines
7) Manufacture, workmanship and testing
8) Operational and training requirements

2.4.4 Work on developing IGF and IGC Codes

The latest working session of the IMO Sub-Committee on Bulk Liquids and Gases (BLG): BLG 16, took place from 30 January to 3 February 2012.

The Sub-Committee continued its work on the development of a new international code of safety for ships using gases or other low-flash point fuels (IGF Code) and on the revision of the International Code for the Construction and Equipment of Ships carrying Liquefied Gases in Bulk (IGC Code), with agreement to forward relevant parts of the draft revised IGC Code to other Sub-Committees for their input. The Sub-Committee also established a correspondence group to further develop the IGF Code intersessionally.

Moreover, the Sub-Committee agreed a number of proposed amendments to chapters 17, 18 and 19 of the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code), relating to specific products, for submission to MEPC 63 (Maritime Environment Protection Committee) and MSC 90 (Maritime safety committee) for approval and subsequent adoption.

A timetable for the review of safety criteria guidelines in chapter 21 of the IBC Code, to address inconsistencies in chapters 17 and 18, was also agreed, with a view to completing the process by 2016.

2.4.5 The international maritime dangerous goods code (IMDG)

The International Maritime Dangerous Goods (IMDG) Code was developed as a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances. The IMDG code does not cover requirements related to storage of ship fuels and as such does not contain direct requirements for LNG as a fuel.

2.4.6 Class rules: general

All seagoing ships are built under the class rules of a classification society. (Inland vessels in general fall under national requirements that are derived from class rules but class as such

does not exist for general inland vessels. However, there is an exception for inland tank ships, see further).

The objective of ship classification is to verify the structural strength and integrity of essential parts of the ship's hull and its appendages, and the reliability and function of the propulsion and steering systems, power generation and those other features and auxiliary systems which have been built into the ship in order to maintain essential services on board. Classification Societies aim to achieve this objective through the development and application of their own Rules. With the introduction of the first LNG carrier the classification societies developed specific rules for the construction and safety of LNG carriers. The use of gas as a shipping fuel will require additional measures. The introduction of gas in the fuel tanks and the introduction of gas processing equipment will necessitate additional safety systems to mitigate the specific risks. To ensure the safety and technical integrity of the LNG system for propulsion the classification societies developed/are developing additional class rules. The use of gas as fuel in ships other than LNG carriers is not yet covered by international conventions and such installations will need additional acceptance by flag authorities.

While every classification society issues its own set of rules, there are general class requirements issued by the IACS (International Association of Classification Societies), the so-called Unified Requirements. Of relevance to LNG fuelled vessels is requirement M59: Control and Safety Systems for Dual Fuel Diesel Engines (1996) from Chapter M: requirements concerning machinery installations.

Regarding the gas fuelled installations onboard there are numerous class requirements that have to be met. These requirements are for example described in the DNV rules for gas fuelled engines installations; Part 6, chapter 13).

Det Norske Veritas was the first classification society which issued rules for gas fuelled engine installations. The use of gas as fuel in ships other than LNG carriers needs acceptance from flag states due to lack of international conventions. The first ever gas fuelled vessel, not being a gas carrier, the ferry GLUTRA, was built in 2000 based on DNV's class rules. At this moment other class societies have issued rules for gas fuelled engine installations as well.

The following section discusses the differences and similarities between the class rules of Det Norske Veritas (DNV), Bureau Veritas (BV), Germanischer Lloyd (GL) and ABS.

The full texts of these class rules are added to the report as an electronic appendix (pdf files on CD-ROM).

2.4.6.1 Class rules: comparison

General
Some of the class rules refer to the IGC code for the design specification, while for other rules reference is made to a class society specific set of rules regarding storage of gas. What all rules have in common are the restrictions on the location of the pressure relief valve, the

maximum filling degree of the fuel tank and the requirements to empty, purge and vent fuel tanks.

Besides these common restrictions, class societies can impose some additional requirements. For example:

ABS requires additional requirements for the full and partial secondary barrier. Their rules state that the secondary barrier must be able to contain spilled LNG for a period of at least 15 days. ABS also requires that the fuel storage (in case of single fuel installation) needs to be divided in two or more tanks of approximately equal size. The two of more tanks should be located in separate compartments.

GL and BV impose additional requirements regarding the pipe connection to the fuel tank. They require that pipe connections to the tank should normally be mounted above the highest liquid level in the tanks. However, both societies have specified different cases in which exceptions are acceptable. BV for instance accepts lower connected piping if the storage tank does not exceed 60 m^3, a drip tray and efficient spill detection is present and the piping is arranged with a quick closing valve.

Storage in enclosed spaces
All four societies have specified additional rules for tanks located in enclosed spaces. All four rules specify that gas in a liquid state may only be stored till a maximum working pressure of 10 bar. However, pressures higher than 10 bar may be permitted after special consideration and approval by the class society, if specific measures are taken into account. They all prescribe that the storage tank must be located as close as possible to the centerline of the ship. To be more specific, they prescribe a minimum distance from the storage tank to the ship's side. The prescribed minimum distance is equal for each society.

All four societies prescribe that the storage tank and associated valves and piping must be located in a space designed to act as a secondary barrier in case of liquid gas leakage. This requires special attention to the material of the second barrier, because of the temperature and pressure that could occur in case of leakage. The rules also prescribe thermal isolation of the second barrier to prevent the hull of the ship to unacceptable low temperatures.

Storage on open deck
All four societies have specified additional rules for tanks located on open deck. They prescribe a minimum distance from the storage tank to the ship's side, sufficient natural ventilation and characteristics of the drip tray. The rules of BV and DNV include the statement that gas storage tanks on open deck must be protected against mechanical damage.

Portable tanks
The class rules of GL and ABS do not specify additional rules for portable tanks. The (conceptual) class rules of DNV and BV do. The BV rules give additional requirements for transportable type C tanks located on open deck. The term additional requirements suggests that all requirements for normal tanks apply to the portable tanks as well. The DNV rules do not give any restrictions about the type and location of the portable tank. The DNV rules state

that the gas fuel systems of portable tanks must have equivalent safety as permanent gas fuel tanks and that tanks are dedicated as LNG fuel tank and certified as such.

In principle the DNV and BV rules do show similarities. The difference can be found in additional guidance on some specific topics. For example; the BV rules give some guidance about the handling of the portable tank, the DNV rules don't.

2.4.7 Recommendations for ship based activities (maritime based)

The shipping industry is transporting LNG as cargo for many years. During those years of service many guidelines and regulations have been developed to ensure safe transport of LNG. However, most of those guidelines and regulations are applicable on LNG cargo carriers and installations. For LNG fuel tanks, no detailed regulations are available. To make the application of LNG fuelled vessels in the value chain feasible, comprehensive (international) legislation is needed. The safety and integrity of the construction of ships that will use LNG as fuel is under supervision of the classification societies that developed specific class rules for this purpose. However these rules are only for classification purposes and cannot be seen as guidelines for operation activities like bunkering (see further).

Competencies of crew & other stakeholders:

⇒ **Recommendation C1**: The use of LNG as shipping fuel will create new hazards compared to conventional fuels. Perform a training needs analysis for people who board LNG fuelled vessels in their line of duty, e.g. ship pilots, surveyors, government inspectors, customs officials, firemen, rescue services,... and on how to potentially enforce this by law.

Related to this recommendation; such a training could contain

- the hazards of LNG,
- the bunkering procedure,
- the measures to be taken in case of calamities.

A distinction could be made according to the vessels type (inland or seagoing).

Currently, the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (or STCW), sets qualification standards for masters, officers and watch personnel on seagoing merchant ships. (STCW was adopted in 1978 by conference at the IMO in London, and entered into force in 1984. The convention was significantly amended in 1995).

