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

PUBLICATIEREEKS
GEVAARLIJKE STOFFEN

Natural gas – liquefied natural gas (LNG) delivery installations for vehicles

Hazardous Substances Publication Series 33-1:2013 version 1.0 (June 2013)

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 33-1 was drawn up by PGS team 33 including representatives from the government and business community. The members of this team are listed in Annex L.

The Publication Series is kept up-to-date by the PGS Management Organization under the direction of a Programme Council which is made up of all the stakeholder parties. 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), and the Dutch Fire Service, the business community (VNO/NCW and MKB Nederland) and employees (vacancy).

The contents of the publication were determined by the PGS Programme Council.

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

June 2013

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Summary

This summary describes the structure of PGS 33-1. The summary also gives instructions on how to handle units and regulations.

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.

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.

LNG is a mixture of primarily methane with possible residual gases such as nitrogen, propane and ethane. Methane is liquefied at atmospheric pressure at temperatures of approx. – 162° C. LNG can be used to produce CNG by a simple technique, known as 'Liquid to Compressed Natural Gas' (LCNG).

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. In the Netherlands there are at present no formal guidelines for the design, construction and management of LNG fuelling installations/filling stations. As for the introduction of CNG, experience has shown that clear guidelines are needed for granting licenses and monitoring, which in themselves are again a condition for a market breakthrough. All stakeholders such as market participants, licensors and monitors need and benefit from the existence of a PGS publication for LNG delivery installations.

0.2 Relation with legislation and regulations

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 B gives a list of relevant legislation and regulations that are important for putting into service and managing LNG delivery installations. These are broken down into the following categories:

General:

– Environmental Licensing (General Provisions) Act (Wet algemene bepalingen omgevingsrecht – Wabo)

- Environmental Management Act (Wet milieubeheer)
- Activities Decree (Activiteitenbesluit)
- External Safety (Establishments) Decree (Besluit externe veiligheid inrichtingen – BEVI)
- External Safety (Establishments) Regulations (Regeling externe veiligheid inrichtingen – REVI)

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)
- Safety Regions/In-house Fire Service Act (Wet veiligheidsregio's/Bedrijfsbrandweer)
- (Inter)national standards for operational management
- Health & Safety catalogues (Arbocatalogi)

Requirements for spatial context:

- External safety policy and the Spatial Planning Act (Wet ruimtelijke ordening – WRO)
- Building Decree (Bouwbesluit)

Transport:

- ADR for road transport

For the most up-to-date version of the legislation and regulations we advise you to consult the website http://wetten.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 establishment of the international agreements and vice versa.

0.3 Government bodies involved

0.3.1 Municipality and province

For most establishments 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.

As regards fire safety, the safety region may be involved on two levels. Firstly because of its statutory advisory task in the situation where this involves a company that falls under the Major Accidents (Risks) Decree (BRZO) and/or the External Safety (Establishments) Decree (BEVI). Secondly the safety 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 acting 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.

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.

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 PGS publication includes regulations for the design, construction, maintenance and management of LNG fuelling stations. 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

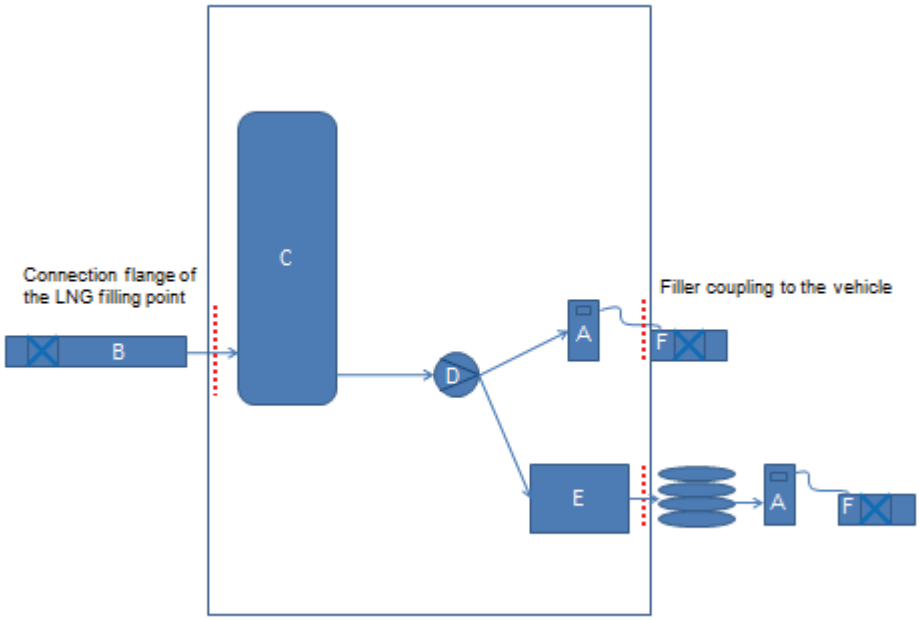
This PGS applies to the activities aimed at the construction and management of onshore LNG fuelling stations for vehicles. PGS 33-2 applies to onshore LNG bunker stations for boats.

The limits of the subject and scope of PGS 33-1 are set out in Figure 1.1. These are determined on the vehicle side by the filler coupling on the delivery hose to the vehicle being refuelled. For resupplying the LNG storage tank the filler coupling on the delivery installation is the limit of the subject and scope. The delivery of CNG, by evaporating and pressurising LNG (LCNG), also falls under the scope of this PGS. The limit is in this case at the outlet from the evaporator. The storage and delivery of CNG is described further in PGS 25.

The large-scale storage of LNG (receiving terminals) falls outside the scope of this PGS.

The transport of LNG by road is laid down in the ADR legislation.

Figure 1.1 – Scope and boundaries PGS 33-1



Legend

A LNG delivery installation
B LNG tanker
C LNG storage tank
D pump
E evaporator, LNG , LCNG , CNG
F motor vehicle

boundaries (connection flange of the LNG and at the filler coupling to the vehicle)

1.4 Equivalence principle

The equivalence principle applies for the application of the regulations from a PGS. This means that other measures may be taken that are equivalent to those included in the PGS. In practice this means that during the preliminary consultation, with regard to a report in the licence application or for monitoring by the Inspectorate SZW of the implementation of the target regulations of the Health & Safety rules and regulations, data shall be submitted showing that at least equivalent protection of the environment, labour protection and fire safety can be achieved with the measures taken. When granting licences, the competent authority assesses whether reporting can ultimately be achieved or with the application of other means and equivalent protection. The Inspectorate SZW reviews this upon inspections with regard to the enforcement of the Working conditions legislation.

1.5 Use of standards and guidelines

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

1.6 Relation with assessment guidelines and inspection criteria

1.6.1 Products bearing the CE marking

All components of an LNG delivery installation shall bear the CE marking if this is used in a scope falling under one of the Directives indicated on the website of the European Commission. For this document the following Directives are important:

- Electromagnetic Compatibility (EMC)
- Low Voltage Directive (LVD)
- Pressure Equipment Directive (PED)
- Machine Directive
- Construction Products Directive (CPD)
- ATEX Directive

Products falling under the CPD shall bear a CE marking. For applications other than those listed in Annex ZA of the relevant harmonised product standard, use of a CE marking is not compulsory.

For all products that may fall under the CPD no additional requirements are laid down with respect to the product characteristics mentioned in the CE markings. The setting of other additional requirements is however permitted.

