Natural gas: liquefied natural gas (LNG) delivery installations for ships

Bunkering ships (shore to ship)

Hazardous Substances Publication Series 33-2:2014 version 1.0

Foreword

This Publication Series provides guidance for companies who produce, transport, store or use hazardous substances and for authorities responsible for granting licences and monitoring these companies. Based on the current state of the art it gives a summary of regulations, requirements, criteria and conditions. This Publication Series is the reference framework for granting licences, drawing up general rules, monitoring companies and could be used for implementing your own corporate responsibilities. The Publication Series focuses on an integrated approach to occupational safety, environmental safety, transport safety and fire safety.

These guidelines are formulated such that should the case arise a company can choose other measures on an equivalence basis.

PGS 33-2 was drawn up by PGS team 33-2 including representatives from the government and business community. The contents of the publication were determined by the PGS Programme Council. This is formed of representatives from the authorities (the Association of Interprovincial Authorities (IPO), the Association of Dutch Municipalities (VNG), the Social Affairs and Employment Inspectorate (Inspectorate SZW), the Dutch Fire Service, the business community (VNO/NCW and MKB Nederland) and employees.

The PGS Programme Council states that this publication was produced by a careful and balanced process and agrees to the inclusion of this publication in the Hazardous Substances Publication Series.

More information on the PGS and the most recent publications can be found on: www.publicatiereeksgevaarlijkestoffen.nl.

A summary of the work field of the Publication Series also giving a list of relevant legislation and regulations and the stakeholders is included in the note 'Legal Context of the Hazardous Substances Publication Series' (*Juridische context Publicatiereeks Gevaarlijke Stoffen*). This can be downloaded from the website mentioned.

The chairman of the PGS Programme Council,

Gerrit J. van Tongeren
April 2014

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Summary

This publication provides guidelines for storing, loading and offloading LNG under safe working conditions and in an environmentally safe and fire-safe manner. The summary also gives instructions on how to handle units and regulations. Furthermore, the relationship with other legislation and regulations is also addressed at length.

In this PGS publication the regulations are shown numbered and in blue boxes (e.g. reg 4.2.1).

The introduction (clause 0) describes the reason for PGS publication and gives a summary of the relevant legislation and regulations and the government bodies involved in granting licenses and monitoring. There is also a brief discussion of the equivalence principle and the use of standards and guidelines. Clause 1 gives information on the purpose and application of this PGS.

Clause 2 describes the construction and design of the LNG delivery installation. Clause 3 sets out the requirements for the installation in operation (in service). Clause 4 covers inspection, maintenance, testing, registration and documentation. Safety measures, incidents and disasters are discussed in clauses 5 and 6.

Finally a number of Annexes are added, including a list of terms, bibliography, standards, description of relevant legislation and regulations and the composition of the PGS 33-1 team.

This publication provides guidelines for bunkering LNG from a ‘fixed’ installation to ships. The regulations in PGS 33-2 describe additional requirements to PGS 33-1. PGS 33-1 provides guidelines for designing safe LNG fuelling installation and for their safe management and maintenance.

0 Introduction

0.1 Reason for development of this PGS

Liquefied Natural Gas (LNG) is one of the emerging fuels in Europe. LNG is attractive as a motor fuel for different modes of transport, such as for road vehicles, boats and rail dependent vehicles. Natural gas and primarily LNG play a crucial part in improving the local air quality and the transition to more sustainable mobility. The construction of an LNG infrastructure lays the basis for driving and running on LNG and liquefied biomethane (LBM). There has now been a breakthrough in driving on natural gas on 'Compressed Natural Gas' (CNG) in the Netherlands. LNG, in addition to CNG, offers solutions mainly for applications for which a big action radius is required such as freight transport.

More sustainability is needed for all modes of transport. The Netherlands wants to invest heavily in sustainable climate-neutral fuels. LNG and CNG are the step towards clean sustainable biomethane in both compressed and liquefied form.

In the Netherlands LNG as a transport fuel has now become a fact. There are several suppliers marketing products for both filling stations and for vehicles/boats. Currently, PGS 33-1 is available for designing, constructing and managing LNG filling stations for road vehicles. This guideline, PGS 33-2, describes how to design, construct and manage LNG installations.

0.2 Relation with legislation and regulation

The majority of the requirements or regulations for the use of hazardous substances are laid down in legislation, whether or not based on European Directives or follow directly from European Regulations. The PGS publications aim to give the fullest possible description of the way in which companies can comply with the requirements resulting from legislation and regulations.

Annex C gives a list of relevant legislation and regulations that are important for designing, constructing and managing LNG delivery installations.

These are broken down into the following categories:

General:
- Environmental Licensing (General Provisions) Act (Wet algemene bepalingen omgevingsrecht – Wabo)
- Activities Decree (Activiteitenbesluit)

Requirements for technical integrity:
- Pressure Equipment (Commodities Act) Decree (Warenwetbesluit drukapparatuur – WBDA)
- Legislation on explosive atmospheres (ATEX 95)

Operational management:

- Working Conditions Act (Arbeidsomstandighedenwet)
- Working Conditions Decree (Arbeidsomstandighedenbesluit)
- Risk inventory and evaluation (Risico inventarisatie en evaluatie – RI&E)
- Pressure Equipment (Commodities Act) Decree (Warenwetbesluit drukapparatuur – WBDA)
- Legislation on explosive atmospheres (ATEX 137)
- Major Accidents (Risks) Decree 1999 (Brzo '99)
- Safety Regions/In-house Fire Service Act (Wet veiligheidsregio's/Bedrijfsbrandweer) (Inter)national standards for operational management

Requirements for spatial context:

- External safety policy and the Spatial Planning Act (Wet ruimtelijke ordening – WRO)
- External Safety (Facilitys) Decree (Besluit externe veiligheid inrichtingen – BEVI)

Transport:

- Inland waterways regulation (Binnenvaartregeling): regulation implementing the Inland Waterways Act (Binnenvaartwet) and the Inland Waterways Decree (Binnenvaartbesluit) that took effect on 30 December 2008 in order to implement European Directive no. 2006/87/EC;
- The Regulation on transport of hazardous substance by land (Regeling vervoer over land van gevaarlijke stoffen – VLG) contains specific regulations for the transport of hazardous substances by road. Annex 1 to this regulation contains the international rules for the transport of hazardous substances, which come from the ADR convention;
- European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN).

In 2010 a start was made with the development of standards for LNG and CNG fuelling installations (filling stations) on an international level, respectively ISO/DIS 16924 and ISO/DIS 16923. The development of this national PGS publication serves as input for the facility of the international agreements and vice versa.

0.3 Government bodies involved

0.3.1 Municipality and province

For most facilitys the municipality is the competent authority for the Environmental Licensing (General Provisions) Act (Wabo). The provinces are the competent authority for most bigger and often more hazardous companies or companies with more severe environmental pollution. It may be decided to use a regional execution service (Regionale uitvoeringsdienst – RUD) to perform the tasks of the competent authority.

0.3.2 Ministry of I&M / Ministry of EZ

In exceptional cases the Minister of Infrastructure and Environment (I&M) (mainly for defence sites) or the Minister of Economic Affairs (EZ) (for mining activities and for oil and gas extraction) is the competent authority as regards the environmental licence.

0.3.3 Fire service/safety region

With the arrival of the safety regions, the municipal and regional fire brigades are disappearing and, as part of the fire service, are going into these safety regions:

- firstly because of its statutory advisory task in a situation where this involves a company that falls under the '99 Major Accidents (Risks) Decree (Brzo '99) and/or the External Safety (Facilitys) Decree (Bevi);
- secondly, the security region (formerly the municipal fire service) may be consulted by the competent authority when determining requirements for fire prevention and fire suppression provisions that may be laid down in environmental licences.

In addition, the fire service is also involved as the emergency service that shall have to act in case of incidents. To be able to act, a number of measures intended for the fire service shall be taken (see for this clauses 5 and 6). Finally the fire service will have to prepare for action and so shall be informed of the situation..

0.3.4 Department of Public Works and the District Water Boards

The Minister of Infrastructure and Environment is the competent body for the Water Act. This covers among other things the coastal waters, the Waddenzee, Eems and Dollard, the IJsselmeer, the Meuse, the Rhine, the IJssel and the Zeeland waters. In practice the Department of Public Works (RWS) is the party who issues the Water Act licence on behalf of the Minister

Waterway management is the government's responsibility in order to make and keep shipping possible, in accordance with the waterway function assigned to the water in question. In the Water Act, waterway management is considered as one of the elements of water system management.

The District Water Boards are the competent body for the other waters that do not belong to the national waters.

0.3.5 National Institute of Public Health and the Environment (RIVM)

The National Institute of Public Health and the Environment carries out research, advises and supports the government with policy. Its clients include the Ministry of Public Health, Welfare and Sport, the Ministry of Infrastructure and Environment, the Ministry of Economic Affairs, the Ministry of Social Affairs and Employment, various inspectorates and the European Union.

0.4 Other bodies

0.4.1 Port authorities

Port authorities, such as Havenbedrijf Rotterdam N.V., manage, operate and develop port and industrial areas. Within the preconditions of public law, and using various means including regulations and enforcement, the (national) port master ensures a rapid, safe and environmentally sound processing of shipping traffic in the area under his control.

1 Application of the publication

1.1 General

Monitoring, enforcement and granting licences are regulated in the relevant legislation. Companies should comply with the current state of the art described when a reference is made from a binding document to the PGS. Binding documents include for example the Activities Decree or an environmental licence. For employee protection the PGS regulations may be included in a Health & Safety catalogue, which is the starting point for monitoring the relevant sector (or target group). Another option is for PGS regulations to be imposed on a company via a requirement for compliance by the Inspectorate SZW (Social Affairs and Employment).

For the application of an updated PGS for granting licences under the Environmental Licensing (General Provisions) Act) (Wabo) we can make a distinction between the following situations:

- new company to be set up;
- extension or change of an existing company;
- existing company.

For a number of questions about the application of an updated PGS in existing situations or in case of an extension of or change to an existing company, please refer to the 'Responses and questions' (Reacties en vragen) on www.publicatiereeksgevaarlijkestoffen.nl.

1.2 Purpose

This document includes additional regulations for PGS 33-1 for designing, constructing and managing LNG bunkering installations on shore and on a floating bunker station. This will ensure an acceptable protection level for people and the environment. These include among other things the design requirements laid down for the installation, the components used and the conditions of use. In addition internal and external risks and safety distances are important.

As regards safety and environment it is important how for example boil-off gas is handled in the different process stages.

1.3 Scope

PGS 33-2 applies to LNG bunkering installations on shore and on a floating bunker station. PGS 33-2 applies to the bunkering of ships of a total net fuel tank volume of a maximum of 500 m^3 of LNG.

Note:
The units m^3 and ton are used in this document. The fact that the density of LNG depends on the composition and temperature and is around 0.45 ton per m^3 should be taken into account here.

Facilitys whose licence provides for a quantity of 50 tons or more are governed by the Brzo '99. When determining the quantity provided for in the licence, the total contents of all connected systems (tanks and piping) are taken into consideration.

PGS 33-2 provides additional regulations for PGS 33-1 *Natural gas: liquefied natural gas (LNG) delivery installations for vehicles* that serves as the starting point.

Delivery to loose refillable tanks has not been included in PGS 33-2.

Note:
There is not yet any experience with refillable LNG tanks. For this reason, there is nothing included in this PGS about this. Specific agreements will have to be made with the competent authority for working with refillable LNG tanks.

PGS 33-2 does not concern the transhipment of LNG as cargo for ships.