The following publications of are offered by SIGTTO as guidance to the industry and, as such, their adoption and implementation cannot be, and is not, mandatory. However, the standards are produced after consultation within the industry and are intended to represent the

default best practice operational training standard for officers serving onboard LNG carriers. The content is at least partly applicable for LNG fuelled vessels:

- LNG Shipping Suggested Competency Standards 2008 - Second Edition
- LNG and LPG Experience Matrix

  "The SIGTTO LNG/LPG Officer Experience Matrix offers transparent guidance to the assessment of the risk profile in relation to the officer complement by balancing thresholds of experience in ranks. The experience matrix considers a number of elements, including length of sea service, experience in rank, experience in LNG/LPG operations and training assessment."
- Crew Safety Standards and Training for Large LNG Carriers

  "This document has been prepared primarily for the guidance of ship owners and operators who may be entering LNG ship operation for the first time. It is also of use to existing LNG operators who are training new crews due to expansion. It highlights the salient statutory requirements for the training of LNG tanker crews and the provisions of the STCW, as it applies to gas tankers. It outlines the publications which are recommended for carriage on board all LNG tankers. It also provides advice on the application of the International Safety Management Code to the training and management of tanker crews. In all these matters, it draws heavily on the experience of SIGTTO member companies that have extensive operating experience with this class of vessel. Hence, it may be considered, as a guide to current best industry practice."

2.5 Ship based activities (inland shipping)

This section gives an overview of the regulatory framework for inland vessels and the available standards. At the moment there are some exceptions to the regulatory framework which are addressed in this section.

In Europe two large organizations have come up with technical rules regarding shipping on inland waterways; the Central Commission for the Navigation of the Rhine (CCNR) and the United Nations Economic Commission for Europe (UNECE).

It has to be noted that in Belgium inland vessels can have limited permission to not only sail on inland waterways but also in the Belgian seawaters. This is regulated through the Royal Decree (KB) of 8 March 2007 (Koninklijk besluit betreffende binnenschepen die ook voor niet-internationale zeereizen worden gebruikt) which states the conditions to be fulfilled for an inland vessel to be allowed in seawaters (e.g. sailing no further than 5 nautical miles away from the coast, and meeting certain requirements for vessel & crew). Before that date, inland vessels could receive permission to sail in the Belgian seawaters based on art. 3 of the Law of 5 June 1972 (Wet op de veiligheid van de vaartuigen) after the receipt of a certificate of vessel integrity (certificaat van deugdelijkheid) indicating the areas of the Belgian seawaters where the vessels are allowed to sail.

2.5.1 The Rhine vessel inspection regulations (RVIR)

The technical rules of the Central Commission for the Navigation of the Rhine (CCNR) are captured in the Rhine Vessel Inspection Regulations (RVIR). By virtue of its stringent requirements, factoring in cutting-edge technology, the Rhine inspection regulations, which is only legally applicable on the Rhine itself, has become Europe's technical reference base for the construction of new vessels, irrespective of whether they are intended for use on the Rhine or elsewhere. The regulation has been transposed into national regulations, and adopted by UNECE, and by the European Community (Directive 82/714/EC superseded by Directive 2006/87/EC).

In 2006, an EC Directive laid down the technical requirements for inland waterway vessels (Directive 2006/87/EC of the European Parliament), and this introduced full harmonization of the technical requirements for inland waterway vessels and Rhine regulatory provisions (with regard to category 3 of major waterways). On the basis of this equivalence, the CCNR has recognized the validity of Community certificates on the Rhine, while Rhine certificates have also been recognized on all EU waterways. In future, Rhine and EU regulations will evolve in tandem so as to remain identical.

This technical regulation is quite stringent but also flexible. The stringency is demonstrated by the fact that the requirements are the strictest and the most technically advanced. Its flexibility can be seen from the range of implementation options:

- transitory provisions, so as to take account of the vested rights of older vessels;
- temporary 3-year provisions: before adopting a new technical rule, the CCNR may test it out for 3 years, after which the provision will be either abandoned or definitively adopted;
- waivers: vessel operators may request the use of technology other than that laid down by regulation if comparable guarantees can be provided; the use of alternative technologies as a result of the waivers may thus open the door to regulatory amendments.

2.5.2 The international carriage of dangerous goods by inland waterways (ADN)

For the transport of dangerous goods on inland waterways the United Nations Economic Commission for Europe (UNECE) developed in 2000 the European agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN). The objective of the ADN is to:

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

The Regulations annexed to the ADN contain provisions concerning 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.

The inland shipping legislation, ADN, RVIR and European directive, contain specific information about the use of fuel in a shipping engine. In article 8.01 sub. 3 of the RVIR and the European directive 2006/87/EG states that the use of fuel with a flashpoint below 55°C is not allowed. Also the ADN prohibits the installation and utilization of engines that use a fuel with a flashpoint below 55°C. The flashpoint of LNG is around -181 °C, which means that the current legislation does not allow the use of LNG as a fuel for inland shipping.

In summary, from the above it can be seen that the regulatory framework for inland ships and barges in Europe is covered by the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), the Rhine Vessel Inspection Regulations (RVIR) and the European directive 2006/87/EG. The member states of the European Union transformed the European directive in country specific shipping rules, implying that LNG as a fuel for inland shipping cannot be used in any of the member states.

In Belgium, the ADN directive is transformed in national legislation via the Royal Decrees (Koninklijke Besluiten) of 31/01/2009 and 4/6/2011 and an addendum of 8/7/2011 (bijlage bij het KB van 4 juni 2011 tot aanpassing van de regelgeving betreffende het vervoer van de gevaarlijke goederen over de binnenwateren aan de wetenschappelijke en technische vooruitgang).

In “Tabel A” of this addendum, a list of substances is mentioned specifying the conditions of transportation via inland waterways for each of the substances. According to this list, it is prohibited to transport LNG as cargo (UN number 1972) over the inland waterways.

2.5.3 Construction requirements for inland tankers

Chapter 9.3 of the addendum of 8/7/2011 to the Royal Decrees (Koninklijke Besluiten) of 31/01/2009 and 4/6/2011 is concerned with construction requirements for tanker ships (defined as ships built to transport substances in cargo tanks). More specifically, so-called type G vessels are defined as tankships destined to transport pressurized or cooled gases, construction requirements 9.3.1.0 to 9.3.1.99 are applicable to these vessels. Specifically, under 9.3.1.8 it is stated that this type of tanker ship has to be built under the supervision of and the rules of a class society.

2.5.4 Current situation for inland shipping

LNG as cargo:

The ADN legislation and its Belgian implementation thus prohibit the transport of LNG as cargo over inland waterways. Eventually, this issue has to be resolved on a European and multilateral level.

LNG as fuel:

The ADN legislation does only apply to inland ships that are certified for the transport of dangerous goods by inland waterways. Ferries and other ships that do not transport dangerous goods do not have to obey to the ADN legislation.

Despite the fact that the current European legislation prohibits the use of LNG as a fuel there are already inland ships inside the European Union that are using LNG as a fuel. In the

Netherlands the first dual fuel inland bunker vessel started to use LNG as a fuel since November 2011. To accomplish the transformation to a LNG fuelled ship and allow it on national waters the Dutch allowed a temporary exemption through UNECE / CCNR. This implies that the vessel that obtained the exemption can sail in all EU countries

This temporary exemption is allowed because of the waiver principle in the RVIR that gives ship-owners and -builders the opportunity to develop alternative equivalent arrangements. (The RVIR states that vessel operators may request the use of technology other than that laid down by regulation if it can provide comparable guarantees). To start the discussion of an alternative arrangement a member state should presented a proposal for a recommendation in which the alternative arrangement is described. The proposal must demonstrate that the alternative arrangement is at least as safe as the original in the RVIR. In the Dutch example the safety of the LNG propulsion system was demonstrated through a hazard identification (HAZID) session organised by a classification society.