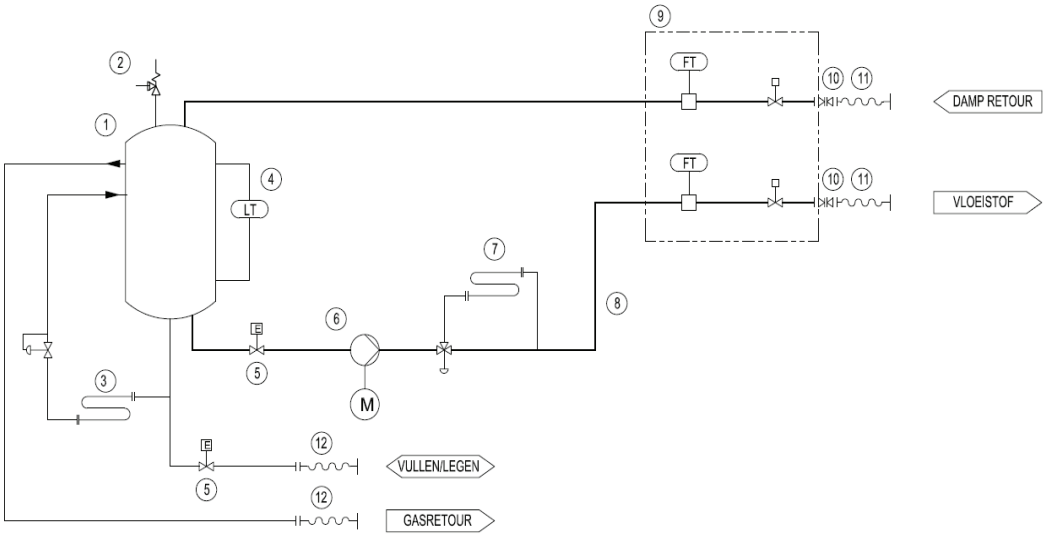
2 Construction and design of the LNG delivery installation

2.1 General description of the LNG delivery installation

This clause describes the requirements laid down for the construction and design of an LNG delivery installation. This includes storage tanks, piping, fittings, and the constructed (installed) LNG delvery installation. This information is relevant for all parties involved in LNG delivery installations. The majority of the requirements are laid down in legislation, whether or not based on European Directives. This legislation is reviewed in Annex B. In this legislation by far the most requirements included are for the construction of LNG storage tanks and fittings. The Inspectorate SZW is responsible for monitoring compliance with this legislation. 2.2.1 and 2.2.2 describe which aspects are important for the construction of storage tanks, piping and fittings 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.

Figure 2.1 shows a simplified diagram of an LNG delivery installation.

Figure 2.1 – Diagram of a basic LNG delivery installation



Legend

1. LNG storage tank
2. safety valves
3. pressure build-up evaporator
4. level measurement
5. shut-off valve
6. pump
7. reheater
8. piping system
9. dispenser
10. break-away couplings
11. delivery hoses
12. filling, offloading hose or filling arm

E = shut-off valve
FT = flowmeter
M = motor (of the pump)
LT = level meter

DAMPRETOUR = VAPOUR RETURN, VLOEISTOF = LIQUID
VULLEN/LEGEN = FILLING EMPTYING; GASRETOUR = GAS RETURN

A basic LNG delivery installation as shown in figure 2.1 normally consists of the following components:

1. LNG storage tank

This is where a stock of LNG is stored. A typical tank has a volume of 30 m3 to 60 m3. These storage tanks are pressure vessels with an operating pressure that may vary from 300 kPa to 2 000 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 by far the most cases vacuum insulated vessels are used. These vessels are twin-walled, where an almost complete vacuum is created in the space between the walls. In addition the space between the walls is also filled with perlite, which limits the insulation loss if the vacuum is lost. A storage vessel may be of an upright or horizontal design. Pressure measurement in the tank is normally carried out at the top of the tank. The tank is filled from an LNG tanker, using an offloading hose or offloading arm. This filling may be carried out by a pump on the LNG tanker, but also by differential pressure. The newly delivered LNG is often colder than what is still in the tank. As a result the pressure in the tank will often fall. Should this not be the case, this can be done in the LNG delivery tanker using a vapour return.

2. Safety valves (Pressure relief equipment)
Pressure relief equipment is fitted to prevent the pressure in the storage tank rising too high under any circumstances. This equipment includes pressure safety devices or blow-off safety devices.

3. Pressure build-up evaporator
A pressure build-up evaporator is often fitted to the LNG storage tank. This converts liquid from the tank into gas and returns it to the tank, as a result of which the pressure in the tank can be increased. A pressure reducing valve itself regulates the pressure in the tank. As an alternative, sometimes an automatic control valve is used, controlled by a pressure switch.

4. Level measurement
The level in the tank is normally measured using a differential pressure measurement over the liquid height. Particularly for horizontal tanks, level measurement is difficult in view of the limited differential pressure and particular attention shall be paid to calibration of the instrumentation. The maximum liquid 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 should also be taken into account, which falls at a higher temperature. As a result with warm LNG too low a level would be measured and so the tank can be overfilled.

5. Shut-off valve
All liquid connections to the tank are fitted with shut-off valves to prevent the storage tank emptying in case of disasters. These shut-off valves can have a dual function. Firstly as a process shut-off valve and secondly as a safety shut-off valve. In addition there are manually operated shut-off valves for maintenance purposes.

6. Pump
A pump may be used to fill the vehicle. This pump delivers the required booster pressure for the vehicle 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. This pump is always positioned lower than the liquid level in the tank. When the pump has cooled to the temperature of use, it can be started.

7. Reheater
It is advisable for the pressure of the LNG storage tank to be low. The temperature of the LNG is then also low. A higher pressure is needed in the vehicle tank. The pressure of the LNG will therefore need to increased, but in some cases also heated, to prevent the pressure in the vehicle tank quickly falling again, and no longer ensuring the fuel supply to the motor. A reheater can be fitted to do this. Various options are available for this, the most obvious being to use the ambient heat. Configurations are also possible where the LNG in the LNG storage tank is brought up to the right temperature and pressure. In this latter case no reheater is present.

8. Piping system
The LNG is transported via piping. The most commonly used material is SS. This is very suitable for the prevailing temperatures. 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.

9. Dispenser
The dispenser is equipped with delivery hoses, as well as start and stop buttons and any flow meters and other instruments. A bypass can also be fitted in the dispenser to enable the piping to be pre-cooled before filling the vehicle.

10. Break-away couplings
To prevent the installation being damaged or large quantities of gas being lost if a vehicle drives away while the hoses are still connected, break-away couplings shall be fitted in the delivery hoses.

11. Delivery hoses
These hoses shall be connected to the vehicle to be filled by a quick coupling. When disconnecting this closes so that virtually no (L)NG is lost. The delivery hose shall be fitted with a filler connection that can only be opened after connection to the vehicle.

12. Filling, offloading hose or filling arm
The hose/arm used by the LNG delivery tanker filling the LNG storage tank.

2.2 Construction of the LNG delivery installation

2.2.1 General

Insulation of the storage tank and any pipework is often carried out for cryogenic applications using vacuum insulation. This means that a vessel or line is of a twin-walled design, with a virtually complete vacuum in the space between the walls. As a result the heat loss is kept to a minimum. A radiation screen is fitted round the cold inner vessel, or the space is filled with perlite. The latter limits the heat losses upon loss of vacuum.

2.2.2 EC declaration of conformity

The EC declaration of conformity and the instructions for use shall be present for LNG storage tanks manufactured in accordance with the European Pressure Equipment Directive (after 29 November 1999). The EC declaration and the instructions for use shall always be present if a CE marking is also affixed. These are inseparably associated with one another.

These aspects are laid down in the Pressure Equipment (Commodities Act) Decree. For this reason no additional regulations are included for these aspects.

2.2.3 Other information for LNG delivery installations

Installation
An LNG delivery installation is an assembly of several pieces of pressure equipment (pressure vessels, installation piping, safety accessories, pressurised accessories, construction etc.), as described in clause 2.1 of the Guidelines relating to Pressure Equipment Directive (PRD). An installation may be an assembly or a pressure system.

Assembly
The term assembly comes from the PED. An assembly is the fitting together of several pieces of pressure equipment into an integrated and functional whole, where the whole assembly bears a CE marking.

Pressure system
The term pressure system comes from the WBDA. A pressure system is a system of several pieces of pressure equipment or assemblies that are assembled into an integrated and functional whole under the responsibility of the user on his industrial site.

Note:
Pressure systems as a whole do not bear a CE marking, while the separate components may have this mark.

Data plate
For assemblies and pressure systems in complex installations, the indication of all the applicable technical data may result in a cluttered data plate. In such cases the data plate of the assembly or pressure system may give a reference to a summary document, often called a classification list. This list gives a summary of the pressure equipment of which the assembly or pressure system consists.

Design

reg. 2.2.1 An LNG storage tank shall be fitted with:

- an installation with which the inner vessel can be emptied;
- display of the maximum filling capacity, see Annex I;
- a level meter, which continuously and visibly indicates the filling capacity;
- a safety device that prevents the tank exceeding the maximum filling capacity;
- a pressure gauge, which has a measuring and indication range of at least the design pressure of the storage tank.