PGS 33-2 does not concern the 'ship to ship' bunkering of LNG.

The scope of PGS 33-2 is explained in the following paragraphs.

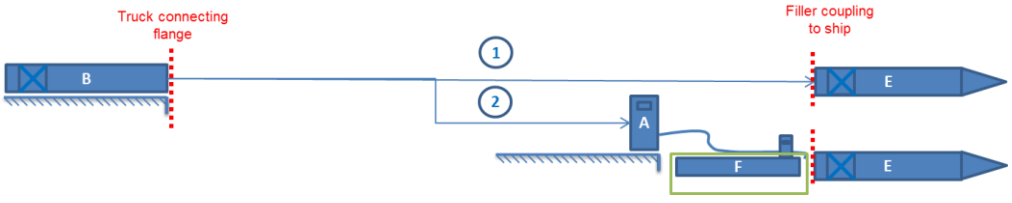
1.3.1 Bunkering from an LNG tank truck

PGS 33-2 applies to the following situations for the direct delivery of LNG from an LNG tank truck (see figure 1.1):

1) Bunkering a ship directly from an LNG tank truck.

2) Bunkering a ship from a tank truck via an on onshore LNG delivery installation and an LNG delivery installation placed on a floating bunker station.

Note:
The requirements laid down for the equipment on a floating bunker station (situation 2) for bunkering LNG are covered by the subject and the scope of PGS 33-2.



Legend

A	Onshore LNG dispenser
B	LNG tank truck
E	Ship
F	Floating bunker station (or floating landing stage)

Boundaries of the scope of PGS 33-2

Is not covered by the scope of PGS 33-2

Figure 1.1 — Bunkering a ship directly from an LNG tank truck

1.3.2 Bunkering from an LNG storage tank (total contents ≥ 50 tons)

PGS 33-2 applies to the following situations for delivering LNG from an LNG storage tank with the total contents of the LNG storage tank and the bunker tank of the LNG fuelled ship together being equal to or greater than 50 tons (see figure 1.2):

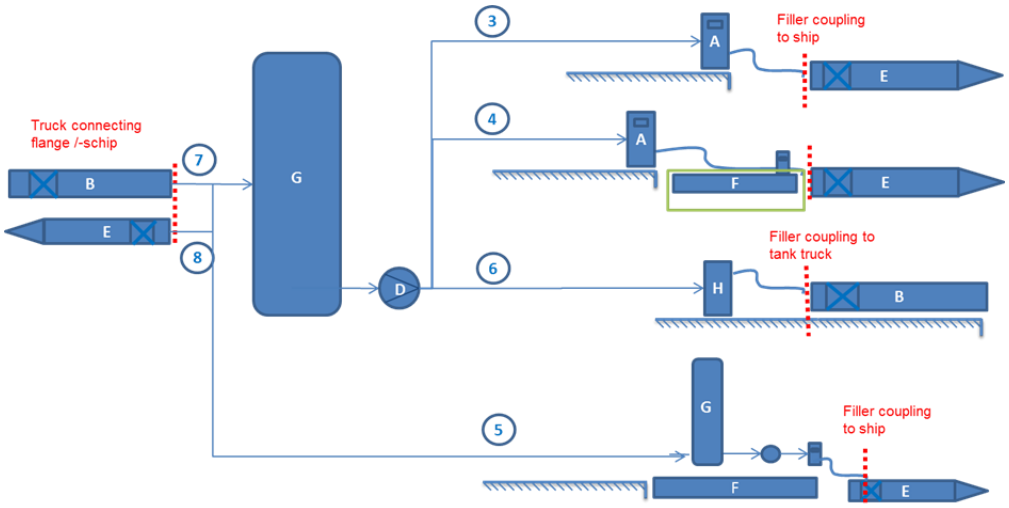
3) Bunkering a ship from an onshore LNG storage tank with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being equal to or greater than 50 tons.

4) Bunkering a ship from an onshore LNG storage tank with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being equal to or greater than 50 tons and where a delivery installation has been placed on a floating bunker station.

5) Bunkering a ship from an LNG storage tank and where a delivery installation has been placed on a floating bunker station with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being equal to or greater than 50 tons.

6) Filling an LNG tank truck from an onshore LNG storage tank with the total contents of the LNG storage tank and the LNG tank truck together being equal to or greater than 50 tons.

Note:
The requirements laid down for the equipment on a floating bunker station (situation 4) for bunkering LNG are covered by the subject and the scope of PGS 33-2. The requirements laid down for a floating bunker station are regulated in the Inland waterways regulation.



Legend

A	Onshore LNG dispenser
B	LNG tank truck
D	LNG tanker ship
E	Ship
F	Floating bunker station (or floating landing stage)
G	LNG storage tank, total storage ≥ 50 tons
H	Delivery installation for loading an LNG tank truck
	Boundaries of the scope of PGS 33-2
	Is not covered by the scope of PGS 33-2

Figure 1.2 — Bunkering from an LNG storage tank ≥ 50 ton and restocking the LNG delivery installation

1.3.3 Restocking the LNG delivery installation (total contents ≥ 50 tons)

The following situations are included in PGS 33-2 (see figure 1.2):

7) Restocking an LNG storage tank from a tank truck with the total contents of the LNG storage tank and the LNG tank truck together being equal to or greater than 50 tons;

8) Restocking an LNG storage tank from a tanker ship with the total contents of the LNG storage tank and the tanker ship together being equal to or greater than 50 tons;

1.3.4 Bunkering from an LNG storage tank (total contents < 50 tons)

PGS 33-2 applies to the following situations for bunkering from an LNG storage tank with the total contents of the LNG storage tank and the bunker tank of the LNG ship together being less than 50 tons (see figure 1.3):

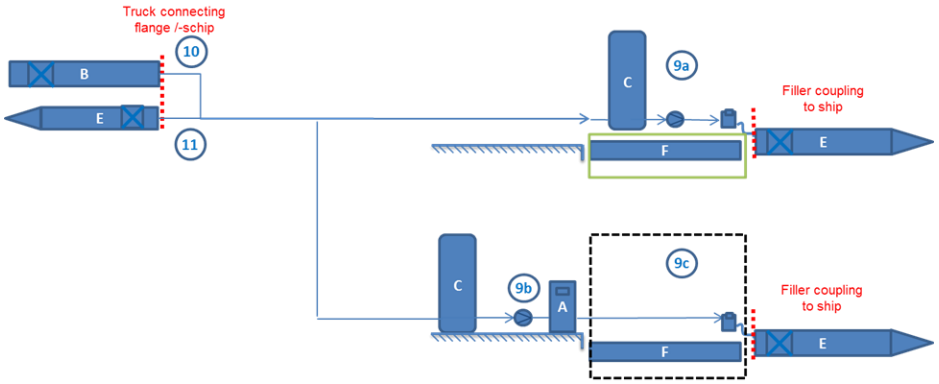
9a) Bunkering a ship from an LNG storage tank and a delivery installation placed on a floating bunker station with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being less than 50 tons.

9b) Bunkering a ship from an onshore LNG storage tank and a delivery installation placed on a floating bunker station with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being less than 50 tons.

9c) Bunkering a ship from an LNG storage tank and an onshore delivery installation with the total contents of the LNG storage tank and the LNG bunker tank on the ship together being less than 50 tons.

Note:
The requirements laid down for the equipment on a floating bunker station (situations 9a, 9b and 9c) for bunkering LNG are covered by the subject and the scope of PGS 33-2. The requirements laid down for a floating bunker station are regulated in the Inland waterways regulation.

Figure 1.3 — Bunkering from an LNG storage tank smaller than 50 tons



Legend

A	Onshore LNG dispenser
B	LNG tank truck
C	LNG storage tank, total storage < 50 tons
D	LNG tanker ship
E	Ship
F	Floating bunker station (or floating landing stage)
	Boundaries of the scope of PGS 33-2
	Is not covered by the scope of PGS 33-2

1.3.5 Restocking the LNG delivery installation (total contents < 50 tons)

The following situations are included in PGS 33-2 (see figure 1.3):

10) Restocking an LNG delivery installation on a floating bunker station from an LNG tank truck with the total contents of the LNG storage tank and the LNG tank truck together being less than 50 tons.

11) Restocking an LNG delivery installation on a floating bunker station from an LNG tanker ship with the total contents of the LNG storage tank and the LNG tanker ship together being less than 50 tons.

1.4 Equivalence principle

The equivalence principle applies to the application of PGS 33-2. This means that other measures may be taken than those included in PGS 33-2. In practice this means that during the preliminary consultation or in the licence application, data shall be submitted showing that at least equivalent protection of the environment, labour protection and fire safety can be achieved. When granting licences, the competent authority eventually assesses whether equivalent protection can be achieved by applying such other means. The Inspectorate SZW reviews this during inspections with regard to the enforcement of the Working Conditions Act.

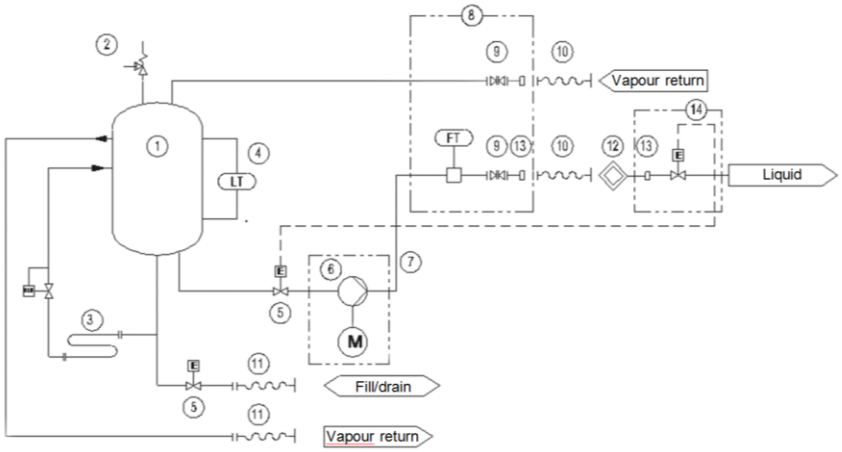
1.5 Use of standards and documents

Where reference is made to other standards and guidelines (for example NEN, ISO, BRL), the version that is in force at the time of publication of this PGS applies.

2 Construction and design of the LNG bunkering installation

2.1 General description of the LNG bunkering installation

This clause describes the requirements laid down for the construction and design of an LNG bunkering installation. This includes storage tanks, piping, fittings, and the completed (installed) LNG bunkering installation. This information is relevant for all parties involved in LNG bunkering installations. The majority of the requirements are laid down in legislation, whether or not based on European Directives. This legislation is reviewed in Annex C. In this legislation, the majority of requirements concern the construction of LNG storage tanks and fittings. The Inspectorate SZW is responsible for monitoring compliance with this legislation. Paragraph 2.2 describes the requirements laid down for the construction of an LNG bunkering installation and where these are laid down by law. Where not provided for by the current legislation and regulations, additional regulations are described in this PGS.



Legend

1. LNG storage tank
2. Safety valves
3. Pressure build-up evaporator
4. Level measurement
5. Shut-off valve
6. Pump (optional)
7. Piping system
8. Dispenser
9. Break-away coupling
10. Delivery hoses
11. Filling, offloading hoses
12 Dry-break/break-away coupling
13. Filler coupling
14 Bunker manifold
E. Shut-off valve
FT Flowmeter
M. Motor (of the pump)
LT. Level meter

Figure 2.1 – A simplified diagram of a 'shore to ship' LNG bunkering installation

If the storage capacity of the facility (including connected systems such as bunker ships, tanker lorries and ships' fuel tanks) is 50 tons or more, the facility shall have to comply with the Brzo requirements. The statutory Brzo requirements include having a safety report with the corresponding quantitative risk analysis (QRA), fire scenarios and a safety management system.