In the 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 on deck:

"The supply pressure from the delivery tanker is likely to exceed the design pressure of the storage tank. The main safeguard is the installation of two independent level gauges with automatic closure of the LNG supply valve on deck on high-high level of either of the level gauges on the tank.

The bunkering system that was proposed at the HAZID was manual, with the vessel's operator in attendance at all times during bunkering to adjust the tank pressure and filling valves. The system will shut down on various fault conditions including high-high tank level and pressure as well as ship blackout. Providing the ships operator is adequately trained and understands the hazards then these safeguards were considered to provide an acceptable level of safety.

Port and Stbd. bunkering manifolds are located at least 2m from the ship side. LNG bunkering manifolds are normally at the ship side and any leakage will be close to the ship side rather than directly on deck. This issue was not resolved and was left open.

In the follow up of this HAZID an automated bunkering procedure was proposed, in which operator supervision and intervention is still required, but some tasks are now controlled by the automation system. The most important ones are maintaining stable pressure in the tank and the purging of the bunkering lines. The revised plan and procedure are subject to plan approval and do not affect this approval in principle."

(extract from Report No. ROT/11.M.0080 Issue 2, dated May 23rd 2011, MTS Argonon HAZARD IDENTIFICATION STUDY, by P. A. Stanney, for Lloyd's Register)

2.5.5 Recommendations for inland shipping

The Central Commission for Navigation on the Rhine (CCNR), which is the responsible organization of the RVIR, met during a plenary session in autumn 2011 to discuss the use of

LNG in inland shipping. During this session the CCNR gave a positive advice to start the process of developing new legislation and standards to allow LNG as fuel. The responsible organization of the ADN, The United Nations Economic Commission for Europe (UNECE), discussed the use of LNG as a fuel in January 2012. However, both organizations have not updated technical guidelines yet. (As mentioned in section 2.5.4, for the vessel Argonon, the Dutch allowed a temporary exemption through UNECE / CCNR).

To create a possible market for LNG propulsion of inland vessels, European regulations need to be adapted to allow shipping fuels with flashpoints lower than 55°C. Before this can be accomplished the European legislations must be extended with additional safety rules for the application of LNG propulsion systems.

In previous paragraphs it has been established that currently, using LNG as fuel for inland ships is prohibited by European directive 2006/87/EG and the ADN. Eventually, this has to be resolved on a European and multilateral level.

Furthermore, as stated in Section 2.5.2 also the transportation of LNG as cargo currently is prohibited over inland waterways by the Royal Decrees (Koninklijke Besluiten) of 31/01/2009 and 4/6/2011 and an addendum of 8/7/2011 (which is the European directive 2006/87/EG and the ADN).

⇒ **Recommendation B1**: Actively pursue an expeditious change of the EU regulations, in order to allow shipping fuels with flashpoints lower than 55°C to be used for inland vessels, guaranteeing involvement of Belgian/Flemish stakeholders in this process.

⇒ **Recommendation B2**: Actively pursue an expeditious change of the EU regulations, in order to make possible the transport of LNG as cargo on inland waterways, guaranteeing involvement of Belgian/Flemish stakeholders in this process.

In the meantime, the Flemish and/or Belgian legislative bodies can only proceed by using temporary exemptions.

⇒ **Recommendation B3**: Consider to draft a frame for temporary exemptions or derogations, e.g. inspired by the Dutch example (By the Federal authorities, department mobility and transport, in consultation with UNECE & CCNR).

Competencies of crew & other stakeholders:

The requirements for obtaining a “Vaarbewijs” are general and seem to cover all types of inland ships. Typical general requirements are knowledge about navigation and boating regulations, basic technical knowledge about the vessels, its engines and emergency procedures … No exclusions are made for LNG fuelled ships, so one could assume that the current legislation is sufficient.

⇒ **Recommendation B4**: Investigate the necessity to adapt the requirements for obtaining a "vaarbewijs" in case of LNG fuelled ships (described in *art. N4 van het KB van 23 december 1998 betreffende het verkrijgen van vaarbewijzen voor het besturen van binnenvaartuigen bestemd voor het goederen- en personenvervoer*)

Related to the competencies and training of people who board LNG fuelled vessels in their line of duty, e.g. ship pilots, surveyors, government inspectors, customs officials, firemen, rescue services, reference is made to recommendation C1.

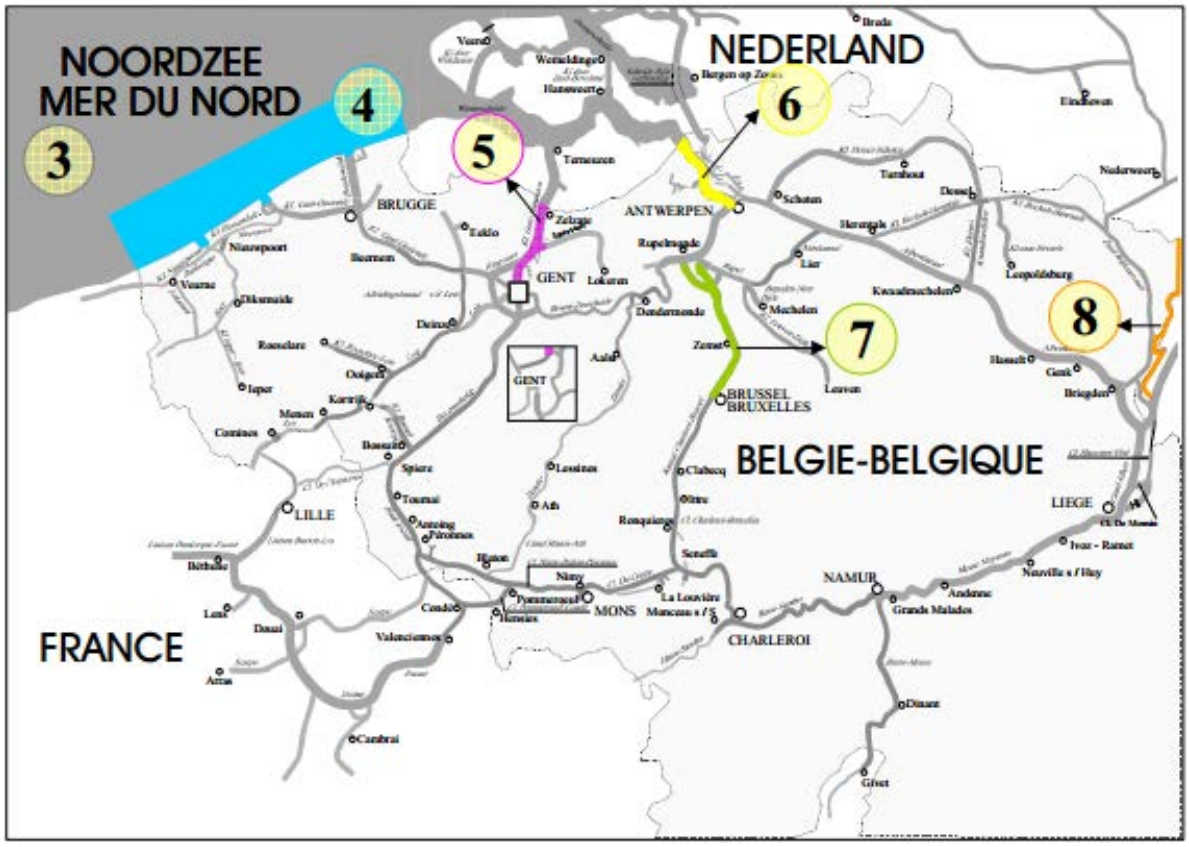
Necessary requirements for crew of inland vessels transporting dangerous substances are regulated in ADN, and thus in the derived Royal Decrees (Koninklijke Besluiten) of 31/01/2009 and 4/6/2011 and the addendum of 8/7/2011. Specifically, chapter 8.2 of the addendum is concerned with this.