2.2.4 Construction of the LNG storage

LNG storage tanks shall comply with the European Pressure Equipment Directive (97/23/EC). With the coming into effect of the Pressure Equipment (Commodities Act) Decree this European Pressure Equipment Directive (Pressure Equipment Directive – PED) is transposed in the Netherlands. For the foundation, support and (emergency) shut-off valves the following regulations apply.

reg. 2.2.2 The LNG delivery installation shall be positioned on a base that is made of non-flammable material. A suitable foundation shall be installed. Any foundation or support structure installed shall be made of material that does not sustain a fire according to NEN 6064.

reg. 2.2.3 The support structure of the storage tank shall continue to perform its function according to R 60 for a fire lasting at least 60 min.

Note:
An asphalt base does not sustain a fire but depending on the thickness and the type of base may deform, as a result of which the stability of the tank is not guaranteed.

reg. 2.2.4 In the LNG filler line and on connections of the LNG storage tank (with the exception of the pressure relieving equipment and level measurements) at as short as possible a distance from the LNG storage tank, manually operable shut-off valves for maintenance and controlled shut-off valves shall be fitted. All safety shut-off valves shall be fitted with an open/closed position indicator. The safety shut-off valves shall close if the servo-mechanism fails. If over the shut-off valve there is a pressure that is equal to at least the assessment pressure of the LNG storage tank, the proper operation of a safety shut-off valve shall be guaranteed. The safety shut-off valves close within 5 s after the voltage fails (activation of ESD).

2.2.5 Catch pit around bund wall

In case of failure of the LNG storage tank a pool of LNG may form under the tank. Calculation has shown that installing a catch pit or bund wall does not have the effect of increasing safety and so is not required.

Note:
Important parameters that determine whether an LNG discharge may result in a pool are the discharge rate and the size of the LNG drip. Calculations (DNV) show that only discharge resulting from a pipe fracture with drip sizes of greater than 1 mm and rates of less than 10 m/s will cause a pool. This situation only arises some time (more than 10 min) after the start of the discharge when the pressure and discharge quantity have reduced. The pool then has a maximum diameter of 12 m. By then the vessel is already 75% empty.

2.2.6 Safety devices

In relation to filling process

reg. 2.2.5 An LNG storage tank shall be designed with two independently operating level measuring systems according to NEN-EN 13645 that ensure that filling of the LNG storage tank stops automatically on reaching the maximum filling capacity (see also reg 3.3.4).

In relation to saturation

reg. 2.2.6 A device shall be present that ensures that the maximum level in the tank is not exceeded as a result of saturation.

Note:
Due to heating of LNG the liquid expands which causes the level in the tank to rise. This process is described as saturation.

reg. 2.2.7 For the central vent stack of the LNG delivery installation:

- no rainwater shall be able to collect;
- it shall not be possible to close this;
- it shall have an discharge in a vertical direction;
- it shall be fitted with a detector for the presence of liquid;
- upon liquid (temperature) detection, the emergency shutdown shall be activated automatically.

reg. 2.2.8 The height of the central vent stack is determined such that a calculation shall demonstrate that:

- (1 m above ground level) the heat radiation at ground level from this source is less than 3 kW/m^2 within the establishment limit and outside it lower than 1 kW/m^2; NEN-EN 13645 gives a maximum value of 3 kW/m^2 for the ‘radiation from flare or lightning of vent in intermediate area’ (though this is outside the limits of the establishment);
- the heat radiation intensity from a flare from the central vent stack on the LNG storage tank is less than 35 kW/m^2;
- no pool of LNG is produced as a result of LNG liquid spray from the central vent stack or rainout.

Note:
See Annex K: ref. [2] for the background calculations.

reg. 2.2.9 The dispenser shall be designed such that the hose pressure cannot rise above the safety pressure of the vehicle tank. The dispenser shall be fitted with a device that terminates the delivery when the LNG delivery tank is completely filled.

Pressure relief of LNG storage tank

reg. 2.2.10 An LNG storage tank shall be fitted with pressure relief equipment according to NEN-EN 13645. These shall be connected to a central vent stack with a vertical mouth at a safe height in relation to the adjacent site (See reg 2.2.8).

2.2.7 Soil protection provisions

Liquefied natural gas that is released will heat up and evaporate within a very short time. No soil protection measures are needed.

2.2.8 Sewer system and street gulleys

reg. 2.2.11 The site layout, slope of the floors and location of street gulleys shall be such that any LNG released:

- cannot run into a street gulley;
- cannot run to another installation with hazardous substances;
- cannot run to/over the access roads;
- cannot accumulate under the LNG delivery installation, the LNG tanker and the motor vehicle refuelling with LNG.

reg. 2.2.12 The site layout, slope of the floors and location of the street gulleys shall form part of the licence application.

2.2.9 LNG piping and fittings

All piping and the corresponding fixings of piping and accessories shall be designed such that no inadmissible stresses arise as a result of mounting, settlement or shrinkage due to temperature differences. This shall take into account the quality of the materials used, such as flange bolts and gaskets.

reg. 2.2.13 When using material with no electrical conductance measures shall be taken to ensure connection of the piping parts with good electrical conductance on both sides of these materials with no electrical conductance.

reg. 2.2.14 Connections shall only be made by competent staff. It shall be possible to demonstrate their competence for example by (training) certificates.

2.2.10 Pressure relief piping

reg. 2.2.15 A piping section between two shut-off valves, in which an inadmissible pressure increase may occur due to the containment of (liquefied) gas, shall be fitted with pressure relief equipment that is connected to the central vent stack.

2.2.11 Filling point of the LNG storage tank

reg. 2.2.16 The LNG filling point of the LNG storage tank shall be above ground.

reg. 2.2.17 The LNG filling point shall be properly protected from collision by vehicles.

reg. 2.2.18 There shall be a provision at the LNG filling point of the storage tank, by means of which the driver of the LNG tanker has a good view of the filling level (in volume per cent) and the pressure build-up in the LNG storage tank during filling and has sufficient time available to intervene in the filling operation before the maximum permissible filling level/pressure level is reached.

reg. 2.2.19 An LNG filling point shall be fitted with metal connection points so that via the filling point the LNG tanker has a potential equalization (earth), with the aim of eliminating any difference in electrostatic charge between the LNG tanker and the LNG storage tank.

reg. 2.2.20 A non-return valve shall be installed in the filling line to the LNG storage tank before the end shut-off valve of the liquid line.

2.2.12 Protection from unauthorised persons

reg. 2.2.21 The LNG delivery installation (with the exception of the dispenser), shall be properly protected against access by unauthorised persons using a partition.

Note:
The partition around the delivery installation shall comprise at least two doors fitted with a panic lock. On the partition next to each door it shall be clearly indicated in letters at least 50 mm high: SMOKING AND NAKED FLAMES PROHIBITED' or a corresponding safety symbol according to the Health and Safety Signalling Decree (Official Journal 530, Oct.1993) shall be affixed. On the outside of the partition the signs 'PROHIBITED FOR UNAUTHORISED PERSONS' and 'STORAGE OF LIQUEFIED NATURAL GAS' shall be affixed as well as the telephone numbers for use in case of disasters.

reg. 2.2.22 The doors of the partition shall be closed, except during the time for carrying out work by the person authorised to do so within the partition.

reg. 2.2.23 No flammable material or flammable vegetation may be present within the partition around the LNG storage tank(s). The partition may be designed in full or in part as a wall, provided provision is made for sufficient ventilation according to NPR 7910.

2.3 Laying of (underground) pipework in LNG delivery installation

2.3.1 General

Piping, accessories, storage vessels and fittings fall under the Pressure Equipment (Commodities Act) Decree. In this paragraph a number of additional regulations are further described.

2.3.2 Laying (underground) piping and fittings

General

The piping materials used shall comply with the Pressure Equipment (Commodities Act) Decree. The piping of an LNG delivery installation may be laid above the ground or in a dry channel, or underground provided it is sufficiently protected from groundwater, chemical, thermal and mechanical influences.