An LNG bunkering installation consists of the following components:

The storage tank
This is where a stock of LNG is stored. These storage tanks are pressure vessels with an atmospheric pressure that may vary up to a maximum level of 2000 kPa. Since the temperature of the LNG delivered is very low and any heat input from the surroundings shall as far as possible be prevented, good insulation is needed. Although conventional insulation using foam is possible, in the majority of cases vacuum insulated tanks are used. These tanks are twin-walled, where a vacuum is created in the space between the walls. In addition, the space between the walls can also be filled with an insulation material, which limits the insulation loss if the vacuum is lost. The inner vessel is made of low-temperature resistant stainless steel and the outer vessel is usually made of carbon steel as that will not become cold. However, at the locations of the piping conduits the outer vessel is made of stainless steel, as resistance to low temperatures shall be better here.

The level in the tank is normally measured using a differential pressure measurement over the liquid height. Depending on the Safety Integrity Level (SIL) classification, this system has two independent measuring systems. Level measurement is particularly difficult in horizontal tanks because of the limited differential pressure and particular attention should be paid to the calibration of the instrumentation. The maximum filling level of the tank is 95%. For horizontal tanks, it should be taken into account that the filling capacity of the tank is not the same as the filling height. The density of the LNG shall also be taken into account, so that, when the LNG is relatively warm, not too low a level is measured as a result of which the tank would be overfilled.

Piping system
The LNG is transported via piping. The materials used shall be suitable for the prevailing circumstances according to NEN-EN-ISO 16903.

Although flanged joints are possible, it is advisable to use welded joints as far as possible, because they are more reliable in case of fluctuating temperatures.

Filling pump
A boat or vehicle is usually filled using a pump. This pump delivers the required booster pressure for the tank to be filled. Before starting the pump it shall first be cooled to the temperature of use. This is done by filling the pump circuit with liquid from the tank. When the pump has cooled to the temperature of use, it can be started.

Bunker overfilling protection device
This protection device serves to prevent the fuel tank from being overfilled. To achieve this, it shall be properly connected so that bunkering stops when this happens.

The dispenser
The installation for filling ships. This installation consists of: the loading installation, the start

and stop buttons and any flow meters and other instruments. This installation can be placed on land, on a floating bunker station or a landing stage.

The loading installation
This installation can consist of a filling hose or a filling arm or a combination thereof to connect the ship to be filled by means of a combined dry-break/break-away coupling. The purpose of this coupling is to prevent LNG from escaping, also in emergency situations.

reg 2.2.1	The tensile force necessary to activate the dry-break/break-away coupling may be a maximum of 500 N (50 kg), measured at the most unfavourable angle at which this force acts on the filling hose. The filling hose with the hose connections shall have a minimum tensile force in longitudinal direction of at least three times the break force of the dry-break/break-away coupling.

Note:
The tensile force necessary to activate the dry-break/break-away coupling is taken to be the extra tensile force that occurs due to a tension being exerted on the filling hose. The tensile force as a consequence of the weight of the filling hose is not taken into account in this.

Filling hose
The filling hose used may not consist of several hoses. It shall be a hose that consists of only one hose length, without couplings and suitable for cryogenic applications.

Insulation flange
The delivery installation may contain an insulation flange/insulation gasket of a non-electrically conductive material to prevent stray currents between shore and ship, according to ISGINTT (International Safety Guide for Inland Navigation Tank-barges and Terminals, chapter 17, section 5). Such a facility is not suitable for simplifying (computerising) or reducing supervision while bunkering.

2.2 Construction requirements laid down for an LNG bunkering installation

2.2.1 General

The regulations concerning the construction requirements laid down for an LNG delivery installation in PGS 33-1 apply. Additional regulations are described in the following paragraphs.

2.2.2 Construction of the LNG storage tank

LNG storage tanks shall comply with the European Pressure Equipment Directive (97/23/EC). The following regulations apply to their foundations, support and (emergency) shut-off valves.

reg 2.2.2	The LNG bunkering installation placed on a floating bunker station shall be constructed such that the floating bunker station is protected against cryogenic effects and heat radiation.

Note 1:
Regulations concerning the construction requirements for a floating bunker station on which

an LNG storage tank has been placed are described in the Inland waterways regulation, annex 3.8.

Note 2:
Any cryogenic effects that can occur shall not be allowed to have any negative effect on the construction.

reg 2.2.3 There shall be an indication of the filling level (in volume per cent or in cm of liquid height) and the pressure build-up in the LNG storage tank, enabling the operating staff to monitor the filling process. This indication shall be positioned such that the operating staff have sufficient time to leave the place where the filling process is being monitored and go to the place where an intervention in the filling process is required before the maximum permissible filling level/pressure level is exceeded.

2.2.3 Safety devices

The safety regulations of PGS 33-1 apply. If an installation is located on a floating bunker station, the following additional safety regulations apply:

reg 2.2.4 The height of the central vent stack is determined by means of a calculation demonstrating that:

1. the heat radiation from this source, at 1 m above deck level, is less than 3 kW/m^2 within the facility limit and lower than 1 kW/m^2 outside it (though this is outside the limits of the facility);
2. the heat radiation intensity from a flare from the central vent stack on the LNG storage tank is less than 35 kW/m^2;
3. no pool of LNG is produced as a result of LNG liquid spray from the central vent stack ('rainout').

Note:
NEN-EN 13645 stipulates a maximum value of 3 kW/m^2 for the heat radiation of a possible flare of the vent stack.

reg 2.2.5 Requirements to reduce the risks of collision are imposed by the waterway manager.

2.2.4 Sewer system and street gulleys

The regulations of PGS 33-1 only apply to the onshore LNG storage tank.

2.2.5 LNG piping and fittings

The regulations of PGS 33-1 apply. Additional regulations are:

reg 2.2.6 When bunkering from an LNG tank truck, potential equalisation (electrical connection to earth) shall be achieved through an earthing point. The LNG tank truck shall therefore be provided with one or several metal connection points as electrical

earthing points. The electrical earthing of the LNG tank truck shall be connected first and disconnected last. The ship shall be earthed before the bunkering actions start. It is allowed for a ship and a tank truck to use one and the same earthing point.

reg 2.2.7 The hose connections between the LNG tank truck or LNG tanker ship and the LNG storage tank and the hose connections between the LNG storage tank and the bunkering ships shall have a combined dry-break/break-away coupling.

reg 2.2.8 The loading installation may contain an insulation flange or insulation gasket of a non-electrically conductive material to prevent stray currents between shore and ship.

reg 2.2.9 The LNG bunkering installation shall have a facility to prevent the delivery pressure from exceeding the safety pressure of the LNG tank of the connected ship.

2.2.6 LNG filling point

The regulations of PGS 33-1 apply. Additional regulations are:

reg 2.2.10 When filling an LNG storage tank on a floating bunker station from an LNG tank truck, the potential equalisation (electrical connection to earth) shall be achieved through an earthing point. The LNG filling point shall therefore be provided with one or several metal connection points as electrical earthing points. The electrical earthing shall be connected as soon as the LNG tank truck has been parked.

reg 2.2.11 The liquid pipeline intended for filling the LNG storage tank shall be fitted with a shut-off valve at the LNG filling point. This shut-off valve shall be properly supported and may not be able to be operated by unauthorised persons.

reg 2.2.12 The connecting hose between the filling point and the delivery installation on the floating bunker station shall have a combined dry-break/break-away coupling.

2.3 Construction of (underground) piping

The regulations of PGS 33-1 apply. Additional regulations are:

Bunker connection point ventilation

reg 2.3.1 If bunker connection points are encased, effective ventilation shall be in place.

3 The LNG bunkering installation in operation

3.1 Introduction

For an LNG bunkering installation to operate safely, the operational management is very important. It is essential here that responsibilities are clearly laid down. As a rule, the following people are stakeholders in an LNG bunkering installation: the owner, the user, the manager, the installer, the LNG supplier and the LNG customer. Each of the stakeholders has their own responsibilities with respect to the operation of the LNG bunkering installation. Annex E provides a checklist for bunkering from an LNG tank truck to an LNG fuelled ship. Annex D provides a checklist for bunkering from an LNG bunker station to an LNG fuelled ship. Apart from the determination of responsibilities a number of other aspects are relevant for safe operational management.

These include, among other things, the following matters:

1. management of the LNG bunkering installation;
2. execution of periodic inspections;
3. monitoring the LNG bunkering installation;
4. filling the LNG storage tank (that belongs to the bunkering installation);
5. filling the bunker tanks on LNG fuelled ships;
6. filling LNG tanker lorries;
7. other hazard sources with hazardous substances.

In 3.2 to 3.4 a number of specific subjects relating to operational management are explained further. In addition for matters that are not laid down in legislation, but which are essential for safe operational management, additional regulations are included.

3.2 General regulations

This paragraph includes regulations that apply to the entire LNG bunkering installation. Filling gas cylinders does not fall under the scope of PGS 33-2.

reg 3.2.1	In case of regular operation, the emission of methane to the environment is not permitted. The LNG bunkering installation shall have a device for collecting the boil-

	off gas or to prevent the formation of boil-off gas.

Note:
This can be effected by collection in a CNG buffer, use in a consuming equipment or the like, or recondensing the boil-off gas.

reg 3.2.2	The user of the facility or a person appointed and instructed by the user of the facility is responsible for the management of an LNG bunkering installation.

reg 3.2.3	If the component of the facility where LNG is delivered is not operational for the delivery of LNG, all shut-off valves shall be in their safe positions.

Note 1:
This involves the shut-off valves located between the LNG storage tank and the LNG bunkering installation. Shut-off valves in the LNG piping between LNG storage tanks and the filling point do not fall under this provision. If LNG is not being delivered, this installation shall be in a safe state. This means that liquid shut-off valves are closed and gas return piping is fitted with non-return valves. The exception to this is circuits and controls that are necessary to keep the installation cold. The opening time of these shut-off valves during the process in order to achieve the correct operating temperature should be restricted to a very limited time, 2 to 3 min. It shall be prevented that liquid is locked up between shut-off valves in a piping section without a safety device.

Note 2:
The current transport regulations (ADR/ADN) continue to be effective in addition to the provisions of this guideline, such as, in particular, the safety obligations of the stakeholders (chapter 1.4 of the ADR/ADN).

reg 3.2.4	The following label has been affixed on or near the bunker connection point: - ATEX zone designation (if necessary); - 'SMOKING AND NAKED FLAMES PROHIBITED'. If pictograms are used, these shall comply with an international standard drawn up for this purpose, or also bear the label.

3.3 Filling the LNG storage tank of the bunkering installation

3.3.1 Introduction to filling the LNG storage tank

Pumping the LNG is the activity with the greatest risk in connection with LNG bunkering installations. In this respect, spatial aspects such as the location of the parking space for the LNG tank truck or the mooring place of the tanker ship are important. Besides these aspects, the nautical circumstances and safety distances while restocking from a ship are very important. In addition there is also the reachability of the LNG storage tank and the filling point and the accessibility of the parking space for the LNG tank truck or the mooring place of the restocking tanker ship in the event of a disaster. The LNG tank truck or ship shall be able to reach and leave the offloading point without hindrance. These spatial aspects and the manner

in which the minimum distances to be observed from the LNG tank truck or the restocking tanker ship to objects within the facility are calculated are described in clause 5.