2.6 Specific regulations for the Belgian waterways and the access to the Flemish ports

Next to the internationally applicable regulations, a list of local regulations exists, either applicable to a specific waterway or more generally applicable to all Belgian waterways. The following list gives an overview of these local regulations.

Generally applicable:
- Algemeen Reglement der Scheepvaartwegen van het Koninkrijk
- Algemeen Politiereglement voor de Scheepvaart op de Binnenwateren

Locally applicable:
- Politiereglement van de Beneden-Zeeschelde
- Scheepvaartreglement van de Beneden-Zeeschelde
- Politie en scheepvaartreglement der Belgische territoriale zee, kusthavens en stranden
- Scheepvaartreglement voor het kanaal van Gent naar Terneuzen
- Scheepvaartreglement voor het kanaal Brussel – schelde
- Scheldereglement
- Reglement betreffende het zeekanaal van Brussel naar de Rupel en de haveninrichtingen van Brussel
- Scheepvaartreglement Gemeenschappelijke Maas
- Bemanningsvoorschriften (KB 9/3/2007)



	Waterweg	Reglement
3	Volle zee en de wateren die daarmee in verbinding staan	Internationale bepalingen ter voorkoming van aanvaringen op zee
4	Belgische territoriale zee, kusthavens en stranden	Politie- en scheepvaartreglement voor de Belgische territoriale zee, kusthavens en stranden
5	Kanaal Gent-Terneuzen	Scheepvaartreglement voor het kanaal van Gent naar Terneuzen
6a	Beneden-Zeeschelde	Politiereglement van de Beneden-Zeeschelde
6b		Scheepvaartreglement van de Beneden-Zeeschelde
7	Kanaal Brussel-Schelde	Reglement betreffende het zeekanaal van Brussel naar de Rupel en de haveninrichtingen van Brussel
8	Gemeenschappelijke Maas	Scheepvaartreglement Gemeenschappelijke Maas

Figure 3 Belgian waterways & applicable regulations

LNG is not mentioned as such in these local regulations. But in these regulations, substances mentioned in chapter 19 of the IGC-code (The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) are considered as dangerous goods. Since liquid natural gas is mentioned in the IGC-code as such, one can conclude that the regulations concerning dangerous goods are relevant for LNG.

Below we will address the relevance of the regulations in the handling/carrying of LNG.

'Algemeen Reglement der Scheepvaartwegen van het Koninkrijk' - (KB van 15 oktober 1935)

These general rules for Belgian waterways do not contain specific additional rules relevant for dangerous goods. The only reference to the transportation of dangerous goods is made in Article 8§ 6, which states that if the vessel is used for the transportation of dangerous goods, the captain has to possess the required certificate.

'Politie- en scheepvaartreglement voor de Belgische territoriale zee, kusthavens en stranden' – (KB van 4 augustus 1981)

This regulation contains police- and shipping rules for the Belgian territorial sea, coastal ports and beaches. It describes the necessary lights and signs (Article 15§2) for inland vessels carrying dangerous goods. Furthermore an individual chapter (chapter 3) is dedicated to the specific provisions necessary for ships carrying dangerous or polluting substances. Rules of reporting of specific information to the harbor master's office and to the Vessel Traffic Service Scheldemonden before entering or leaving the port are mentioned here (Article 21 to 25). An important remark made here is that a vessel which has carried dangerous/polluting goods but which doesn't yet possess a declaration from the competent authority or recognized expert that confirms that the vessel is free of dangerous/polluting goods is concerned equal to a vessel carrying these goods. Furthermore, Article 26 gives a list of responsibilities for the captain of the vessel carrying dangerous goods (§1), such as compliance with the IMO Gas Carrier Code, SOLAS, continuous radio-telephone connection (*marifoonverbinding*) and responsibilities specific for the captain of a sea vessel carrying liquefied gasses in bulk included in the IMO Gas Carrier Code (§2), such as sufficient crew members on board to safely maneuvering the vessel, no cleaning or degassing of the tanks without permission, compliance with the IMO Gas Carrier Code. Also rules for announcement of incidents or unfavorable circumstances are described in this chapter (Article 27).

'Scheldereglement'

No specific rules are set for transportation of dangerous goods in the regulations specific for the river Scheldt. More general rules about ship pilots and the use of ship pilot services are mentioned here.

'Scheepvaartreglement Westerschelde 1990'

Specific requirements for vessels sailing on the Westerschelde River are described in this regulation. Specific lights and signs for sea vessels carrying dangerous goods are mentioned (Article 31§5), apart from the general required lights and signs. For inland vessels Article 31§6 is relevant, also indicating specific lights and signs required for transportation of certain flammable substances. Furthermore, article 51a makes clear which information has to be delivered by sea vessels transporting dangerous goods.

'Politiereglement en Scheepvaartreglement van de Beneden-Zeeschelde'

For the part of the river Scheldt named 'Beneden-Zeeschelde', specific police regulations and shipping rules exist. The shipping rules do not contain specific requirements concerning the transportation of dangerous goods or the transportation of substances in bulk; they contain more general requirements such as traffic rules for shipping and the general requirements for signs and lights on ships.
The police regulations do contain relevant information. Chapter 4 contains requirements applicable to ships carrying dangerous or polluting goods. Differences are made between requirements for sea vessels and requirements for all types of vessels. Rules are set concerning the announcement of all the relevant information to the harbormaster (Articles 27-28) and to the 'Vessel Traffic Service Scheldemonden' (Article 29). Furthermore, some responsibilities of the captain of a sea vessel are mentioned, such as the compliance with the IMDG code and with SOLAS, the use of the necessary signs, the use of checklists (Article 31). Furthermore, Article 31§1 sets specific requirements for sea vessels carrying liquefied gases in bulk, so relevant for LNG. These requirements describe for example the necessity of a sufficient amount of crew members on the vessel to safely maneuver the sea vessel, the prohibition of cleaning or degassing of the vessel without permission, compliance with the IMO Gas Carrier Code.

An explicit requirement is made in relation to the weather conditions, stating that departure is prohibited and sailing has to be interrupted as much as possible when the visibility is (less) than 2000 m. Article 33, relevant for all vessels transporting dangerous goods, describes the prohibition of anchoring or mooring in a specific part of the Beneden-Zeeschelde, Article 34 describes the regulations concerning lights and signs, comparable to the requirements set in the *'Scheepvaartreglement Westerschelde 1990'* and in *'Politie- en scheepvaartreglement voor de Belgische territoriale zee, kusthavens en stranden'.* Also obligations for the operators of loading and unloading stations are described, stating that the responsible of the station has to inform the responsible police department with the relevant information of the vessel carrying the dangerous goods and that it's prohibited to load or offer dangerous goods for transport without first supplying the captain with the relevant information.

'Scheepvaart reglement voor het kanaal Gent-Terneuzen' – (KB van 23 september 1992)

Most of the relevant regulations here are again related to the supply of the necessary information to different parties when transporting dangerous goods over the Ghent-Terneuzen canal and the necessary lights and signs on the ship. Furthermore Article 12 states that ships carrying dangerous goods can't sail within a distance of 50m when passing each other.