LNG piping in a dry channel

reg. 2.3.1 When using a dry channel it shall be demonstrated that this structure has sufficient load bearing capacity.

Note

The calculation of the construction shall be based on the results of a soil mechanics survey according to NEN 3680.

reg. 2.3.2 The LNG piping in the channel shall be of one piece or of a welded design.

Note:

The piping may be of various insulation designs (for example cryogenic or vacuum insulation).

reg. 2.3.3 LNG piping of an LNG delivery installation shall be protected from chemical, mechanical and thermal influences.

reg. 2.3.4 LNG piping of an LNG delivery installation may be laid above the ground. If this is not possible, this piping may be laid in a (dry) channel, or underground provided it is sufficiently protected against chemical and mechanical influences.

reg. 2.3.5 Underground LNG piping for LNG delivery installations shall be laid such that that no material stresses can arise as a result of mounting, settlement or temperature differences.

Note:

For underground LNG piping it is possible that freezing phenomena of the soil may have an effect on limiting the thermal shrinkage of the piping. This shall be taken into account in the design.

reg. 2.3.6 If the LNG piping is laid in a channel, the design and the installation of the channel shall be such that under normal climatological conditions this is dry and designed such that no gas can accumulate in the channel or can move freely through the channel. Furthermore the channel shall be easily accessible for visual inspection.

Underground pipework

reg. 2.3.7 The underground LNG piping shall be of a twin-walled design where the outer casing has the same design conditions as the product-carrying piping.

Note:
Example for vacuum conditions: the twin-walled nature of the piping shall be resistant to the product, pressure and temperature conditions.

reg. 2.3.8 A leak detection system shall be present that is coupled to an alarm system. Upon activation of the alarm this signal shall be reported to the manager(s) of the building or site whereupon immediate action shall be taken.

reg. 2.3.9 Underground piping shall be made of only one piece of piping or be welded and shall be fitted with a corrosion protection system that protects the piping externally from corrosion.

Note:
Welding shall be carried out by qualified welders, for example according to NEN-EN 287-1. Tests on welds, if required by the Pressure Equipment Directive by non-destructive detection techniques shall be carried out according to an (inter)national standard existing for this purpose, for example NEN-EN 473.

reg. 2.3.10 All underground LNG piping for LNG delivery installations shall be laid in a layer of clean sand at least 0.1 m thick laid all round. This sand shall be cleaned of stones and other hard objects. Underground LNG piping shall be buried sufficiently deeply to withstand the mechanical loads expected. The ground covering shall be at least 0.6 m.

Note:
Reg 2.3.10 shall in any case be complied with if the following action is taken: the underground LNG piping is installed according to BRL K901. During filling of the piping trenches the external cladding shall be checked with a current meter according to BRL-K901.

Detection chamber of twin-walled underground LNG piping

reg. 2.3.11 The detection chamber shall be checked for tightness. It shall be possible to submit written evidence of the adjustment for inspection.

reg. 2.3.12 The detection system shall be resistant to the product, pressure and temperature conditions.

3 The LNG delivery installation in operation

3.1 Introduction

For an LNG delivery 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 delivery 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 delivery installation. This is covered further in Annex J. Apart from the determination of responsibilities a number of other aspects are relevant for safe operational management.

This includes among other things the following matters:

- management of the LNG delivery installation;
- execution of periodic inspections;
- monitoring the LNG delivery installation;
- filling the LNG storage tank;
- execution of work on the LNG delivery installation.

In 3.2 to 3.6 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

The regulations included in 3.2 apply to the whole LNG delivery installation. Filling gas cylinders does not fall under the scope of PGS 33.

reg. 3.2.1	In case of regular operation the emission of methane to the environment is not permitted. The LNG delivery installation shall have a device for collecting the boil-off gas or to prevent the formation of boil-off gas. The dispenser shall be fitted with a vapour return system, which collects the gas released, or a fully enclosed system without a vapour return system.

Note:
This can be effected by collection in a CNG buffer, where regulation reg 3.6.2 shall be complied with, or recondensing of the boil-off gas formed.

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

reg. 3.2.3 If the establishment is not opened for the delivery of LNG, all shut-off valves shall be in the safe position.

Note:
This involves the shut-off valves located between the LNG storage tanks and the LNG delivery 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/controls that are necessary to keep the installation cold. The opening time of these shut-off valves during chilling adjustments/cycles must be restricted to a very limited time, 2 to 3 min.

reg. 3.2.4 Delivery to separate refillable cylinders is not permitted.

Note:
There is not yet any experience with refillable LNG cylinders for vehicles. For this reason (at present) there is nothing included in this PGS about this. However, when this does apply, specific agreements with the competent authority shall be included for this.

3.3 Filling the LNG storage tank

3.3.1 Introduction to filling the LNG storage tank

General
For LNG delivery installations filling the LNG storage tank is the activity with the greatest risk. In this respect spatial aspects such as the location of the parking space for the LNG tanker and the internal distances are very important. In addition there is also the reachability of the reservoir and the filling point and the accessibility of the parking space for the LNG tanker. The LNG tanker shall be able to reach and leave the offloading point without hindrance. These spatial aspects and the minimum distances to be observed from the LNG tanker to objects within the establishment are described in clause 5.

In addition to these spatial aspects the offloading procedure and safety devices on the LNG tanker, in combination with devices fitted to the LNG delivery installation, shall guarantee an adequate safety level while filling the reservoir.

Requirements for delivery by the LNG tanker
The safety requirements for an LNG tanker are laid down in the ADR.

This guideline does however contain a few additional safety requirements that are necessary in the Dutch situation for the safe filling of the LNG storage tank of an LNG delivery installation. Because during loading or offloading of LNG an LNG tanker forms part of the establishment, some of these safety devices are required on the basis of the license or general rules applicable for these establishments. Where possible and relevant regulations on this are included in the underlying publication:

- requirements relating to the offloading hose (see reg 3.3.8);
- procedure for offloading the LNG tanker (see Annex E).

reg. 3.3.1 The LNG tanker to be offloaded shall be parked in the direction of driving away such that in case of need it can drive away to the public road without manoeuvring. The route shall be kept clear for the LNG tanker delivering LNG to the LNG storage tank to drive away.

Filling the LNG storage tank

For filling the LNG storage tank it is essential that this only takes place by and under the responsibility of the tanker driver, after obtaining the permission of the responsible manager of the LNG delivery 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 present at these times.

reg. 3.3.2 For delivery from the LNG tanker to the storage tank the driver shall be present during the filling process. To guarantee this the LNG delivery installation shall be designed with a dead man's button that shall be activated every 3 min. If the dead man's button is not activated in time, the pump stops and/or shuts off the delivery automatically.

When offloading a fixed procedure shall be followed. In addition to technical indications this procedure also includes instructions for the LNG tanker driver, such as:

- before filling the LNG storage tank is started, the driver shall assure himself that the situation in the vicinity is sufficiently safe, and
- during filling of the LNG storage tank the driver shall be able to operate the controls of the LNG tanker and check that the maximum permissible filling of the reservoir is not exceeded.

reg. 3.3.3 It shall be clearly indicated at the filling point what the maximum filling capacity of the storage tank is.

reg. 3.3.4 In an LNG storage tank the maximum liquid volume may not be higher than 95% of the actual tank volume. The expansion of the liquid during the hold time shall be taken into account here. If no measures are taken to ensure this, the maximum filling capacity shall be determined based on ADR. See Annex I for an example of calculation of the maximum filling capacity according to ADR.

reg. 3.3.5 As soon as the maximum permissible filling level is reached, the filling shall be stopped automatically (see reg 2.2.5).

3.3.2 Additional regulations for filling the LNG storage tank

reg. 3.3.6 The procedure for filling an LNG storage tank at an LNG delivery installation for motor vehicles shall be laid down (see for example Annex E).

reg. 3.3.7 When disconnecting the offloading hose virtually no (L)NG may escape. Any (L)NG that has been escaped shall be removed using a safe removal device. The maximum quantity of 'gaseous' LNG that may be released, may not exceed the maximum capacity of the offloading hose.

reg. 3.3.8	The offloading hose shall be replaced at least once every three years, unless the regular periodic visual inspection shows that earlier replacement is necessary. This replacement may be omitted if the offloading hose is inspected for soundness after these three years and hydraulically tested in accordance with NEN-EN 12434 or NEN-EN 13766. If defects are found in this test it shall be ensured that the hose is replaced after all. This test shall then be repeated annually. The test may be carried out by or on behalf of the operator of the LNG tanker or the manager of the LNG delivery installation. A written, dated certificate of this test shall be prepared. If requested it shall be possible for the LNG tanker driver to show this certificate. 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.