In addition to these spatial and nautical aspects the offloading procedure and safety devices on the LNG tank truck or ship, in combination with devices fitted to the LNG bunkering installation, shall guarantee an adequate safety level while filling the tank.

3.3.2 Requirements laid down for restocking

The ADN and ADR contain safety requirements that are necessary in the Dutch situation for the safe filling of the LNG storage tank of an LNG bunkering installation. Because during loading or offloading of LNG an LNG tank truck or LNG tanker ship forms part of the facility, some of these safety devices are required on the basis of the licence or general rules applicable to these facilitys. Annex F to this publication describes the standards that shall be complied with, e.g. as regards the offloading hose. Annex E of PGS 33-1 includes a procedure for offloading the LNG tank truck.

reg 3.3.1 The LNG tank truck to be offloaded shall be parked such that in case of need it can drive away to a safe location without manoeuvring.

reg 3.3.2 The LNG tanker ship to be offloaded shall be moored such that in case of need it can sail away to a safe location without manoeuvring.

3.3.3 The actual filling

Filling the LNG storage tank of the bunkering installation

It is essential that the LNG storage tank is filled by and/or under the responsibility of the operating staff, that is the driver of the LNG tank truck, or respectively the captain of the LNG tanker ship after obtaining the permission of the responsible manager of the LNG bunkering installation. This does not mean that the responsible manager shall be present at all times during offloading. In some cases night-time offloading, for example in case of applicable window times, is in fact desirable. There will not always be staff of the LNG bunkering installation present at these times.

reg 3.3.3 Before the filling of the LNG storage tank is started, the operating staff shall assure themselves that the situation in the vicinity is sufficiently safe. During filling of the LNG storage tank, the operating staff shall be able to operate the controls of the LNG tank truck or the LNG tanker ship and check, from their location, that the maximum permissible filling level of the LNG storage tank is not exceeded.

The following regulation applies when filling from an LNG tank truck

reg 3.3.4 The driver of the LNG tank truck shall be present during the entire storage tank filling process. To guarantee this, the LNG bunkering installation shall be constructed with a dead man’s switch that shall be activated every 3 min. If the dead man’s button is not activated in time, the pump and the restocking stop automatically.

When offloading, a fixed procedure shall be followed. In addition to technical indications, this procedure also includes instructions for the LNG tank truck driver.

The following regulation applies when filling from an LNG tanker ship

reg 3.3.5	According to the ADN, there shall be a connection that enables the pump to be stopped in the event of an emergency situation. The safety measures of the ADN shall be observed.

When offloading, a fixed procedure shall be followed. This procedure contains technical, company-internal and operational regulations. In addition, statutory frameworks also exist, such as the use of the ADN checklist.

An example of the procedure for filling an LNG storage tank at an LNG bunkering installation is included in annex E of PGS 33-1.

Additional regulations for filling the LNG storage tank

reg 3.3.6	If an offloading hose is used, it shall be subjected to hydrostatic testing once a year, as referred to in NPR 5527. If any defects occur during this inspection, the offloading hose shall be replaced. The test can be carried out by or on behalf of the manager of the LNG delivery installation. A written, dated certificate of this test shall be prepared. This certificate shall be available to be shown upon request. In addition the fabricator of these hoses may lay down requirements relating to service life, inspection and maintenance. The fabricator's instructions shall be followed.

reg 3.3.7	Before filling can take place, the hose shall be inspected visually as stated in NPR 5527. If any defects are found during this inspection, the offloading hose shall be replaced.

Note:
Paragraphs 4.2 and 4.3 of NPR 5527 describe how the user shall inspect a hose or a hose assembly. Annex D of NPR 5527 contains a checklist that can be used in this context.

reg 3.3.8	The offloading of an LNG tanker ship may not take place at the same time as the offloading of a tank truck with other motor fuels within the same facility, unless the LNG tanker ship is located more than 25 m away from the tank truck.

reg 3.3.9	While offloading from an LNG tanker ship, no other ships from outside the facility may come alongside the tanker ship.

reg 3.3.10	Filling the LNG storage tank may not be possible before the connection between the controls of the shut-off valves of the LNG tanker ship to be offloaded and the emergency shutdown device of the shut-off valves of the LNG storage tank has been effected. The remotely operable shut-off valve present in the filling line may only be opened during the filling process.

3.4 Bunkering LNG

3.4.1 General

The tank on board a ship is filled from a lorry or from the bunkering installation using a hose or a filling arm. The filling process is started using a pump or a pressure difference generated by an evaporator.

Regulations for bunkering, the actual delivery of LNG to the user

reg 3.4.1	Adequate personal protection equipment (PPE) shall be used for the delivery of LNG, i.e. at least safety goggles and gloves, both suitable for handling cryogenic substances, while connecting and disconnecting. Attention shall also be paid to protective clothing. The PPE shall bear a CE mark.

reg 3.4.2	The surroundings of the bunker connection point shall be sufficiently illuminated.

reg 3.4.3	The bunkering checklist(s) from the annexes shall be used.

Note:
This concerns the following bunkering checklists:
- checklist for bunkering from an LNG bunker station (annex D);
- checklist for bunkering from an LNG tank truck (annex E).

3.4.2 Regulations for the delivery to LNG fuelled ships

General
It is essential that the delivery of LNG to ships takes place by and under the responsibility of the operating staff of the bunkering installation or the driver of the LNG tank truck. During the filling process, the captain is responsible for the activities that shall take place on the ship.

reg 3.4.4	Before delivering the LNG is started, the operating staff shall assure themselves that the situation in the vicinity is sufficiently safe. While delivering the LNG, the operating staff shall be able to operate the controls of the delivery installation and the LNG fuelled ship and check, from their location, that the maximum permissible filling level of the LNG tank of the ship is not exceeded.

reg 3.4.5	Delivering LNG is only allowed if supervised simultaneously by both the operating staff of the bunkering installation and the acting captain of the LNG fuelled ship.

reg 3.4.6	The propeller screws of the LNG fuelled ship to which delivery is made may not be running.

If delivery is made from an LNG tank truck, the engine of the tank truck shall be switched off while connecting and disconnecting, in accordance with the ADR.

reg 3.4.7	When LNG is not being dispensed, the installation shall be in a safe state.

Note:
A safe state means: that the system stays at an acceptable pressure and temperature. All shut-off valves in the system that do not contribute to this should be closed.

reg 3.4.8	While bunkering, an LNG fuelled ship shall be moored safely, taking into consideration local circumstances.

reg 3.4.9	When the LNG bunkering installation is switched off, the electronic control and protection system forming part of the installation shall be set such that the delivery of LNG is not possible. However, the protection and alarm equipment shall be fully ready for immediate use.

reg 3.4.10	If various fuels and environmentally hazardous substances are bunkered at the same time, the facility and the receiving ship shall be fitted out for this. The bunkering actions shall take place under separate and careful supervision. Both bunkering actions shall be considered as separate actions with suitable procedures.

Supervision of bunkering operations

reg 3.4.11	The continuous and effective supervision of bunkering operations shall be assured.

Note:
This can be assured through procedures or through physical facilities. In all events, 'continuous' shall be taken to mean that the operating staff is not going to do any other work as a result of which the supervision is insufficiently assured.

Filling hose or filling arm

reg 3.4.12	The filling hose used shall be a one hose length, without any couplings and flanges.

reg 3.4.13	The filling hose, vapour return hose and filling arm shall comply with the standards listed in table F.1 of the ISO Guidelines for systems and installations for supply of LNG as fuel for ships.

Operating instructions

reg 3.4.14	Only authorised staff may operate the bunkering facilities. This shall be clearly indicated on the control panel.

If operating instructions have been applied locally, they shall have been applied such that they are clearly visible and legible, with pictograms and/or text at least in Dutch.

3.4.3 Regulations for supervision of LNG bunkering installations and bunkering

PGS 33-1, paragraph 3.7, monitoring the LNG delivery installation applies, supplemented by the following regulation.

reg 3.4.15 The LNG bunkering installation shall have a procedure (checklist) to ensure that the filling pressure does not become higher than the desired pressure of the connected ship.

3.4.4 Bunkering LNG

The bunkering of ships with LNG as a fuel from a fixed or floating LNG bunkering installation, or from an LNG tank truck, is described in 3.4.2. Additional regulations for specific situations are described in this paragraph.

The following regulations apply to the delivery of LNG from a tank truck to a ship via a delivery installation placed on a floating bunker station:

reg 3.4.16 If a pump is applied between the tank truck and the ship, the pump shall be fitted out such that the creation of a vacuum in the tank truck is prevented.

reg 3.4.17 The filling hose between the onshore LNG storage tank and the delivery installation on the floating bunker station shall have a combined dry-break/break-away coupling.

3.4.5 Regulations for customers of LNG

The regulations for an LNG fuelled ship are listed in such instruments as the Decree on inland shipping vessels (Binnenschepenbesluit), Police regulations for inland shipping (Binnenvaartpolitieregelement - BPR), Inspection regulations for vessels on the Rhine (Reglement Onderzoek schepen op de Rijn - RSOR), ADN, and in any preliminary regulations in preparation thereof and/or any exemptions. These regulations shall be complied with.

reg 3.4.18 The checklist from annex D or E shall be filled in.

reg 3.4.19 The regulations listed in the checklist (annex D or E) shall be complied with.

reg 3.4.20 The acting captain is responsible for the agreements made between the staff of the ship and the staff of the bunkering installation (in the checklist (annex D or E)).

reg 3.4.21 The checklist (annex D or E) shall be kept available for at least 24 hours after bunkering by the manager of the bunkering installation and the LNG fuelled ship that has received the bunkers.

reg 3.4.22 The facility manager shall register the following details for all deliveries:

- the details of the customer;
- date and time of the delivery;
- the quantity of LNG delivered.

reg 3.4.23 Equipment that is not explosion safe can create sparks and may not be used inside the facility. A clearly visible prohibition sign shall be affixed, see reg. 3.2.4.

3.5 LNG tank truck

3.5.1 General

The calculation of the internal and external safety distances in clause 5 determines where the LNG tank truck may be parked.

Note:
In derogation of PGS 33-1, placing the LNG tank truck within a radius of 10 m of the LNG storage tank and the LNG dispenser is possible since additional safety measures are applied, such as a second operator who can stop the offloading on their own (paragraph 3.4.2).

3.5.2 Regulations for loading an LNG tank truck

The regulations for loading an LNG tank truck are comparable to delivering to an LNG fuelled inland vessel. LNG bunkering installations can possibly also play a role in the distribution chain for onshore delivery (to delivery installations according to PGS 33-1). I.e. this does not concern delivering to the fuel tank of the lorry, but to filling the transport tank which in turn will be used to restock, for example, a delivery installation according to PGS 33-1.

The points listed in 3.4 serve as starting points. It is expected that a delivery to an LNG tank truck will be done by the same tank truck driver(s) involved in filing the LNG storage tank. As a result, a significant degree of equality in procedures/regulations is a good way to increase safety and reduce the chance of incidents.

reg 3.5.1 Loading an LNG tank truck is only allowed if supervised simultaneously by both the operating staff of the bunkering installation and the tank truck driver.

reg 3.5.2	The emergency shutdown devices of the installation shall also be able to be used when loading an LNG tank truck.

4 Testing, maintenance, registration, inspection and enforcement

4.1 Introduction

The regulations of PGS 33-1 apply to testing, maintenance, registration and inspection.

4.2 Enforcement and training

4.2.1 Enforcement

The enforcement points of PGS 33-1 shall apply unchanged to the onshore part of the LNG installation. The following enforcement bodies are relevant to the floating part of the LNG installation:

- Human Environment and Transport Inspectorate (for certifying bunkering installation and all installations);
- both classification societies and recognised private inspection agencies can carry out the inspections for the Human Environment and Transport Inspectorate;
- the authority granting the operating permit.