Furthermore, the Dutch Ministry of Infrastructure and the Environment, Rijkswaterstaat, was contacted to discuss the possibilities or limitations of the future passage of vessels with LNG through the Terneuzen lock complex. They have answered as follows:

Wij hebben in reactie op een vraag van […] al eens gekeken. Voor de E[xterne]V[eiligheids] risico's hebben wij aangegeven dat het vooralsnog niet relevant is (ten eerste is de kans op lekvaren van de LNG tank erg klein / verwaarloosbaar en daarnaast wordt LNG ingedeeld in de stofcategorie GF0 waarvan de risico's voor EV transport verwaarloosd worden)

So, currently, there are no limitations for the locks of Terneuzen..

2.6.1 General nautical regulations with procedures for LNG traffic

Next to the abovementioned local regulations, there are the general nautical regulations with procedures for LNG traffic that are defined and maintained by the following institutions:

- DAB Loodswezen (Flemish government agency for ship piloting)
- MRCC – Ostend (Maritime Rescue & Coordination Centre)
- MBZ (Maatschappij der Brugse Zeevaartinrichtingen: Zeebrugge Port Authorities)

These procedures contain the regulations valid for LNG traffic in the port of Zeebrugge (to and from the Zeebrugge terminal). There are two sets of regulations, one for large LNG carries (ships with a hull length exceeding 200m) and one for small LNG vessels (hull length < 200m).

The procedures prescribe:

- Nautical regulations upon arrival:
    - Pilot boarding
    - Route
    - Permission to enter the port
    - Reports
    - Shipping regulations
    - Police patrol
- Stay in the port of Zeebrugge
- Nautical regulations upon departure:
    - Permission to leave the port
    - Reports
    - Route and pilot disembarking
    - Shipping regulations
    - Police patrol

The rules contain:

- Specifications regarding the simultaneous presence of other gas tankers or ammunition carrying vessels
- Specifications concerning the availability of tugs and their equipment
- Specifications concerning the under-keel clearance of the LNG tanker
- Specifications concerning the meteorological conditions:
    - Wind force
    - Visibility
    - Tidal currents

2.6.2 Dutch – Flemish cooperation for the Westerscheldt

The estuary of the Scheldt is located partly on Dutch territory and partly on Belgian (Flemish) territory. Both countries have signed several treaties and cooperation agreements in order to efficiently manage all aspects of traffic on the Westerschelde together, through the joint "Vlaams-Nederlandse Scheldecommissie (VNSC)". This is of relevance for the ports of Antwerp and Ghent, since the access route to these ports passes through the Dutch territory.

The treaty concerning the common nautical management (het Verdrag inzake het Gemeenschappelijk Nautisch Beheer, 2005) sets the scene for the common traffic management. The treaty ensures safe and smooth traffic in the Scheldt estuary, with special attention for an integrated traffic chain approach for all traffic from sea to berth and vice versa.

The treaty contains agreements to monitor the external safety along the Westerscheldt. More specifically it concerns requirements to:

- keep the risks of transport of dangerous substances at an acceptable level. This means that the risks are analysed for all spatial-economical developments and evaluated against existing risk normation (if any)
- the authorities' responsibles will aim for prevention of the risks at the source
- the authorities' responsibles will follow up developments with regard to transport of dangerous substances and take appropriate action

In respect to the developments in relation to LNG, the impact on safety should be monitored according to the above treaty. In relation to the existing risk criteria, it can be mentioned that Flanders has no specific risk criteria for the transport of dangerous substances. The Dutch risk criteria defines that the 10^{-6} risk contour should never attain the shore. This is defined in Basisnet (frame for transport of dangerous substances for road, rail and water). The legal frame for Basisnet Water is defined in the Law Transport Dangerous Substances (Wet Vervoer Gevaarlijke Stoffen).

In Basisnet Water, the Westerscheldt river is defined as seagoing route. The table below summarizes the requirements along the Westerscheldt

Table 2 Requirements with regard to external safety on the Westerscheldt and its shores

	Related to traffic on the water	
	Individual risk (10^{-6} max)	**Group risk**
Westerscheldt estuary	On the shore line	Not applicable, guidance on individual risk is sufficient

In order to monitor the risks on the Westerscheldt river a set of studies have been drafted. The most important ones are mentioned underneath:

- **Basic study 2003:** quantitative risk analysis performed by DNV in 2003 for the Province of Zeeland "Quantitative Risk Assessment (Wester)Schelde river", in order to assess the risk of transport of dangerous goods by (sea) transport on the Westerscheldt river.
- **Forecast study 2004:** quantitative risk analysis performed by DNV in 2004 for ProSes "QRA future transport of dangerous goods on the Westerscheldt river", in order to assess the risks of the dangerous goods transport on the Westerscheldt river in 2010, 2020 and 2030 based on the previous model.
- **Actualisation study 2011:** quantitative risk analysis performed by DNV in 2011 for VNSC (Flemish/Dutch Scheldt Commission) "QRA future transport of dangerous goods on the Westerscheldt river", in order to assess the risks of the dangerous goods transport on the Westerscheldt river in 2015 en 2030 based on the previous model and new developments/insights.

The Actualisation study has shown that traffic on the Westerscheldt involving hazardous substances can still grow without this having as effect that the 10^{-6} risk contour will attain the shore. In this report an overview is given of the location specific risks (for 2015 and 2030) at the locations Hansweert, Breskens, Oostgat, Terneuzen en Vlissingen. The highest location specific risk is calculated at Oostgat (3.04E-07 and 4.36E-07 for respectively 2015 and 2030), followed by Vlissingen (2.94E-07 and 2.93E-07 for 2015 en 2030). The risks at Hansweert and Terneuzen are more or less at the same level and between 1.5 and 2E-07. The level of the location specific risk at Breskens is much lower. On can conclude that this would mean that risk can still increase with a factor 2,3 before being critical and having the 10^{-6} risk contour attaining the shore at Oostgat.

Transport of dangerous goods on the Westerscheldt is dominated by the category of 'flammable gases'. This leads to the conclusion that this category is mainly responsible for the risks rather than the transport of toxic substances (mainly ammonia).

Increased transport of LNG (carriers and feeders and ship LNG fuel tanks) will influence the risks on the Westerscheldt river. It should be analyzed to what extent the increased transport

of LNG carriers and LNG fuelled ships will have an impact on the safety risk on the Westerscheldt river.

⇒ **Recommendation E1**: In respect to the treaty concerning the common nautical management (het Verdrag inzake het Gemeenschappelijk Nautisch Beheer, 2005) and its specific requirements 'to keep the risks of transport of dangerous substances at an acceptable level and to follow up developments with regard to transport of dangerous substances' it should be noted that a revision of the Actualisation study 2011 is to be performed. This is to be addressed by the responsibles of Flemish Authorities' department MOW in the VNSC.

2.6.3 Recommendations for vessels holding LNG as fuel

Looking at the situation of LNG as propulsion fuel, stakeholder platform discussions such as the European Seaports Organisation (ESPO) Workshop on LNG Bunkering indicate that "it is not desirable to apply the stringent safety measures for large scale LNG import vessels to ships running on LNG fuel […]. The safety rules and procedures for those ships need to be carefully considered in order to make LNG bunkering in ports both safe and realistic." (ESPO News 18.06 - 20/04/2012- ESPO Workshop on LNG Bunkering).

In the current regulatory framework, LNG as fuel is not explicitly considered. This void could lead to a possible conflict if one the one hand vessels holding LNG as cargo are bound by a set of stringent regulations regarding hazardous cargo, while on the other hand LNG fuelled ships are not subjected to specific regulations; even when it is possible that the amount of LNG held as fuel on some large vessels is equal to or larger than the amount of LNG as cargo.