Note:
According to current practice and the ADR, the offloading hose shall be periodically visually inspected. For this reason no regulations relating to the visual inspections are included. Based on these visual inspections (UV corrosion, hairline cracks) the hose is as a rule replaced on a preventive basis within the first six years. After the third year this is done more often than in the first three years. When determining the risk distances to external objects, the REVI takes into account a certain chance of failure of the offloading hose. This chance of failure is arithmetically directly related to the test frequency. RIVM calculations have shown that the test frequency stated in this regulation is in line with the chance of failure used, which takes into account the necessary uncertainties (frequency of use, weather conditions, service life, use by professionals).

reg. 3.3.9	The liquid line intended for filling the LNG storage tank shall be fitted with a shut-off valve at the LNG filling point. This/these shut-off valve(s) shall be properly supported and may not be operated by unauthorised persons.

reg. 3.3.10	The offloading of an LNG tanker may not be carried out at the same time as the offloading of a tanker with other motor fuels within the same establishment, unless the LNG tanker is located more than 25 m away from the other tanker.

reg. 3.3.11	The motor of the LNG tanker may not be running during connection and disconnection of the offloading hose or offloading arm required for the filling. The motor may only be running during filling, if this is necessary for filling the LNG storage tank. The mechanical brake of the LNG tanker shall be applied during delivery to the LNG storage tank in operation.

reg. 3.3.12	Filling the LNG storage tank may not be possible before the connection between the controls of the shut-off valves of the LNG tanker to be offloaded and the emergency shutdown device of the shut-off valves of the LNG storage tank has been put in position. The remotely operable shut-off valve present in the filling line may only be opened during the filling process.

3.4 The delivery of LNG

3.4.1 Regulations for the delivery of LNG

General

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

reg. 3.4.2 The following label shall be affixed to the delivery installation (dispenser):

- 'TURN OFF MOTOR';
- '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.
At the site of the delivery installation and the vehicles that load or offload fuel or other liquids sufficient light shall be present to carry out the required operations safely. The whole establishment shall be illuminated during loading and offloading such that sufficient visibility is ensured.

reg. 3.4.3 By the parking bay of a refuelling vehicle at least one powder fire extinguisher with 9 kg powder shall be present to be able to fight the start of a fire effectively. If several vehicles can refuel at the same time, each parking bay shall be provided with at least one powder fire extinguisher according to the above specification. See also reg. 5.6.1.

Note:
This refers only to the extinguishers intended for the dispenser. Fire extinguishing equipment in a building (such as the shop/kiosk) fall under the Occupancy Decree. The number of parking bays corresponds with the number of vehicles that can refuel simultaneously.

reg. 3.4.4 The fire extinguisher can be reached without hindrance and is always available for immediate use and is installed within 5 m of the relevant dispenser.

Regulations for delivery to motor vehicles

General

The motor of the vehicle to which delivery is made, shall always be switched off before connecting the delivery hose and if present the vapour return hose. The motor of the vehicle to which delivery is being made may not be switched on until after the above hoses have been disconnected and put away.

reg. 3.4.5 When LNG is not being dispensed, the installation shall be in a safe state.

Note:
This means that all liquid shut-off valves have been closed and the gas return piping has been fitted with non-return valves, with the exception of circuits/controls that are needed to keep the installation cold and at an acceptable pressure.

reg. 3.4.6 When the LNG delivery installation is switched off, the electronic control and protection system forming part of the installation shall be switched such that that the delivery of LNG is not possible. The protection and alarm equipment shall however be fully ready for immediate use.

Ventilation of dispenser

reg. 3.4.7 The dispenser shall be fitted both at the bottom and at the top with two ventilation openings located opposite one another.

Note:
If the dispenser is fitted with a cabinet, this shall be fitted both at the bottom and at the top of the vertical wall with two ventilation openings located opposite one another, of which the total passage may not be less than 50 cm^2.

Dead man's button

reg. 3.4.8 On or in the dispenser a button or handle shall be fitted that shall be installed such that delivery of LNG can *only* take place by pressing on this button with the hand. This button is designed such that it can only be operated by hand. If the pressure on the button or handle disappears the delivery of LNG shall be stopped after a maximum of 3 s (so-called 'Dead man's button'). When the vehicle tank is completely filled, the dispenser shall immediately be turned off, at for example maximum pressure or minimum flow. It is permitted to design the dead man's button such that it is possible to release it for a maximum of 2 s for example to be able to change hands. Equivalent devices shall be submitted to the competent authority for approval.

Break-away coupling and vapour return hose

reg. 3.4.9 A dispenser with delivery hose and vapour return hose shall have a break-away coupling. The break-away coupling is fitted with a shut-off valve as a result of which upon breaking of a hose the discharge of LNG or vapour at the prevailing installation pressure is not possible. The vapour return hose is fitted with a non-return valve through which the dispenser buffer cannot flow back to the vehicle tank.

Delivery hose and vapour return hose

reg. 3.4.10 The delivery hose and the vapour return hose for LNG may not be longer than 5 m, but shall be at least 3 m long.

reg. 3.4.11 The delivery hose and vapour return hose shall comply with NEN-EN 12434 or NEN-EN 13766. The delivery hose for LNG shall be marked differently to the vapour return hose.

Nozzle

reg. 3.4.12 Nozzles are used for the delivery of LNG to a vehicle. These nozzles are only opened on coupling to the LNG storage tank such that on disconnection of the hose they close automatically *and* immediately. The nozzles are designed such that for the delivery of LNG, the potential difference between the LNG delivery installation and the tank of the vehicle is eliminated.

Operating instructions

reg. 3.4.13 The dispenser shall be marked with clear operating instructions. These instructions are affixed in a permanently and clearly visible and legible way. The instructions shall be given in a way that is understandable for the customer, with pictograms and/or text in at least Dutch.

Collision protection

reg. 3.4.14 The dispenser shall be effectively protected against collision by vehicles.

Emergency shutdown

reg. 3.4.15 The dispenser is fitted with an emergency shutdown device that can be operated on the dispenser and near the filling point.

3.4.2 Regulations for supervision of LNG delivery installations and automatic dispensers

The Working Conditions Act states that employees aged under 18 years may only carry out hazardous work under expert supervision. In addition the work and responsibilities shall be appropriate for the limited work experience inherent in the young age and incomplete physical and mental development of these employees. The supervision of the delivery of LNG may therefore only be carried out by persons aged 18 years and over.

reg. 3.4.16 The supervising person shall be 18 years or over and shall have had instructions from the establishment manager on the safe operation of the delivery installation and the execution of the emergency plan in case of disasters. This person shall have a view of the delivery of LNG. The supervisory person shall also physically release the delivery installation for the delivery of LNG. If there is no supervision, the delivery installation shall be locked. The manager shall keep a record of instructed customers.

Note
Under direct supervision is understood to mean that a supervising person is present within the establishment.

reg. 3.4.17 For the delivery of LNG without direct supervision via an automatic LNG dispenser, the LNG delivery installation shall be designed with the following devices:

a) a device that only makes delivery possible and releases the installation for use after identification of the permitted customer (see also reg 3.4.19);
b) a device that registers the details of the delivery as referred to in reg 3.4.20;
c) a call button, emergency telephone or equivalent other device with which the user or the person appointed by the user can be called and communicated with during opening times. This device shall be installed near the dispenser in a clearly visible place. The organization of the reporting system shall be clearly and visibly determined by the user;
d) in the vicinity of the delivery installation and in a readily accessible place an emergency shutdown device shall be installed. Upon activation of the emergency shutdown device the liquid shut-off valves shall go into a safe state within 15 s and rotating parts shall be switched off, in addition the user or person appointed by the user shall automatically be given an alarm. Paragraph c) above also applies here. In case of an ‘unmanned’ station, where the driver also has the task of supervision, he is the person who pressed the emergency shutdown or call button. This shall be taken into account in the organization of

the reporting system.