At least the following documents shall be able to be shown here:

- the installation book;
- documents/reports on periodic inspections of the LNG installation (components), and (safety) equipment;
- reports on incidents with registered improvements that have been carried out in order to prevent the incidents recurring;
- bunkering installation hull report;
- proof that the staff have received proper training for bunkering LNG.

4.2.2 Training courses

Any staff that have an operational involvement in the bunkering process shall have passed the training course provided by a training institution that has developed a training course aimed specifically at LNG. It shall be obligatory to take a repeater course with a final test every five years.

Staff working at the bunkering installation on the ship shall be able to furnish proof of such training course on the occasion of an inspection.

5 Safety measures

5.1 Introduction

This clause includes the regulations concerning the various safety measures of LNG bunkering installations.

This includes regulations for determining internal and external safety distances, requirements for the electrical system and measures to prevent and contain fire and explosion hazard.

5.2 General

When designing, constructing and operating an LNG bunkering installation, various statutory frameworks for road, water and land come together. A brief sketch of the situation is provided to enable a good understanding of the relevant requirements:

- regardless of whether it is placed onshore or on a floating bunker station at the quay, the entire LNG bunkering installation is covered by the requirements and regulations of the Environmental Licensing (General Provisions) Act (Wabo) and this PGS;
- the diversity in configurations and design parameters of LNG bunkering installations has been found to be so great that the PGS team has not been able to establish an unambiguous and exhaustive list of safety measures for every specific situation. Therefore, this clause contains general regulations and references to relevant standards. Granting permits and licences requires that bespoke solutions shall be provided for the specific situations;
- as soon as the quantities of hazardous substances are such that the facility falls under the Brzo '99, it shall, in accordance with that legislation, have a major accidents prevention policy and a safety management system. The facility holder shall then be under the statutory obligation to provide bespoke solutions when identifying the hazards and when establishing, achieving and maintaining the necessary safety measures, including the preparation for emergency situations and drawing up an emergency plan;
- the requirements laid down for a floating bunker station are then imposed directly from the Inland waterways regulation, annex 3.8. This concerns such matters as the structural safety, the layout and compartmentalisation, electrical safety, signalling, detection, fire alarm system and fire extinguishing system;
- the ships that come to bunker and the ships that come to restock the LNG tank(s) of the bunkering installation are covered by the shipping regulations. The designs of these ships are assessed by classification societies (as a statutory obligation) and this is not covered by the scope of this PGS. Internationally, efforts are undertaken to standardise the loading coupling between the ship and the shore and the coupling of emergency shutdown systems between the ship and the shore;
- an LNG tank truck shall comply with the ADR during transport. The safety devices fitted on the tank truck for this purpose also function during the loading and offloading

processes in an facility. This concerns such matters as overpressure protection and an emergency shutdown linked to the shut-off valves;

– a tank truck that comes to offload into the tank of an LNG bunkering installation is identical to a tank truck that comes to offload into the tank at an LNG filling station. Where possible, the requirements of PGS 33-1 are therefore also followed for this activity;
– the requirements laid down for an LNG tank truck that delivers LNG directly to an LNG fuelled ship are described in this PGS;
– the requirements laid down for an LNG tank truck that comes to load at an LNG bunkering installation are described in this PGS;
– if a bunkering installation also has an LNG dispenser for delivery to lorries that use this fuel, the requirements described in PGS 33-1 apply to that component of the installation;
– personnel that carry out work on the installation shall wear operational gas detectors on their bodies.

reg 5.2.1 The following points concerning the facility of the LNG bunkering installation shall be filled out in detail in the licence application:

- the overview of the installation for the operating staff, both from the operating location and from the LNG delivery installation;
- measures and provisions to promote safety and environmental protection;
- the provision of a stand for the LNG delivery tank truck inside the facility so that it does not adversely affect the proper operation and the overview of the whole installation during the delivery (filling of tanks);
- the provision of a mooring place for the LNG restocking ship inside the facility so that it does not adversely affect the proper operation and the overview of the whole installation during the delivery (filling of tanks);
- the provision of a mooring place for the ship to be bunkered inside the facility so that it does not adversely affect the operation and the overview of the whole installation during the delivery (filling of tanks);
- accessibility to installation components for operation and maintenance;
- accessibility to the installation for fighting possible fires;
- possibilities to escape if incidents occur.

reg 5.2.2 In conjunction with the statutory filing requirements, when filing the building application for a bunkering installation, the design of the bunkering installation shall be enclosed, stating as a minimum:

- the dimensions and specifications of the installations and of the expected tanker lorries and ships;
- the design standards to be followed, with a substantiation of choices in the event a standard allows for several options;
- the safety studies that have been and are still to be carried out;
- the hazards and hazard scenarios identified, with a detailed elaboration of such scenarios;
- a calculation of the internal and external safety distances that are to be achieved;
- the detection systems and safety measures and facilities to be achieved, both in order to prevent incidents and to reduce the consequences of incidents;
- the concurrence with other installations and activities and the measures and facilities to be provided in that regard;
- the standards and frequencies to be adopted for inspecting, maintaining and testing the safety measures and facilities. The gas, fire and cold detection and the fire

safety facilities are also included in this.

reg 5.2.3 In the context of the above regulation, the following standards shall at least be applied to an LNG bunkering installation:

- PGS 33-2;
- NEN-EN 1160 as regards the hazard characteristics of LNG;
- NEN-EN 13645 for installations of a capacity up to 200 tons;
- NEN-EN 1473 for installations of a capacity of 200 tons or more;
- NEN-EN-ISO 28460;
- the other relevant standards from annex F.

reg 5.2.4 The elaboration of the hazards and scenarios referred to in reg 5.2.2 shall at least describe the following effects:

- cryogenic effects on people and materials;
- oxygen displacement by the release of LNG;
- heat radiation contours of 1 kW/$m^{2\ and}$ 3 kW/m^2 and10 kW/m^2 and 35 kW/m^2;
- the distance at which 50% and 100% of LEL value is reached for gas clouds.

5.3 Internal safety distances

5.3.1 Introduction

No specific internal safety distances have been derived for LNG bunkering installations. In order to determine the internal distances, it is important to know whether the total content of the LNG bunkering installation is more or less than 50 tons. If the total content is less than 50 tons, the bunkering installation is not governed by Brzo ‘99 and the internal safety distances established for LNG filling stations (PGS 33-1) are observed. If the total content is equal to or more than 50 tons, the LNG bunkering installation is governed by Brzo ‘99 and the internal safety distances shall be determined (see annex III of Brzo '99, paragraphs 1e and 1g). The manner in which this can be done has not been prescribed for Brzo ‘99 facilitys, but examples of risk identification tools are HAZID, HAZOP and FMEA. Internal safety distances can be determined for LNG bunkering installations with a total content of 50 tons or more, using the method described in the background document 'Bepaling interne veiligheidsafstanden voor LNG-tankstations ten behoeve van de in ontwikkeling zijnde PGS 33' (Determination of internal safety distances for LNG filling stations for PGS 33 that is in development) that accompanies PGS 33-1. Here a foreseeable accident scenario is selected that is considered as a decisive accident scenario and that has an occurrence frequency of roughly 10^{-3} to 10^{-5} a year. This scenario is deemed to be the most suitable for determining the internal safety distances.

5.3.2 Basic assumptions for internal safety distances

Internal safety distances are determined between a component of the LNG bunkering installation as a hazard source on the one hand and the objects to be protected in the facility on the other. The distances shall be such that LNG incidents cannot escalate.

A tank truck or cargo ship that delivers, receives or bunkers LNG is not covered by the scope of PGS 33-2. However, as soon as these components are connected to the bunkering installation, they form part of, i.e. are components of, the facility. Cargo tanks or other tanks that are not connected are not components of the facility. For this reason, tanker lorries and cargo ships shall be taken into consideration when establishing internal safety distances. These components are marked by an * in the summary below.

The potential hazard sources of an LNG bunkering installation are:

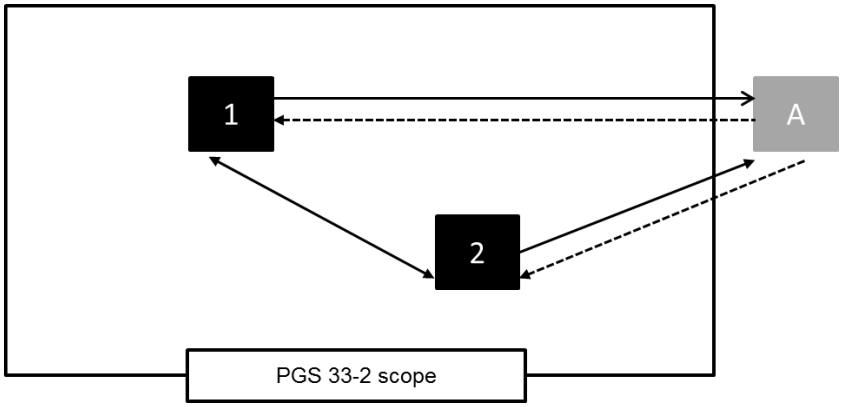
- a tank truck delivering or receiving LNG*;
- an LNG storage tank (buffer storage);
- a fixed or floating LNG an delivery installation;
- an LNG delivering ship (cargo ship)*;
- an LNG bunkering ship*.

The objects that potentially need to be protected are:

- a tank truck delivering or receiving LNG*;
- an LNG storage tank (buffer storage);
- a fixed or floating LNG delivery installation;
- an LNG delivering ship (cargo ship)*;
- an LNG bunkering ship*;
- buildings in which there are hazardous substances;
- other installation components with hazardous substances.

Figure 5.1 and the note explain how the internal safety distances shall be determined.

Figure 5.1 – Schematic view of how to determine internal safety distances.



- *Note:*
  1 and 2 are installation components of an LNG bunkering installation that are within the scope of PGS 33-2. The components are both hazard sources (installation components with a hazardous substance) and the potential hazard receivers (a person, a vulnerable installation component or building within the facility) and the internal distance from every component to the other component is determined. The internal distance between 1 and 2 is calculated twice. In the first situation, component 1 is the hazard source and component 2 is the potential hazard receiver, whereas this will be the other way around in the second situation. This is indicated by the double arrow. The largest internal distance between 1 and 2 should be observed.
- *A is an installation part that is not covered by the scope of PGS 33-2 and which can be subject to its own guidelines. In the context of PGS 33-2, this component is deemed to be the potential hazard receiver for which an internal distance to the hazard sources 1 and 2 shall be determined (continuous single arrow) or to be a hazard source. The internal distances shall then be determined between part A (dotted single arrow) and installation parts 1 and 2. The internal distance to be actually observed is the larger one of the two.*

Internal safety distances are determined based on the heat radiation that an installation component can resist. The objects to be protected within the facility are protected for the selected, decisive accident scenario against a maximum heat radiation of 10 kW/m$^{2.}$ An exception can be made for LNG-carrying objects if it can be demonstrated that the radiated object can resist a heat load of 35 kW/m^2 without this leading to any escalation.

There can be hazard sources in the facility that do not contain any LNG. Examples of such hazard sources are buildings with flammable materials, installations for the delivery of fuels (petrol, diesel, propane, LPG, fuel oil and CNG) and other hazard sources such as hazardous substances storage. As regards the required internal safety distances between these hazard sources and any objects and people on LNG bunkering installations to be protected, the PGS publications drawn up for the hazard sources in question are initially referred to.