To illustrate this point the following example is given: following the Police regulations for navigation on the Beneden-Zeeschelde, for an LNG carrier (vessel A), departure is prohibited and sailing has to be interrupted as much as possible when the visibility is less than 2000 m, since vessels A carries LNG as cargo and is thus considered as a vessel transporting hazardous substances. For an LNG fuelled vessel (vessel B) this would not be the case, even if the amount of LNG in the fuel tanks of vessel B could exceed the amount of the LNG in the cargo tanks of vessel A.

⇒ **Recommendation E2**: Establish a common point of view on the necessary/desired level of equivalence between vessels containing LNG as cargo and vessels only containing LNG as fuel, and further define specifications based on this decision. This decision should be made by the Federal authorities and the Flemish authorities together. This level of equivalence could be established following a risk based approach.

2.7 Unbundling of the gas and electricity market

Pipelines, transmission lines and power stations were in the past often controlled by a single company, a so called vertically integrated company[2]. This made it hard for small businesses to get a foothold and for cross-border networks to develop. Since July 2007, all EU households are free to select a gas and electricity supplier, but their choice was still often limited by one company's market dominance within their region.

On the 21st of April 2009, the European Parliament adopted the so called 3rd Energy Package. One of the most important issues of the "3rd Energy Package" is "unbundling" - separating the operation of gas pipelines and electricity networks from the business of providing gas or generating power. This would mean for example that vertically integrated companies such as Électricité de France/ Gaz de France-Suez would not be able to simultaneously generate power and own the grid.

The regulation, being part of the 3rd Energy Package, has come into force on the 3rd of March 2011. This legislation needed to be adopted by the different Member States by the same date. In Belgium this legislation has been finally published in 2012 (Law of 8 January 2012, Belgian Publication Journal 11 January 2012).

The law of 8 January 2012 changes articles 8 to 8/6 of the Law of 12 April 1965 (Gaslaw). Through this changed legislation Belgium transposes the unbundling model via Ownership unbundling (In addition to legal unbundling, the holding company has to sell either its network activities or both its production and trade activities). Note that the existing text of articles 8 to 8/6 of the gaslaw – introduced by 2nd Energy Package - remain unchanged, even though Fluxys[3] is no longer a vertically integrated gas company. The new unbundling legislation exits in parallel with existing legislation. The new legislation is not only applicable for the transportation activities of Fluxys but will be applied in the same manner to storage and LNG activities.

In respect of article 15/1 of the Gaslaw, NV Fluxys and NV Fluxys LNG are responsible for the exploitation, the maintenance and the development of the transportation grid. By enforcement of article 8/1 of the gaslaw, NV Fluxys has been temporary appointed as responsible for managing the gas grid and the storage installation for gas, and the NV Fluxys LNG for managing the LNG installations.

The impact of the unbundling of the Energy market has a potential impact on the LNG bunkermarket. While in the traditional oil bunkermarket, companies can either store oil and get paid for storage, or either buy and sell oil (become owner of the molecules) it is unclear whether these same two possibilities would exist for LNG bunkering given the provisions of

[2] Vertically integrated companies are companies which are active in one or more stadia of the production process. In the case of the Energy market this means a company active in at least the transportation and distribution or distribution and production of gas delivery. Production and delivery can remain integrated.
[3] Distrigas has been split into two companies: Fluxys responsible for transport infrastructure, and Distrigas for trading and import of gas (a commercial company).

the 3rd Energy Package. In addition it needs to be clarified how to deal with bunker barges, more specific whether gas producers can own bunker vessels.

One could assume that LNG for bunkering purposes would not be covered by the 3rd Energy Package-legislation, as this legislative framework seems intended for fuel for domestic or industrial consumption, rather than as fuel for vessels. Furthermore, definitions of transmission and distribution only relate to pipelines and not to ships. In addition it can be argued that the current developments in LNG shipping are not considered to be in conflict with the open market principle.

Eitherway, a clear answer needs to be provided, on European level by DG Energy and Transport, and on Belgian level by CREG[4] and Federal Government Department Economy (FOD Economie, K.M.O., Middenstand en Energie / FPS Economy, SMEs, Self-Employed and Energy).

⇒ **Recommendation A6**: Actively pursue the CREG and the Federal Government Department Economy to provide a clear answer, validated by the European DG Energy and Transport, on whether or not LNG for bunkering purposes is covered by the 3rd Energy Package-legislation.

2.8 Overview of the recommendations for the completion/adaptation of the regulatory framework

2.8.1 Overview of recommendations for onshore activities

⇒ **Recommendation A1**: LNG is not mentioned explicitly in Vlarem II as shipping fuel. It is recommended to start the process of incorporating the necessary requirements in Vlarem II; for example as an extra "subafdeling" under 5.16.4. Necessary requirements would for instance be fixed safety distances, technical requirements for materials & installations, fire fighting requirements, permits & legal compliance checks. This legislation has to be prepared on a regional level and more explicitly by the Flemish Government Department of Environment, Nature and Energy, division Environmental Permitting. (see §2.1.2)

⇒ **Recommendation A2**: Ensure alignment with international standards available (and under development) when developing the regulations under Rec A1. Reference can be made to the Dutch PGS 33[5] (publicatiereeks gevaarlijk stoffen). (see §2.1.2)

[4] Commission for the Regulation of Electricity and Gas

[5] The draft of PGS (Publicatiereeks gevaarlijke stoffen: publication series dangerous substances) 33 Natural Gas – delivery facilities for liquefied natural gas (LNG) for motorized verhicles ("PGS 33 Aardgas – afleverinstallaties van vloeibaar aardgas (LNG) voor motorvoertuigen") is published and available for public consultation through
http://content.publicatiereeksgevaarlijkestoffen.nl/documents/other/PGS33_Concept_v0.1_web.pdf
It is expected that the final guideline will be published by the end of 2012.

⇒ **Recommendation A3**: Initiate a process to ensure early involvement and cooperation between local and regional authorities, port authorities, fire brigades and other stakeholders to get an idea on the suitability of locations for onshore LNG bunkering facilities and to guarantee a smooth permitting process. (see §2.1.2)

⇒ **Recommendation A4:** Consider starting a public engagement process to inform the public and promote the (environmental) benefits of LNG compared to conventional fuels and to demonstrate that risks of LNG are well controlled. This can be a joint effort of federal, regional, local authorities and the harbors. (see §2.1.2)

⇒ **Recommendation A5:** Even though the activities of LNG transportation by truck are fully covered by the existing ADR framework, Fluxys' practice to impose extra requirements + the truck approval procedure could serve as example for procedures/requirements the ports could impose on future LNG bunkering trucks, to guarantee safe operations as well as full compatibility between the truck/trailer systems and the receiving infrastructure. (see §2.1.4)

⇒ **Recommendation A6**: Actively pursue the CREG and the Federal Government Department Economy to provide a clear answer, validated by the European DG Energy and Transport, on whether or not LNG for bunkering purposes is covered by the 3rd Energy Package-legislation. (see §2.7)

2.8.2 Overview of recommendations for ship based activities (inland shipping)

⇒ **Recommendation B1**: Actively pursue an expeditious change of the EU regulations, in order to allow shipping fuels with flashpoints lower than 55°C to be used for inland vessels, guaranteeing involvement of Belgian/Flemish stakeholders in this process. (see §2.5.5)

⇒ **Recommendation B2**: Actively pursue an expeditious change of the EU regulations, in order to make possible the transport of LNG as cargo on inland waterways, guaranteeing involvement of Belgian/Flemish stakeholders in this process. (see §2.5.5)

⇒ **Recommendation B3**: Consider to draft a frame for temporary exemptions or derogations, e.g. inspired by the Dutch example (By the Federal authorities, department mobility and transport, in consultation with UNECE & CCNR). (see §2.5.5)