Note:
The supervising person may also be the driver.

reg. 3.4.18 The LNG delivery installation shall be designed with a device that checks whether the delivery pressure set is not higher than the design pressure of the vehicle connected. The supervising person shall ascertain that the delivery pressure corresponds with the vehicle pressure. For this a device shall be fitted that prevents a high delivery pressure system being coupled to a vehicle with a low pressure system. This can for example be done with a 'Radio frequency identification system' (RFID system), a suitable filler coupling or an electronic protection system.

3.4.3 Regulations for customers of LNG

reg. 3.4.19 The delivery of LNG may only be carried out by a customer who is registered by the establishment manager as a permitted customer.

reg. 3.4.20 The establishment manager shall determine upon this registration in a statement to be signed by the customer that:

a) the customer is familiar with and will comply with the following instructions for the delivery of LNG:
- on the site of the LNG delivery installation smoking and naked flames are prohibited;
- before the hose connection between the delivery installation and the vehicle LNG tank is created, the motor of the vehicle shall be turned off;
- the hose connection or connection with a filling arm shall be properly made where the use of attachments other than those supplied by the licensor is prohibited;
- after the hose connection or connection with the filling arm has been disconnected, the hose and the hose coupling (nozzle) shall be put away in the place intended for this;
- only vehicle LNG tanks mounted permanently in or on the motor vehicle that are intended for delivery of LNG to the motor of the vehicle may be filled;
- filling of other (refillable) cylinders is prohibited;

b) the customer (the person who operates the LNG delivery installation) has had practical instruction for filling the vehicle LNG tank with the licensor's delivery system;

c) the customer only has permission for personal use of the LNG delivery installation.

reg. 3.4.21 The establishment manager shall keep a register of the customers accepted by him (driver and type of vehicle) and the statements signed by them (user/director/driver).

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

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

These data shall be kept for at least two weeks.

Note
The purpose of the retention period of two weeks is so that in case of an incident or disaster it can be checked what operations were carried out at a particular time with the LNG delivery installation and by whom.

reg. 3.4.23 A mobile telephone (also DECT) may cause sparking and may not therefore be used during the delivery of LNG and in case of an incident with LNG. A clearly visible prohibition sign shall be affixed.

Note:
For this reason a land telephone line or connection with the control room or the maintenance company is necessary.

3.4.4 Regulations for the operation of LNG delivery installations and automatic dispensers

reg. 3.4.24 The putting into operation of the LNG delivery installation and the removal of the lock after the protection system has been triggered may only be carried out by the establishment manager or a person appointed and instructed by the establishment manager. The installation shall be designed such that it can only be put (back) into operation by the person appointed for this.

reg. 3.4.25 The LNG delivery installation put into operation shall be such that:

a) if no LNG is delivered:
- the identification and registration device is ready for use;
- the emergency button and the call installation are ready for use;
- the safety devices, such as the temperature-sensitive elements in the panels of the delivery installation, the protection on the non-closed state of the remotely controlled shut-off valves, the thermal protection of the pump motor and the protection against low pressure in the liquid delivery line are ready for use;
- the gas detection is active;

b) during the delivery of LNG:
- the identification and registration device is activated;
- the remote controlled shut-off valves are opened;
- the 'dead man's button' is pressed;
- the pump motor is connected to the electrical mains;
- the emergency button and the call installation are ready for use;
- the protective devices, such as the temperature-sensitive elements in the panels of the delivery installation, the thermal protection of the pump motor and the protection against low pressure in the liquid delivery line, are ready for use;
- the gas detection is active;

c) upon terminating the delivery of LNG, which is done by releasing the 'dead man's button', the installation and the protection system go to the situation indicated under a);

d) in case of incidents:
- the installation is automatically switched off and locked if the automatically operating protective devices, such as the temperature-sensitive elements/gas detection in the panels of the delivery installation, the thermal protection of the pump motor, the protection against the remote controlled shut-off valves not being closed and the protection against low pressure in the liquid delivery line, are activated;
- the installation is automatically switched off and locked if the emergency button is

operated;
- the indication of the installation being out of operation or faulty shall be clearly visible for the customer;
- the establishment manager or a person appointed and instructed by the establishment manager shall be given an automatic and in any case acoustic alarm when the emergency button is operated and/or the temperature-sensitive elements in the panels of the delivery installation and/or the protection against the remote controlled shut-off valves not being closed are activated;
- the establishment manager or a person appointed and instructed by the establishment manager can be warned via the call installation.

reg. 3.4.26 The LNG dispenser shall be switched off when the person supervising the establishment or a person appointed and instructed by the establishment manager is not present in the establishment or cannot be called or cannot be present within 3 min at the site of the installation.

reg. 3.4.27 The LNG delivery installation shall remain switched off if the protective devices have been in operation and the reason for this has not been rectified.

reg. 3.4.28 When the installation is out of use, there shall be a clear indication of this present for the customer.

3.5 Work on the LNG storage tank and accessories

3.5.1 Introduction to work on the LNG storage tank

Prior to the work the accredited installer assesses whether it is necessary for the reservoir to be completely gas-freed, shall only be depressurised or whether the work can be carried out with a reservoir under pressure.

Note:
An LNG storage tank should only be depressurised and gas-freed when maintenance or repair work is carried out on the storage tank itself or the pipework and shut-off valves and safety devices that are connected directly to the LNG storage tank.

Inspection and testing of larger LNG storage tanks are carried out on the site of use as well as the first fill with gas after initial installation and execution of maintenance and degassing prior to carrying out maintenance.

An LNG storage tank may only be removed or moved when all the liquid has been removed from the reservoir. This shall be carried out on the installation site by a company specialising in this. The way in which work on the LNG storage tank shall be carried out safely is not embodied in legislation, which is the reason why regulations for this are included in the following paragraph.

3.5.2 Regulations for work on the LNG delivery installation

reg. 3.5.1 When carrying out work on an LNG delivery installation on the site of use the checklist from Annex F, or a similar document, shall be filled in. The filled in checklist shall be available to show during the work. The measures arising from the filled in checklist to promote safety shall be taken.

Note:
Filling in a checklist is in any case important when carrying out work such as filling with gas and gas freeing, replacing a submersible pump and replacing spring safety devices. However in case of other work (on for example the delivery installation) it is also possible that LNG is released and this checklist shall be used. The purpose of this checklist is to ensure a safe situation during execution of work where LNG may be released. This checklist does not contain any technical information on the work carried out. For this reason it is not necessary to keep the checklists in the installation log book. Information on the work carried out shall however be included in the log book.

reg. 3.5.2 The filling with gas/putting into operation of an LNG delivery installation shall be carried out according to a suitable procedure for this.

reg. 3.5.3 Gas freeing an LNG delivery installation shall be carried out according to a suitable procedure for this.

reg. 3.5.4 The replacement of a submersible pump of an LNG storage tank shall be carried out according to a suitable procedure for this.

reg. 3.5.5 The replacement of a spring safety device on an LNG storage tank may only be carried out if the storage tank has been degassed. An exception may only be made to this method if an alternative method is used for this that has been approved by the authorised inspection body (aangewezen keuringsinstelling – AKI).

Note:
For above-ground LNG storage tanks such methods are already common (see for this one of the procedures included in Annex I of this guideline). For underground LNG storage tanks a method is being developed in which the spring safety device can be replaced without the reservoir being degassed. This latter has however not (yet) been authorised at the time of publication of this guideline.

reg. 3.5.6 The placing, moving or removal of an LNG storage tank may only be carried out in the liquid-free and natural gas-free state.

3.6 Regulations for the LCNG installation

For the production of CNG the LNG is first pressurised and then gasified using an evaporator to 25 MPa – 30 MPa CNG. Before the CNG is stored in a CNG buffer a number of regulations shall be complied with.

reg. 3.6.1 The LCNG installation shall comply with the Pressure Equipment (Commodities Act) Decree. In addition the components of the LCNG installation shall be assessed in the quantitative risk analysis (QRA).

reg. 3.6.2 Before the gas is delivered to the CNG buffer the temperature of the gas shall be a minimum of 0 °C.