Note:
An internal safety distance also applies from the boundary limit of the facility because any third-party objects to be protected may be placed directly against them, without the facility holder having any influence over this.

5.4 External safety distances

The presence of an LNG bunkering installation involves a potential hazard for people who live and/or work in the direct vicinity of the bunkering installation. The danger is caused by the presence of large amounts of LNG. The regulations on external safety dictate that safety distances shall be observed between (components of) risk-causing installations and objects located outside the facility that are vulnerable (to a limited degree). What will apply to LNG bunkering installations is that, when filing for a licence, an insight into the risks shall need to be provided using a quantitative risk analysis (QRA).

Note:
LNG bunkering installations with a total content equal to or greater than 50 tons are facilitys that are governed by Brzo '99. According to article 7 of the External Safety (Facilitys) Regulations (Regeling externe veiligheid facilitys (Revi)), the place-related risk shall be determined using the Bevi Risk Calculations Manual. Chapter 1 of this manual describes the calculation method for Brzo facilitys and in principle applies to LNG bunkering installations with a total content equal to or greater than 50 tons. A calculation method is being developed for LNG bunkering installations that shall be considered as a further elaboration of chapter 1 of the Bevi Risk Calculations Manual. This method is expected to be ready in 2014 after which it will be included in the Bevi Risk Calculations Manual as a new chapter at some future time yet to be determined.

5.5 Electrical installation and explosion safety

The requirements laid down for the electrical installation and explosion safety are described in PGS 33-1.

5.6 Fire hazard and fire fighting

Paragraph 5.6 of PGS 33-1 goes into the possibilities and impossibilities of putting out NG/LNG fires. Since a flammable gas is concerned, the source shall be addressed by activating the emergency shutdown device so that the discharge will stop in most cases.

In addition, it shall be ensured that, in case of a leak, the LNG can discharge to a safe location. If a collection facility is provided, this can be made safe by means of a light foam installation or by a layer of foamed glass blocks. Both solutions reduce the heat radiation of a possible pool fire in the collection facility.

Depending on the duration of the scenario and the effects of the fire, implementing fire safety facilities can be found to be necessary. This can concern both passive (over-dimensioning to preserve the load-bearing capacity or fire-resistant clothing) and active (cooling using water) fire safety facilities.

What is of primary importance is that the LNG installation can be protected against fires in its surroundings. Examples of such fires are a vehicle that is on fire or a fire on board a ship, or a fire in a shop or another hazardous substance storage area.

To fight the start of fires, handheld extinguishing equipment shall be present, in accordance with the specifications of PGS 33-1.

In case of delivery from a tank truck or a tank container on a ship, the standard quantity of extinguishing agent according to the ADR is present. In accordance with the shipping legislation, the ship has suitable firefighting facilities. This amount is sufficient for that situation.

reg 5.6.1	In accordance with the provisions of reg 5.2.2, it shall have been elaborated in detail in the application what hazards and scenarios are possible within the facility and what fire safety facilities are implemented and maintained.

reg 5.6.2	Sufficient firefighting means shall be present at the LNG bunkering installation to be able to fight the start of a fire on any component of the installation effectively.

Note:
Since several fuels can be present at an LNG bunkering installation and other activities can also take place, the purpose of these regulations is to ensure that firefighting equipment, tailored to the situation in question, is present in order to be able to fight the start of a fire. The measures and facilities in accordance with reg 5.2.1 to 5.2.4 shall be elaborated in detail for all scenarios in the application.

reg 5.6.3	It shall be possible to reach fire extinguishers without any hindrance and they shall always be available for immediate use.

Note:
Reg 5.6.1 of PGS 33-1 refers to NEN-EN 3-7 concerning fire extinguishers.
The performance requirements and the test method to be allowed to market fire extinguishers in Europe have been laid down in NEN-EN 3-7. The values 43A and 233B in that standard indicate that a powder extinguisher can put out a test fire of a certain size for a class A (solid) and class B (liquid) fire. These values are accompanied by the requirement that the powder extinguisher shall be able to operate for at least 15 seconds. The standard gives the manufacturer of the extinguisher the freedom to achieve the performance requirements using a filling volume of 1, 2, 3, 4, 6, 9 or 12 kg of powder. The application of 6-kg powder extinguishers is customary in the ADR, ADN and PGS 28. The performance requirement 43A/233B applies to the permanently installed powder extinguishers present within the facility. The suitability of powder extinguishers of types A and/or B for putting out (gas) fires of type C has not been laid down in NEN-EN 3-7, but is left to the discretion of the manufacturer.

5.7 Emergency shutdown devices

5.7.1 General

Paragraph 5.7 of the PGS 33-1 applies.

5.7.2 Detection systems

The detection systems on an LNG bunkering installation play a crucial role in the swift detection of possible leaks and fires so that the installation and connected tanker lorries and ships can then quickly be put in a safe state by the automatic activation of Emergency Shutdown Systems (ESD systems). In addition, these systems ensure the rapid warning of the people present at the installation and alerting of the in-house emergency organisation.

In addition to PGS 33-1, the following regulation applies.

reg 5.7.1	In accordance with the provisions of reg 5.2.2, the application shall provide detailed information about the detection facilities to be achieved in the facility and the actions to be coupled thereto.

Note:
This can be achieved e.g. by temperature detection, flame detection and/or gas detection.

reg 5.7.2	Sufficient detection means shall be present that automatically activate the emergency shutdown circuit in the event of a gas leak or fire in the LNG delivery installation.

5.7.3 Detection systems and emergency shutdown facility

reg 5.7.3	Several emergency shutdown devices that can be operated quickly by the staff present shall be available. The emergency shutdown shall be able to be activated both on the ship and on the shore and shall intervene in the bunkering installation and on the LNG ship to be bunkered. The emergency shutdown shall be able to be both activated manually and in an automated manner at all times.

The bunkering operation will be able to be stopped effectively and safely without any liquid or vapour being released, both manually and automatically, by means of an emergency shutdown signal. The emergency shutdown signal shall be sent to both the ship to be bunkered and to the bunkering installation in order to ensure that the right actions are triggered in both individual installations at the same time.

The emergency shutdown facility shall be suitable for the capacity of the installations and can be activated by one or more of the following sources:

- gas detection;
- fire detection;
- manual activation of both the ship to be bunkered and the bunkering installation;
- break-away detection;
- electrical power failure;
- detection of an excessively high level in the fuel tank(s);
- high-pressure detection;
- detection of an excessively large liquid flow;
- detection of the filling arm/filling hose leaving its safe working zone.

Note:
A cable connection shall be created between the ship to be bunkered and the bunkering installation as prescribed in the ADN (chapter 9) for anti-overfilling protection and pump emergency shutdown.

5.8 Safety studies

reg 5.8.1	According to the standards listed in annex B, and in accordance with the provisions of

reg 5.2.2, safety studies shall be carried out for the facility.

5.9 Simultaneous activities while bunkering

See reg 5.2.1. It shall be specified clearly in the application which activities can take place at the same time at the LNG bunkering installation, so that the competent authority can form an opinion thereof. The checklist then provides for the operational coordination of simultaneous activities, see part B of annexes D or E.

6 Incidents and disasters

Brzo '99 applies to installations of a content equal to or greater than 50 tons. An element of this is 'planning for emergency situations'.

PGS 33-1 applies to installations of a content of less than 50 tons.

In addition to PGS 33-1, the following regulations apply.

reg 6.1.1	In case of any disaster at the LNG bunkering installation, the waterway manager and/or the port authority shall be alerted.

reg 6.1.2	The emergency plan and the alerting instructions shall be coordinated with the local/regional emergency services.

Annex A Terms and definitions

For the application of this guideline the following terms and definitions apply.

Authorised inspection body (Aangewezen keuringsinstelling – AKI)
body authorised by the Minister of Social Affairs and Employment (SZW) that may carry out (re)inspection work and/or assessments under the Pressure Equipment Decree

Natural gas
substance that is in a gaseous state at a temperature of 15 °C and a pressure of 101.325 kPa and consists mainly of methane or another substance that, because of its characteristics, is equivalent to methane (definition of the Gas Act)

Delivery pressure
pressure in the LNG delivery installation measured on the discharge side of the delivery installation

Delivery hose
flexible hose, including the couplings and the filler connection that forms part of the delivery installation with which LNG is delivered to the LNG storage tank or the vehicle tank

Shut-off valve
mechanism to regulate the flow of a medium (gas, solid, slurry or liquid), by (partly) opening or closing one (or more) flow openings by manual operation or remote control

Operating staff
staff that has been educated and is qualified to carry out all actions necessary to load and/or offload LNG

Manager
the person who is responsible for the operation of the bunker installation and has an agreement with the user/owner

Note:
The user can also be the manager or the owner.

Assessment
checking the design against PED, WBDA, ATEX, PGS 33-1

Competent authority
managing body of a corporate body governed by public law, for example a municipal executive of a municipality that has been given a competence described in a law to take a written, binding decision on a particular subject that has legal consequences for citizens and/or companies

Boil-off gas
evaporated LNG which is produced as a result of the leaking in of heat

Outside air
place in the open air where, without mechanical means, the air speed is usually higher than 2 m/s and rarely less than 0.5 m/s and where no hindering obstacles are present

Note:
A situation with one side wall and a roof is regarded in this guideline as an outside air situation.

Bunkering
delivering LNG as a fuel to ships

Bunker installation
facility intended or used for the storage or delivery of fuel to ships for propulsion or for some other form of use

Declaration of conformity
declaration in which the fabricator declares that the equipment/assembly is fabricated according to the code indicated in the design and that monitoring is carried out by an independent third party (Nobo)

Floating bunker installation
floating equipment with a permanent mooring place intended or used for the storage or delivery of fuel to ships for propulsion or for some other form of use

Dry-break/break-away coupling
facility that automatically interrupts the flow of natural gas so that the quantity of natural gas released is minimised if, as a consequence of an excessive movement of the ship, the loading installation breaks away from the ship while bunkering

Owner
see user

Fabricator
the person who manufactures the equipment or the (PED) assembly and issues a declaration of conformity for this

FMEA (Failure Mode Effect Analysis)
carrying out a failure analysis of equipment and components. The different ways in which the components fail are elaborated here in terms of effect and safety importance for the entire device and the surroundings. The vulnerable components can then be identified and any supplementary requirements for the reliability of the vulnerable and critical components can be laid down

HAZID (Hazard Identification)
identifying potential hazardous events, their consequences and the safety measures and facilities present. The HAZID is done in the form of a brainstorming session. A HAZID is applied in order to document whether the follow-up phases of a design process shall take the reduction of risks as a consequence of potential incidents into account

HAZOP (HAZard and OPerability study)
systematic study using guide words into all foreseeable deviations from a normal process operation (including commissioning and decommissioning), into the causes and effects of such deviations in a qualitative meaning, and into the actions necessary. A study is made as to whether the installation can function differently than intended by the normal design intention. The purpose of a HAZOP is to prevent faults, accidents and (environmental) incidents by establishing and implementing improvements to the design of an installation

Loading system
assembly consisting of a fixed filling arm with swivel points or a filling arm with a flexible filling hose to facilitate coupling and/or uncoupling

Note:
Loading system sometimes also refers to a single hose.

LNG tanker ship
ship used to transport LNG to the LNG delivery installation

Gas degasification
lowering the methane content to a volume percentage of less than 0.5 % (5 000 ppm)

User (in line with PED)
the person who will use the installation and shall comply with the licence and Dutch legislation

Facility (in line with the Environmental Management Act (Wm))
any business activity undertaken by people as a business or to an extent as if it was as a business that is done within certain limits

Note:
This then means the complete business of which the LNG delivery installation is a part.