⇒ **Recommendation B4**: Investigate the necessity to adapt the requirements for obtaining a "vaarbewijs" in case of LNG fuelled ships (described in *art. N4 van het KB van 23 december 1998 betreffende het verkrijgen van vaarbewijzen voor het besturen van binnenvaartuigen bestemd voor het goederen- en personenvervoer*). (see §2.5.5)

2.8.3 Overview of recommendations for ship based activities (maritime based)

⇒ **Recommendation C1**: The use of LNG as shipping fuel will create new hazards compared to conventional fuels. Perform a training needs analysis for people who board LNG fuelled vessels in their line of duty, e.g. ship pilots, surveyors, government inspectors, customs officials, firemen, rescue services,... and on how to potentially enforce this by law. (see §2.4.7)

2.8.4 Overview of recommendations for port activities (excluding bunkering)

⇒ **Recommendation D1:** It is recommended to consider the LNG on board LNG bunker vessels navigating in the port generally in a similar way as other hazardous cargo transported in the port. In this way all regulations applicable to the transport of hazardous cargo in the ports will be applicable to these bunker vessels. (see §2.2.3.1)

⇒ **Recommendation D2**: Port authorities need to update their port by-laws, codices and general or municipal police decrees with specific aspects for LNG cargo vessels. (see §2.2.3.1)

⇒ **Recommendation D3**: Consider to explicitly describe the case of floating installations in Vlarem instead of only having it as an internal guideline. This has to be done on a regional level and more explicitly by the Flemish Government Department of Environment, Nature and Energy, division Environmental Permitting. (see §2.2.3.2)

2.8.5 Overview of recommendations for vessels holding LNG as fuel

⇒ **Recommendation E1**: In respect to the treaty concerning the common nautical management (het Verdrag inzake het Gemeenschappelijk Nautisch Beheer, 2005) and its specific requirements ‘to keep the risks of transport of dangerous substances at an acceptable level and to follow up developments with regard to transport of dangerous substances’ it should be noted that a revision of the Actualisation study 2011 is to be performed. This is to be addressed by the responsibles of Flemish Authorities’ department MOW in the VNSC. (see §2.6.2)

⇒ **Recommendation E2**: Establish a common point of view on the necessary/desired level of equivalence between vessels containing LNG as cargo and vessels only containing LNG as fuel, and further define specifications based on this decision. This decision should be made by the Federal authorities and the Flemish authorities together. This level of equivalence could be established following a risk based approach. (see §2.6.3)

2.8.6 Overview of recommendations related to bunkering

⇒ **Recommendation F1**: Develop regulations/procedures for truck to ship (TTS) bunkering. (see §2.3.5)

⇒ **Recommendation F2**: Develop regulations/procedures for ship to ship (STS) bunkering. (see §2.3.5)

⇒ **Recommendation F3**: Develop regulations/procedures for small scale LNG station to ship bunkering (ITPS: intermediary storage to ship via LNG pipeline). (see §2.3.5)

⇒ **Recommendation F4**: Develop regulations/procedures for simultaneous bunkering & cargo handling. (see §2.3.5)

⇒ **Recommendation F5**: Develop regulations/procedures for simultaneous bunkering & passenger embarking/debarking. (see §2.3.5)

⇒ **Recommendation F6**: Develop standards (NBN) and procedures (or amend current standards and procedures) for metering, measurement, fuel sampling & quality control. (see §2.3.5)

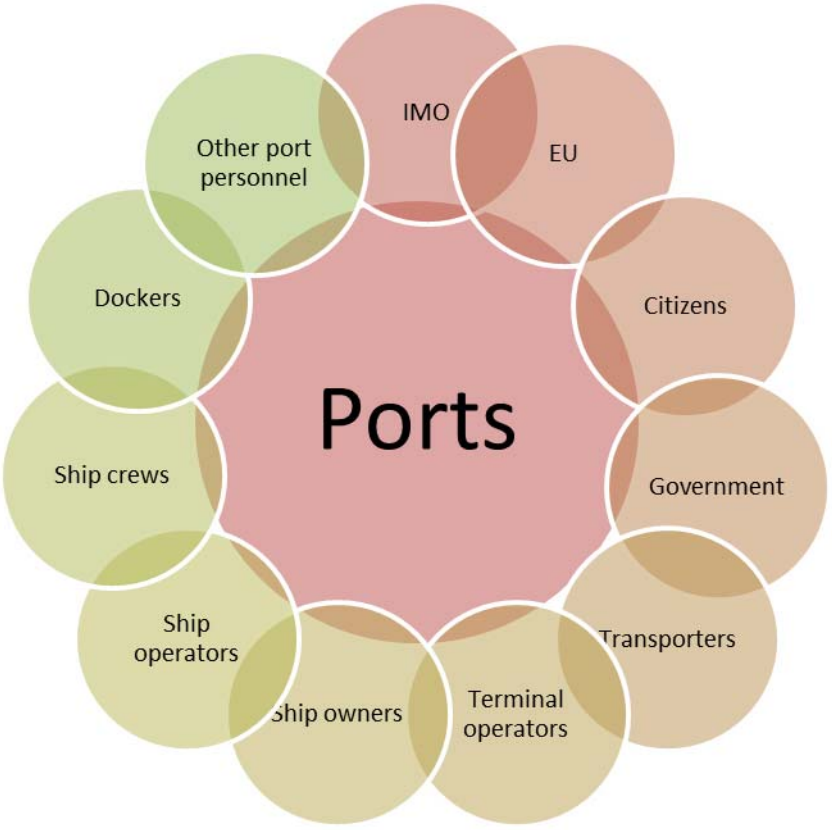
⇒ **Recommendation F7**: Initiate the process for accreditation/recognition of LNG bunkering companies valid in the Flemish seaports. Such an accreditation procedure should establish minimum safety and quality levels for the bunkering companies, and establish that non-compliance to the rules implies the loss of the accreditation and subsequently the denial of access to the ports. (see §2.3.5)