Note:
The delivery of gas to a CNG buffer that is too cold may weaken the material as a result of which the buffer may fail.

reg. 3.6.3 The gas that is delivered to the CNG installation shall be odorised beforehand.

reg. 3.6.4 If the gas falls outside the delivery specifications according to PGS 25 and reg 3.6.2 and reg 3.6.3, the delivery to the CNG system shall be automatically stopped.

3.7 Monitoring the LNG delivery installation

The LNG delivery installation shall under normal conditions not require continuous monitoring. However in the case of process disruptions intervention may be necessary for example to prevent the installation emitting (venting) hydrocarbons to the atmosphere for an unnecessarily long time or going into an emergency shutdown situation. Also process conditions and not the mechanical failure of the process component may cause different process components (for example delivery pump) to not function properly.

reg. 3.7.1 Every LNG delivery installation shall have a system with which disruptions can be notified via an alarm or notification system to a responsible person (process controller). The alarm or notification system and the responsible person shall be available as long as the LNG delivery installation is in operation. Availability of the LNG delivery installation is determined by the presence of LNG in the LNG storage tank.

reg. 3.7.2 For every station a responsible person shall be appointed who has the required competencies to be able to interpret and possibly to rectify malfunctions that occur when putting the LNG delivery installation into operation. This may be done locally or remotely. The required knowledge level of the appointed person is at least VAPRO A [National Institute for Vocational training and education in the Processing industry and laboratories] (crebo [Central register for Vocational Education] level 2).

4 Testing, maintenance, registration, inspection and enforcement

4.1 Introduction

This clause describes the requirements with respect to assessment, inspection, testing and maintenance of LNG delivery installations (being pressure equipment according to the Pressure Equipment (Commodities Act) Decree).

It also contains the requirements relating to the registration, documentation and enforcement of these aspects.

This information is relevant for the user of an LNG delivery installation and for the authorised inspection bodies.

Not all aspects important for safety relating to maintenance and inspection of an LNG delivery installation are set down in legislation. For this reason this PGS contains additional regulations. This clause includes the additional regulations for maintenance and inspections and testing that are carried out by external parties and are compulsory.

The European Pressure Equipment Directive 97/23/EC (PED) regulates only the assessment of the new build phase and inspection of the installation of stationary pressure equipment. Inspection before putting into service (keuring voor ingebruikneming – KvI) and reinspection are regulated at national level in the Pressure Equipment (Commodities Act) Decree. This aims as far as possible to comply with the European Directive. Inspections and reinspections shall be carried out by an authorised inspection body (AKI), also known as notified bodies (NOBO) or authorised user inspectorate (keuringsdienst van gebruikers – KVG). Mixtures of natural gas with air can form an explosive atmosphere that can be ignited by heat sources e.g. sparks and so on. An LNG delivery installation and its direct vicinity shall for this reason comply with requirements relating to explosion safety. Relevant for this are the two European ATEX guidelines, ATEX 95 and ATEX 137.

ATEX 95 relates to technical integrity and contains target regulations for equipment and protective systems that are used in potentially explosive atmospheres. The requirements are primarily important for fabricators and importers of explosion-safe equipment. In the Netherlands ATEX 95 has been transposed in the Explosion-safe equipment (Commodities Act) Decree and is further explained in Annex G. ATEX 137 describes how to work safely in an environment where there is an explosion hazard. ATEX 137 has been transposed in clause 3 Equipment of Workplaces of the Working Conditions Decree. Among other things this includes the following obligations for employers:

- the assessment of explosion risks (risk inventory and evaluation);
- the classification of areas where explosive atmospheres may occur into hazard zones;
- the taking of both technical and organisational measures in hazard zones;
- the information of employees and

– the setting down of the above in an explosion safety document.

Rules for drawing up an explosion safety document and how an employer shall handle explosion safety can be found in the section ‘Safe working — Explosive Atmosphere’, see Annex K: ref. [3].

4.2 Inspections

4.2.1 Introduction

An installation shall comply with Article 12 and 12a of the Pressure Equipment (Commodities Act) Decree which means that the assessments and inspections that shall be carried out on an assembly (checking against the essential safety requirements) also apply for a pressure system.

Note:
Assessments and inspections must be carried out by the NOBO, AKI or KVG.

After assessing the conformity of the installation consideration is given to whether the total installation or the separate pieces of pressure equipment (subassemblies/lines) shall undergo an inspection before putting into service (KvI). NOTE Inspection covers new build, inspections before putting into service and inspections during the phase of use (periodic reassessment, interim inspections, modifications and repairs). For all these inspections mentioned the user and/or the fabricator is responsible.

4.2.2 New build

The installation of all the components of an LNG delivery installation shall be approved by an authorised and registered inspection body (NOBO) according to the Pressure Equipment (Commodities Act) Decree. All the components shall comply with the European Pressure Equipment Directive and on this basis shall bear a CE marking with the Nobo number of the Nobo that has carried out monitoring.

The assessment of the installation into an installation is described in PRD Section 2-1 and is carried out by considering seven steps, namely:

1. Basic design of the installation.
2. Determination of design conditions for each piece of pressure equipment.
3. Design of the pressure equipment.
4. Fabrication and final inspection of the pressure equipment.
5. Detailed design of the installation.
6. Fabrication and final inspection of the installation.
7. Handing over of installation for inspection before putting into service (KvI).

4.2.3 Inspections before putting into service

Three inspection systems for putting into service are distinguished:

– Pressure Equipment (Commodities Act) Decree (KvI);

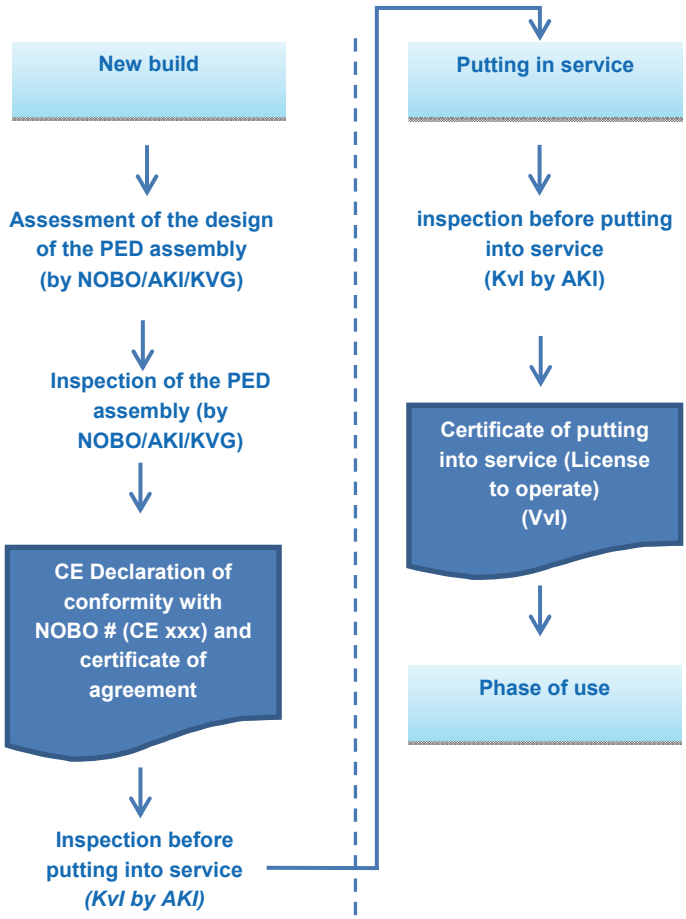
- Explosion-safe equipment Commodities Act (ATEX 95);
- Working Conditions Decree (ATEX 137).

Pressure Equipment (Commodities Act) Decree (Kvl)
Before a new LNG installation at the delivery installation is put into service, it shall be inspected according to the Pressure Equipment (Commodities Act) Decree by an AKI authorised to do so. The inspection before putting into service (Kvl) shall be carried out according to PRD Section 2-2 and includes the following verifications and checks:

- verification of the pressure equipment in the light of the instructions for use, manufacturing book and markings;
- checking the external condition of the pressure equipment;
- checking the operation of the safety accessories and pressurised accessories;
- checking the set-up of the pressure equipment.

Upon approval a certificate of taking into service (verklaring van ingebruikneming - Vvl) is issued.