Inspection
statutory obligation to be carried out by an independent body (for example AKI)

Liquefied biomethane (LBM)
liquefied biomethane

Liquefied natural gas (LNG)
natural gas that is liquefied for transport and storage purposes after treatment

LNG delivery installation
installation including the LNG storage for delivering LNG to ships that use LNG as a motor fuel

LNG dispenser
assembly of parts used to deliver LNG to a ship. The LNG dispenser consists of: the loading installation, the start and stop buttons and any flow meters and other instruments. The LNG dispenser can be placed on land, on a floating bunker station or a landing stage

LNG installation
collection of assembled installation components that (can) contain LNG

LNG tank truck
lorry with a tank intended for transporting LNG in accordance with the requirements of the ADR

Note:
In the context of this PGS, LNG tank truck refers to both a tank truck and a semi-trailer with a tank container.

LNG storage tank
buffer/reservoir (pressure vessel) in which a stock of LNG is stored

LNG filling point
filling point of the LNG storage tank via which restocking is carried out

Emergency shutdown
switching off and/or shutting down an item of equipment, vehicle or installation as quickly as possible in case of an emergency

QRA
Quantitative risk assessment
Quantitative risk analysis
numerical evaluation of the chances, effects and consequences of accidents and the combination of these in risk measurements

Non-return valve
component in the installation that prevents the return of gas and/or liquid

Supervising person
person who has received instructions about the safe operation of the delivery installation and the execution of the emergency plan in case of disasters, e.g. the facility manager or a customer, for example a driver

Note 1:
This must be laid down administratively and be demonstrable.

Note 2:
If the customer of the LNG (the acting captain of the ship to be bunkered) or the driver of the LNG tank truck have received instruction, specifically for a location, they can be seen as a supervising person. If this person leaves the site, delivery shall now no longer be possible without identifying a new supervising person.

Annex B Standards

[A]	NEN 1010	Safety requirements for low-voltage installations
[B]	NPR 2578	Management and maintenance of LPG, propane and butane installations
[C]	NEN 3011	Safety colours and safety signs in workplaces and public areas
[D]	NEN 3140	Operation of electrical installations – Low voltage
[E]	NPR 5527	Guidelines for checking, inspection and assessment of industrial hose assemblies in use
[F]	NEN 6064	Determination of the non-combustibility of a building product
[G]	NPR 7910-1	Classification of hazardous areas with respect to explosion hazard – Part 1: Gas explosion hazard, based on NEN-EN-IEC 60079-10-1:2009
[H]	NEN-EN 3-7	Portable fire extinguishers – Part 7: Characteristics, performance requirements and test methods
[I]	NEN-EN 287-1	Qualification test of welders – Fusion welding – Part 1: Steel
[J]	NEN-EN 473	Non-destructive testing - Qualification and certification of NDT personnel – General principles
[K]	NEN-EN 1160	Installations and equipment for liquefied natural gas – General characteristics of liquefied natural gas
[L]	NEN-EN 1473	Installations and equipment for liquefied natural gas – Design of onshore installations
[M]	NEN-EN 1474-1	Installations and equipment for liquefied natural gas – Design and testing of marine transfer systems – Part 1: Design and testing of transfer arms
[N]	NEN-EN 1474-2	Installations and equipment for liquefied natural gas – Design and testing of marine transfer systems – Part 2: Design and testing of transfer hoses
[O]	NEN-EN 1474-3	Installations and equipment for liquefied natural gas – Design and testing of marine transfer systems – Part 3: Offshore transfer systems
[P]	NEN-EN 12434	Cryogenic vessels – Cryogenic flexible hoses
[Q]	NEN-EN 13458-2	Cryogenic vessels - Static vacuum insulated vessels – Part 2: Design, fabrication, inspection and testing

[R]	NEN-EN 13458-3	Cryogenic vessels - Static vacuum insulated vessels – Part 3: Operational requirements
[S]	NEN-EN 13645	Installations and equipment for liquefied natural gas – Design of onshore installations with a storage capacity between 5 t and 200 t
[T]	NEN-EN 13766	Thermoplastic multi-layer (non-vulcanised) hoses and hose assemblies for the transport of liquid petroleum gas and liquefied natural gas – Specification
[U]	NEN-EN-IEC 60079-0	Explosive atmospheres - Part 0: Electrical equipment – General requirements
[V]	NEN-EN-IEC 60079-14	Explosive atmospheres - Part 14: Electrical installations design, selection and erection
[W]	NEN-EN-IEC 60204	Safety of machinery - Electrical equipment of machines
[X]	NEN-EN-ISO 16903:reeks	Characteristics of LNG influencing design and material selection
[Y]	NEN-EN-ISO 28460	Petroleum and natural gas industries - Installation and equipment for liquefied natural gas - Ship-to-shore interface and port operations
[Z]	ISO 16923	Natural gas fuelling stations - CNG stations for fuelling vehicles
[AA]	ISO 16924	Natural gas fuelling stations - LNG stations for fuelling vehicles

Annex C Relevant legislation and regulations

Introduction

The majority of the requirements or regulations laid down for the use of hazardous substances are laid down in legislation, whether or not based on European Directives or follow directly from European regulations. The PGS publications aim to give as complete as possible a description of the way in which companies can comply with the requirements arising from legislation and regulations.

This summary is broken down into the following categories:

- general;
- requirements for technical integrity;
- operation;
- requirements for spatial context;
- transport.

For the most up-to-date version of the legislation and regulations we advise you to consult the website www.wetten.overheid.nl.

In 2010 a start was made with the development of standards for LNG and CNG fuelling installations (filling stations) on an international and European level, respectively ISO 16924 and ISO 16923. The development of this national PGS publication serves as input for the facility of the international agreements and vice versa.

General

Environmental Licensing (General Provisions) Act (Wet algemene bepalingen omgevingsrecht – Wabo)
The Environmental Licensing (General Provisions) Act (Wabo) came into effect as of 1 October 2010 with the corresponding Ambient Law Decree (Besluit omgevingsrecht – Bor) and the corresponding Ministerial Regulation on Ambient Law (Ministeriële regeling omgevingsrecht – Mor). A large number of existing licensing systems have transferred to the Wabo, including those of the Environmental Management Act (Wet milieubeheer) and the Housing Act (Woningwet). This means that for an facility for which the former ‘milieuvergunning’ type of environmental licence was required, an ‘omgevingsvergunning’ type of environmental licence is now necessary to build or modify an facility (environmental activity). The actual Bor and, consequently, annex 1 of the Bor indicate the 'International Plant Protection Convention (IPPC) facilitys' and respectively 'other facilitys that require a(n environmental) licence'.

Activities Decree (Activiteitenbesluit)
The Decree on general rules for environmental management of facilitys (Barim (Besluit algemene regels voor inrichtingen milieubeheer) or Activities Decree) gives general environmental rules for companies for whom a licence is not compulsory. In addition, for certain activities, the decree contains regulations that may also apply to facilitys for which a licence is compulsory. The Activities Decree does not apply to the IPPC facilitys referred to

above at all, unless flammable liquids are delivered there. By ministerial regulation or in the licence the legislator refers to specific PGS regulations for certain activities.

The Activities Decree makes a distinction between three types of facilitys: A, B and C. Type A and type B facilitys fall fully under the general rules of the Activities Decree, where for type A facilitys, because of their low environmental impact, the 'light regime' and no reporting obligation applies. Type B facilitys are facilitys for which the licence obligation is lifted but that do have a reporting duty. Type C facilitys are facilitys for which a licence is compulsory as indicated in annex 1 of the Bor. The latter group of established shall have a licence. Since the regulations from the Activities Decree directly apply to certain activities, these regulations may not be included in the licence.

Requirements for technical integrity

Pressure Equipment (Commodities Act) Decree (Warenwetbesluit drukapparatuur – WBDA)

The European Pressure Equipment Directive (PED) has been transposed in the Pressure Equipment (Commodities Act) Decree (WBDA) in the Netherlands. The requirements of the European Directive for design and new build are further interpreted in harmonised European standards.

The WBDA lays down requirements for the technical integrity of installations for the use and storage of pressurised gases or liquids. The requirements focus among other things on the strength of pressure equipment under different conditions, on safe operation, inspection equipment, drain and vent devices, corrosion, wear and tear, assembly of different components, filling devices and overfilling protection devices and safety accessories.

However, certain things are not regulated in the Pressure Equipment (Commodities Act) Decree. For example, it does not apply to components of installations with a pressure of 500 hPa (positive pressure with respect to the atmospheric air pressure) or lower. This means that in the Netherlands, the rules of the Health & Safety legislation as regards a general duty of care of the employer and the safety of work equipment and workplaces are applicable. If equipment is marketed that does not fall under the scope of the Pressure Equipment (Commodities Act) Decree, the product liability which a fabricator has towards his customers still applies.

For monitoring the taking into service and periodic re-inspection of pressure equipment under the Pressure Equipment (Commodities Act) Decree, national inspection bodies ('authorised inspection bodies' or 'AKI') are appointed by the Ministry of Social Affairs and Employment (SZW).

Legislation on explosive atmospheres (ATEX 95)

ATEX (Atmosphère explosible) is the synonym for two European Directives in the field of explosion hazard. ATEX 95 (Directive 94/009/EEC) concerns technical integrity and contains target regulations for equipment and protective systems used in potentially explosive atmospheres. In the Netherlands ATEX 95 is transposed in the Explosion-safe equipment (Commodities Act) Decree.

Operation

The **Working Conditions Act** (Arbeidsomstandighedenwet) states the rights and obligations of both employer and employee in the area of working conditions. The Working Conditions Act applies wherever work is carried out, not only in companies, but also in associations or foundations.

The **Working Conditions Decree** (Arbeidsomstandighedenbesluit), an elaboration of the Working Conditions Act, sets out further rules which both employer and employee shall comply with to prevent health and safety risks (target regulations). It also contains different and additional rules for a number of sectors and categories of employees.

In the Health and Safety Act revised in 2007 employers and employees were given more scope and responsibility for interpreting themselves the way in which they comply with the law within their own branch. This has the advantage that in enterprises H&S policy can be followed that takes into account the specific features of the sector.

In the Working Conditions Act the government provides a clear legal framework (target regulations) with as few rules and administrative burdens as possible. Employers and employees together make agreements about the way in which they can meet the regulations laid down by the government. These agreements may be laid down in so-called **Health & Safety catalogues**.

These describe the different methods and solutions that employers and employees have agreed together for meeting the target regulations laid down by the government. For example through descriptions of techniques and methods, good practices, standards and practical guidance.

According to the Working Conditions Act and the Working Conditions Decree every organization shall have an expert in-house emergency organization.

Additional risk inventory and evaluation (ARIE scheme)
Companies where a certain quantity of hazardous substances is present or can be formed in installations (regardless of the actions envisaged) shall carry out an Additional risk inventory and evaluation (ARIE) aimed at preventing serious accidents and implement a package of measures based thereon.

Risk inventory and evaluation (Risico-inventarisatie en evaluatie – RI&E)
Every company with staff shall investigate or have investigated whether the work may constitute a hazard or may cause damage to the health of the employees. This investigation is called an RI&E and shall be laid down in writing according to article 5 of the Health and Safety Act, together with an action plan.

Pressure Equipment (Commodities Act) Decree (Warenwetbesluit drukapparatuur – WBDA)
In addition to requirements for technical integrity, the WBDA also contains a few requirements relating to operation. For example general requirements are laid down for the competence of maintenance mechanics relating to pressure equipment. It does not however discuss specific competencies for working on installations with hazardous substances.