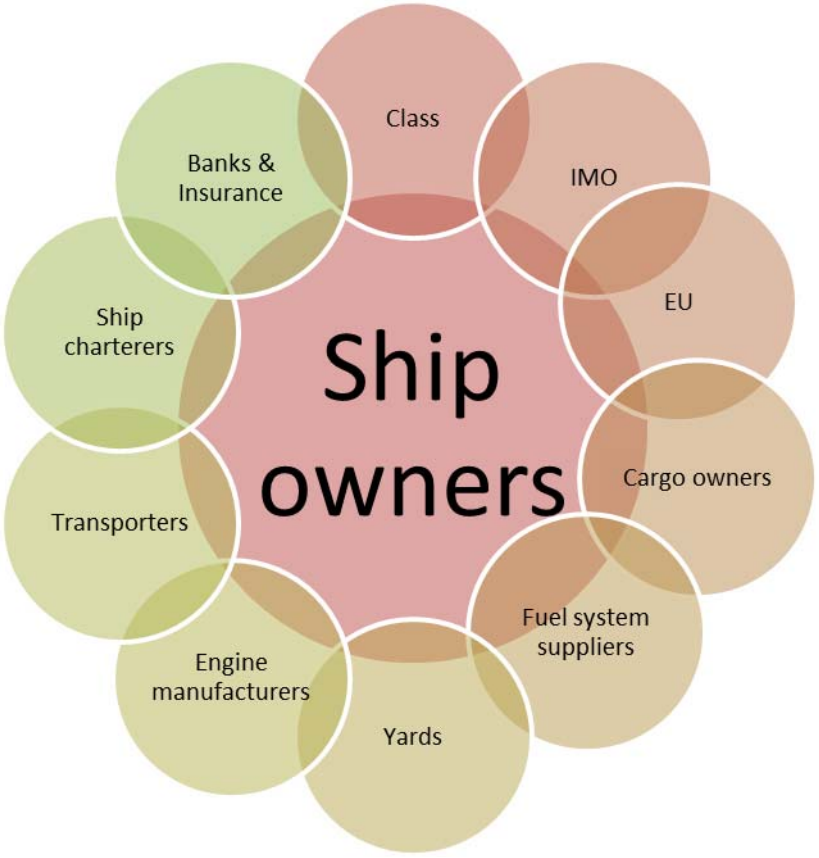
2.8.7 Project/process approach

2.8.7.1 Stakeholders for LNG bunkering in ports

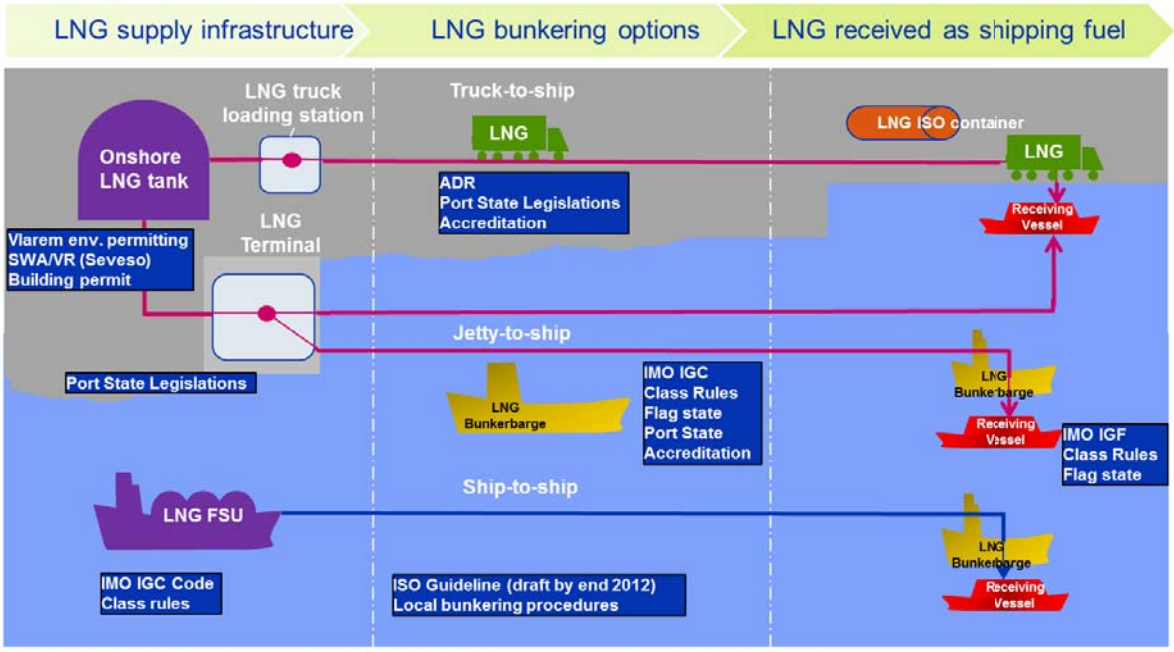
Each party foreseeing a future role in the supply chain of LNG as shipping fuel in the ports, has to establish a plan in order to prepare appropriately. The first step is to define the stakeholders; indicative examples are given below. This will set boundary conditions for the plan, through revealing the drivers & enablers, roadblocks & showstoppers.


Fuel owners
Banks & Insurance
Traders
Personnel
Asset owners
Transporters
Land owners
Authorities
Ports
Engineering companies


Ports
IMO
EU
Citizens
Government
Transporters
Terminal operators
Ship owners
Ship operators
Ship crews
Dockers
Other port personnel


Ship owners
Class
IMO
EU
Cargo owners
Fuel system suppliers
Yards
Engine manufacturers
Transporters
Ship charterers
Banks & Insurance

Below is a scheme illustrating the parties of interest in the LNG value chain & their major governing regulations:



2.8.7.2 Construction and operation of land installations

For the construction of land installations for the storage or handling of LNG, the following regulatory process steps have to be followed:

1. Application for an environmental permit:

- For a class 1 facility (storage of > 10 000 m^3 of natural gas; or facilities for the non-domestic filling of compressed or liquefied toxic, explosive or flammable gases) or a class 2 facility dependent of a public authority: application with the province (bestendige deputatie van de provincieraad);
- For a class 2 facility (storage of 1 000 m^3 - 10 000 m^3 of natural gas: application with the municipality (college van burgemeester en schepenen);
- For a class 3 facility (storage of < 1 000 m^3 of natural gas) : a notification (melding) has to be submitted to the municipality (college van burgemeester en schepenen.

If it concerns an installation for the above-ground storage of natural gas, in quantities exceeding 100 000 m^3; the applicant must add an environmental impact assessment to the application, or otherwise issue a duly motivated request to be relieved of this obligation.

If the permit capacity exceeds 50 tons of LNG, a notification to the Department Environment, Nature & Energy has to be submitted & the other requirements stated in the left half of Table 1 have to be fulfilled.

If the permit capacity exceeds 200 tons of LNG, a notification to the Department Environment, Nature & Energy has to be submitted as well as a safety report (SWA-VR) has to be submitted & the other requirements stated in the right half of Table 1 have to be fulfilled.

2. Application for a building permit:

The application for a building permit can be joint to the application for an environmental permit as explained in section §2.1.3.

For the operation of land installations for storage or handling of LNG in the ports, following aspects have to be addressed:

Zoning (land exclusion zones and control of ignition sources around the jetty) will be addressed in the permitting process, port authorities and fire brigades can further advise in the facility siting and e.g. impose traffic (exclusion) zones and truck movement procedures. Other aspects to take into account are site security & access control, and adequate training of personnel. For loading/unloading facilities, earthing requirements will be part of the operational procedures.

2.8.7.3 Construction and operation of LNG trucks

As explained in section § 2.1.4, technical (construction) requirements for LNG trucks are governed by the ADR, and moreover port authorities or terminal operators can impose extra requirements; a practice currently already in place for trucks loading at Fluxys' Zeebrugge terminal. The same holds for minimum (training) requirements for the truck drivers. Ports can further coordinate truck logistics by imposing general and/or zone-specific traffic rules, speed limits, dedicate parking places, prescribe certain routes and define time schedules.

Truck loading and truck to ship bunkering operations will require specific bunkering procedures, describing a.o.t. connection, pre-cooling, inertisation, venting, prevention against overfilling, disconnection.

2.8.7.4 Construction and operation of LNG feeder vessels, LNG bunker barges, LNG fuelled vessels

As amply described in sections 2.4 and 2.5, construction of all vessels will be subject to IGF and/or IGC code and supervised by a class society. Requirements for ship crews was also discussed in these paragraphs.

Next to technical requirements and requirements for the crew, bunkering requires comprehensive bunkering procedures. Certain aspects of bunkering are specific to the vessel and will thus be governed in the verification process of the class and be part of the ship's operating guidelines.

Other aspects with regard to bunkering will be port- or location-specific. Ports will most likely impose designated locations for bunkering, based on safety and security considerations and taking into account specific limitations linked to e.g. the port lay-out and the vessels' specifications such as size, navigation and mooring restrictions, and prescribe the use of and

requirements for tug boats. Port specific regulations could further limit the distance (minimum distance) and speed (maximum speed) of other nautical traffic in the proximity of the locations where bunkering takes place in order to limit the likelihood of collisions but also the relative movement (roll, pitch and yaw) between either the two bunkering vessels (in case of ship-to-ship bunkering) or the bunkering vessel and the jetty, due to waves generated by other vessels passing. Furthermore, ports can restrict bunkering operations in low visibility conditions, bad weather conditions and so on.

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