Legislation on explosive atmospheres (ATEX 137)
ATEX (Atmosphère explosible) is the designation of two European Directives in the field of explosion hazard. Within businesses where an explosion hazard exists, the ATEX 137 directive (Directive 1999/92/EC) shall be complied with. This obligation is laid down in the Netherlands in the Working Conditions Decree (Arbeidsomstandighedenbesluit).

ATEX 137 describes the minimum safety requirements for creating a safe and healthy work environment for employees potentially at risk from explosive atmospheres. For the Netherlands these guidelines are included in the Health & Safety (ARBO) legislation and regulations. Employers are obliged to take measures that:

- as far as possible prevent the occurrence of explosive atmospheres;
- avoid the ignition of explosive atmospheres;
- limit the harmful consequences of an explosion.

The employer shall describe the risks in an explosion safety document and shall also describe the technical and organisational measures taken to minimise such risk there. The explosion safety document forms part of the RI&E.

Major Accidents (Risks) Decree (Besluit risico's zware ongevallen '99 (Brzo '99))
Brzo '99 is an important element of the implementation of the Seveso II directive. It contains requirements for companies that work with substantial amounts of hazardous substances. These requirements concern both the technical aspects of safety and operational aspects, such as safety policy, procedures and communication. A Brzo company shall implement a coherent safety management system that assures safe operation. A specification of a safety management system for risks of serious accidents is provided in NTA 8620. Furthermore, Brzo companies with many hazardous substances shall have a safety report containing an identification of hazards and a description of risk control as regards internal safety, external safety, environmental safety and disaster relief. Besides this, large Brzo companies shall also draw up internal disaster plans. Furthermore, the public authorities that grant and enforce licences and permits can demand a quantitative risk analysis from these large companies.

Security Regions/In-house Fire Service Act (Wet veiligheidsregio's/Bedrijfsbrandweer)
The Security Regions Act (Wet veiligheidsregio's) came into effect on 1 October 2010. After this date, designating which facilitys are obliged to have an in-house fire service is a competence of the administration of the security region.

This Act includes the regulations for an in-house fire service organization in Article 31, as well as in chapter 7 of the Security Regions Decree (Besluit veiligheidsregio's). The new regulations incorporate the results of the 'Updating in-house fire services' project.

The Security Regions Decree contains a description of the procedure that the government and companies shall follow to arrive at an opinion on any in-house fire service obligation:

The Security Regions Decree states very specifically what details an in-house fire service report ("rapport inzake de bedrijfsbrandweer" – 'report on the in-house fire service') shall contain. According to the Security Regions Decree the administration of the security region shall only lay down requirements in the designation order on:

- staff;
- provisions;

- equipment;
- personal protection equipment;
- alarm and cooperation;
- scope of the in-house fire service.

The In-house Fire Service Guide (werkwijzer Bedrijfsbrandweren), published by the Landelijk Expertise Centrum Brandweer Brzo, is an aid in appointing an in-house fire service. This guide covers the following subjects in detail:

- statutory frameworks for in-house fire service provision;
- industrial safety;
- procedure for appointing the in-house fire service;
- hazard scenarios and drawing up the in-house fire service report;
- monitoring and enforcement;
- preparedness for in-house fire services
- training and practices;
- quality requirements of government organization.

(Inter)national standards for operation
(Inter)national standards have been drawn up that describe a method for a safe operation using a safety management system. Current examples are the Occupational Health and Safety Assessment Series (OHSAS) 18001 for OHS management systems, ISO 14001 for setting up an environmental management system, or the Dutch Technical Agreement NTA 8620 for the safety management systems of Brzo companies.

Requirements for spatial context

In addition to technical integrity and operation, the spatial context of storage and transfer installations is also important for assessing the hazards relating to such an installation and managing the risks. A distinction is made between three types of distance requirements:

- hazard zones around electrical installations;
- distances between components of an installation, storage and flammable objects on the site;
- distance requirements relating to buildings inside and outside the facility and public functions outside the facility.

Building Decree (Bouwbesluit)
The Building Decree 2012 includes general rules for fire-safe building and use of buildings.

The purpose of the Building Decree 2012 as regards limiting the spread of fire (fire compartmentalisation) is to be able to control a fire so that people can escape safely and the fire does not spread to other buildings. The Building Decree specifies in principle (for new builds) that buildings shall be divided into fire compartments with an area of use of no more than 1 000 m² and in a number of cases – industrial functions – up to 2 500 m² (for storage facilities for packaged hazardous substances PGS 15 has the limit of 1 000 m²). For a larger area of use, equivalent safety shall be demonstrated. This may among other things be done using the survey report Method for Manageability of Fire (Methode Beheersbaarheid van Brand) (edition 2007). Note: in combination with hazardous substances, this requires special

attention because there are exclusions in the model, among other things for substances with rapid fire spread.

NEN 6068 states how this resistance to fire breakthrough and fire flashover shall be determined based on the fire resistance and the design of the building.

External Safety (Facilitys) Decree (Besluit externe veiligheid inrichtingen – Bevi)
Further requirements may be laid down by the Bevi – coupled with the Environmental Management Act – for the external safety of facilitys with specific risks for people outside the site of the facility. The purpose of the Bevi is to limit the risks to which citizens are exposed in their living environment due to activities with hazardous substances performed in facilitys up to a set limit. Since October 2004, the Bevi has obliged the competent authority, when granting licences under the Environmental Management Act and for relevant spatial developments (in particular zoning plans), to take into account the external safety (place-related risk and group risk). Based on the Bevi, the distances to be maintained for a number of industrial sectors are specified in a ministerial regulation (External Safety (Facilitys) Regulations (Regeling externe veiligheid inrichtingen)). For other companies, for example Brzo companies, the distance to be maintained shall be determined by a risk calculation using the calculation rules stated in the Bevi. This indirectly imposes safety standards on companies which by using, storing, transporting or producing hazardous substances form a risk for people outside the industrial site.

The Bevi in outline:

- the Bevi regulates how a municipality or province shall handle risks for people who are present outside a company with hazardous substances;
- the Bevi determines the place-related risk. With this municipalities and provinces can determine safety distances around risk companies;
- the Bevi imposes an accountability duty on the competent authority if the group risk increases;
- when companies are located too close, for example to housing, extra safety measures are necessary. In the most extreme cases, municipalities and provinces can have a company move or demolish housing.

If an facility falls under the Bevi, it is a Type C facility under the Activities Decree.

Transport:

Transport falls under international conventions for the transport of hazardous substances. These regulations and their translation are embodied in ministerial regulations in the Transport of hazardous substances act (Wet vervoer gevaarlijke stoffen) and in the Ships Act (Schepenwet). The following international conventions are important here:

Inland waterways regulation (Binnenvaartregeling)
Regulation implementing the Inland Waterways Act (Binnenvaartwet) and the Inland Waterways Decree (Binnenvaartbesluit) that took effect on 30 December 2008 in order to implement European Directive no. 2006/87/EC.

ADR for road transport
Accord européen relatif au transport international des marchandises Dangereuses par Route.
The Regulation on transport of hazardous substance by land (Regeling vervoer over land van

gevaarlijke stoffen – VLG) contains specific regulations for the transport of hazardous substances by road. Annex 1 to this regulation contains the international rules for the transport of hazardous substances, which come from the ADR convention.

ADN for carriage by inland waterways

Accord européen relatif au transport international des marchandises Dangereuses par voie de Navigation intérieure. The Regulation on transport of hazardous substances by inland waterways (Regeling vervoer over de binnenwateren van gevaarlijke stoffen (VBG) contains specific regulations for the transport of hazardous substances by inland waterways. Annex 1 to this regulation contains the international rules for the transport of hazardous substances, which come from the ADR convention.

Annex D Checklist from an LNG bunker station to an LNG fuelled ship

The checklist for bunkering from an LNG bunker station to an LNG fuelled ship can be found on www.lngbunkering.org.

Annex E Checklist for bunkering from an LNG tank truck to an LNG fuelled ship

The checklist for bunkering from an LNG tank truck to an LNG fuelled ship can be found on www.lngbunkering.org.

Annex F List of relevant standards and directives for LNG bunkering

Table F.1 – Relevant international and European standards and directives in relation to LNG bunkering ('onshore' installations)

Component	Function	Design	Qualification test	Testing
Coupling	Connection to ship's manifold	NEN-EN 1474-1	NEN-EN 1474-1	NEN-EN 1474-1
Hoses	Transfer of LNG and NG	NEN-EN1474-2		
		NEN-EN 12434		
		NEN-EN 13766		
		BS 4089		
Swivel joints	Product line articulation	NEN-EN 1474-1	New design qualification	NEN-EN 1474-1
Bearing	Articulation of support structure	NEN-EN-ISO 28460, NEN-EN 1474-1	NEN-EN-ISO 28460 NEN-EN 1474-1	NEN-EN 1474-1
ERS	Emergency disconnector	NEN-EN-ISO 28460, NEN-EN 1474-1	NEN-EN-ISO 28460 NEN-EN 1474-1	NEN-EN 1474-1
Break away coupling	Emergency disconnector	NEN-EN 1474-1	NEN-EN 1474-1	NEN-EN 1474-1
Loading arms	Loading system	NEN-EN-ISO 28460, NEN-EN 1474-1		NEN-EN-ISO 28460, NEN-EN 1474-1
Transfer system	LNG bunkering loading solution	NEN-EN-ISO 28460	NEN-EN 1474-3	NEN-EN-ISO 28460, NEN-EN 1474-1
		NEN-EN 1160		
		NEN-EN1474-1		
		OCIMF Mooring Equipment Guidelines		
		NEN-EN-IEC 60079		
		IGC\IGF Code		
		NFPA 70		
		NFPA 58		
		NFPA 59A		
		NEN-EN 13645		
		API 2003		

		ISO/TS 16901		

Annex G Bibliography

[1] API 2003, *Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents*

[2] *LNG Bunkering: Truck to ship, Port of Rotterdam* (in preparation)

[3] NFPA 58, *Liquefied Petroleum Gas Code*

[4] NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*

[5] NFPA 70, *National Electrical Code*

[6] OCIMF, *Mooring Equipment Guidelines*

Annex H Composition of PGS team

Name	Organization
Mr M. van Abeelen	Brandweer Nederland (Dutch Fire Service)
Mr M. Bakker	Det Norske Veritas
Mr L. Besemer	Slurink
Mr C. Boon	Port of Rotterdam Authority
Mr W.F. Büthker	Chairman
Mr G. Deen	Deen Shipping
Mr T. Dorsman	Classification societies
Mr B. Groothuis	Cofely
Mr K. Ham	TNO
Mr A. van der Hoeven	Department of Public Works (Rijkswaterstaat)
Mr J. Knoll	Shell
Mr L. Korvink	Ministry of Infrastructure and the Environment (I&M)
Mr E. van de Laar	Ministry of Economic Affairs (EZ)
Ms S. Lambers	Gulf Oil Netherlands
Mr E. van Leeuwen	Cryonorm
Mr H.C. Nobel	Bunker Services
Mr W. Schouten	NOVE
Mr A. Schroot	Danser Containerline
Mr J. Smit Roeters	Chemgas Shipping
Ms M. Spoelstra	Ministry of Social Affairs and Employment (SZW)
Mr L. Velgersdijk	Gate Terminal
Mr S. Verweij	Gutteling
Mr L. Vijgen	VNG
Mr K. Vinke	Lloyd’s Register Nederland
Mr T. Wingelaar	Caruton Barging Service Organization
Mr B. Joormann	Lloyd’s Register Nederland
Mr E. Wijbrands	Shell
Mr J. Raven	Ballast Nedam