Figure 4.1 – Inspection documents for new build and putting into service



The Pressure Equipment (Commodities Act) Decree does not apply to equipment in which the pressure is less than or equal to 0.5 bar positive pressure with respect to atmospheric pressure. For pressure equipment which does not fall under WBDA, the duty of care according to the Working Conditions Decree applies. The user is responsible for this.

Explosion-safe equipment Commodities Act (ATEX 95)
It is preferable to install the LNG delivery installation in the outside air.

reg. 4.2.1	All electrical equipment used in a zoned area shall comply with ATEX 95 according to product specifications and European Directives and shall at least comply with zones laid down in NPR 7910-1. The fabricator shall include this in the declaration of conformity.

If parts of the LNG delivery installation are located in places where no outside air conditions prevail, the zoning according to NPR 7910-1 applies, see also regulations in clause 5.

Working Conditions Decree (ATEX 137)
An explosion safety document shall be drawn up according to the European Directive.

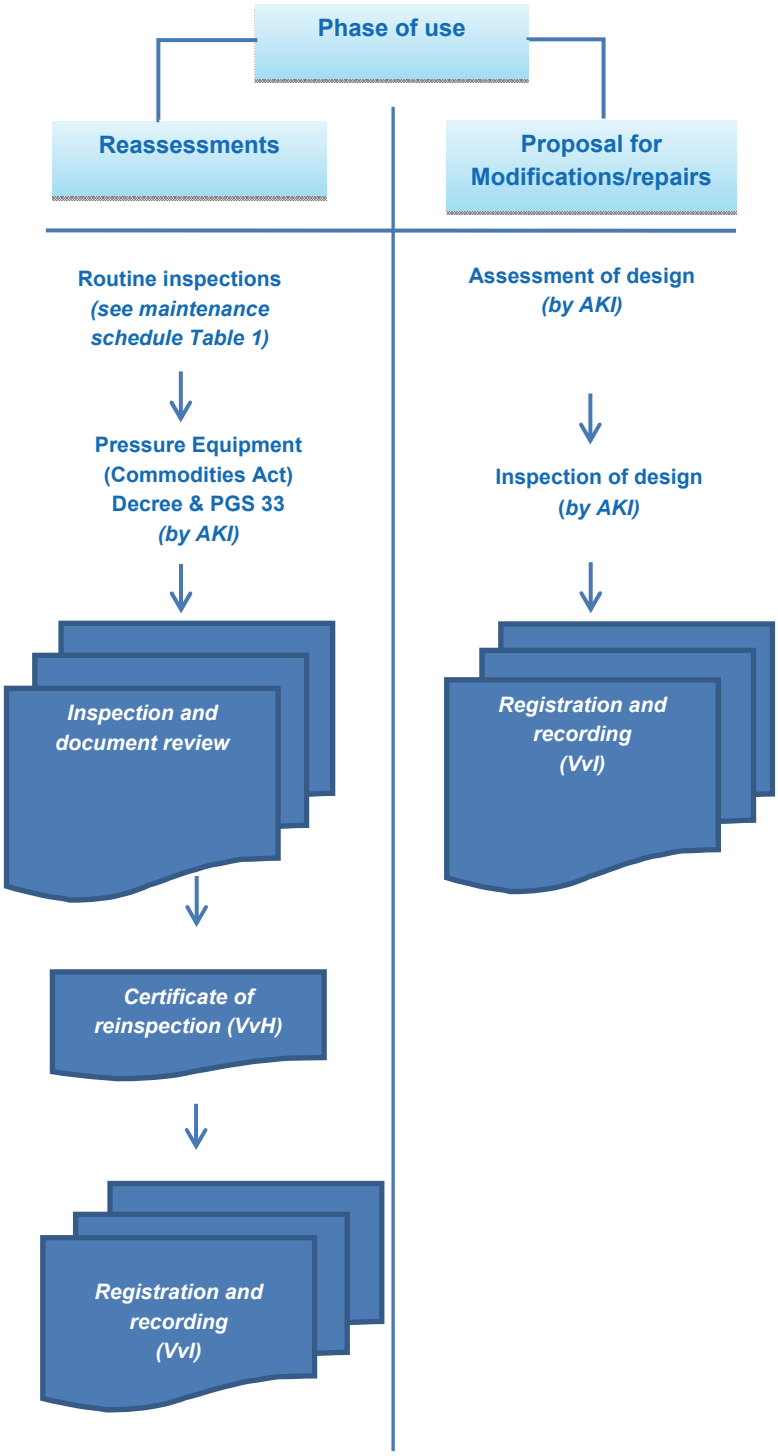
reg. 4.2.2	During the work for delivering the product and filling the LNG storage tank, smoking, naked flames and the presence of other ignition sources are not permitted. A clearly visible prohibition sign shall be affixed.

4.2.4 Inspection during the phase of use

Inspection during a phase of use (see also figure 4.2) covers:

- periodic reassessment;
- routine inspections;
- modifications and repairs.

Figure 4.2 – Inspection documents for the phase of use



Periodic reassessment

The Pressure Equipment (Commodities Act) Decree also includes requirements for the phase of use, including requirements relating to (periodic) reinspection and reassessment. Reassessment of installations is carried out by the AKI or KVG, based on the requirements in this PGS and the Pressure Equipment (Commodities Act) Decree according to PRD Section 2-3.

Repairs and modifications

The requirements relating to repairs and modifications are set out in Article 14 of the Pressure Equipment (Commodities Act) Decree and shall be carried out according to PRD Section 2-5.

Note:
The assessment and inspections shall be carried out by the AKI or KVG.

Routine-inspections

Routine-inspection, maintenance and overhaul of LNG delivery installationss is reserved only for expert and competent staff. Requirements for expertise and competence of staff are included in the authorisation regulations drawn up for this or at the discretion of the AKI, see 4.3. Maintenance shall also be carried out in accordance with the fabricator's instructions.

Table 4.1 shows the inspection periods and also includes a practical maintenance schedule.

Table 4.1 – Testing and maintenance schedule for LNG delivery installations

Activity (check for:)		Inspection before taking into service	Routine inspections			Periodic reassessment	Routine inspections					Periodic reassessment
		year										
		0	1	2	3	4	5	6	7	8	9	10
1. Leak tightness												
1.1	Before putting into service according to PRD Section 2.2	o										
1.2	Annual visual external inspection for leaks (ice formation)		x	x	x	o	x	x	x	x	x	o
1.3	Gas tightness inspection (reservoir connections, flanged joints and accessories, for example gas detector)	o	x	x	x	o	x	x	x	x	x	o
2. Functional operation of accessories		o	x	x	x	o	x	x	x	x	x	o
3. Visual external inspection												
3.1	Corrosion	o	x	x	x	o	x	x	x	x	x	o
3.2	Damage	o	x	x	x	o	x	x	x	x	x	o
3.3	Contamination	o	x	x	x	o	x	x	x	x	x	o

Activity (check for:)		Inspection before taking into service	Routine inspections			Periodic reassessment	Routine inspections					Periodic reassessment
		year										
		0	1	2	3	4	5	6	7	8	9	10
3.4	Support and foundation for condition and damage	o	x	x	x	o	x	x	x	x	x	o
4. Functional protection												
4.1	Blow-off pressure safety cut-out according to PRD	o				o						o
4.2	Overfilling protection	o	x	x	x	o	x	x	x	x	x	o
4.3	Emergency shutdown devices	o	x	x	x	o	x	x	x	x	x	o
4.4	Gas detection	o	x	x	x	o	x	x	x	x	x	o
4.5	Dead man’s button	o	x	x	x	o	x	x	x	x	x	o
4.6	Alarm or notification systems	x	x	x	x	x	x	x	x	x	x	x
5. Documentation												
5.1	Inspection of log book					o						o
5.2	Vvl inspection, AKI reports	o				o						o
5.3	Checking of routine inspection reports		x	x	x	o	x	x	x	x	x	o
5.4	Installation schedule approved by AKI	o				o						o
6. Location												
6.1	See NPR 2578	o	x	x	x	o	x	x	x	x	x	o
7. Other												

Activity (check for:)		Inspection before taking into service	Routine inspections			Periodic reassessment	Routine inspections					Periodic reassessment
		year										
		0	1	2	3	4	5	6	7	8	9	10
7.1	Earthing	o	x	x	x	o	x	x	x	x	x	o
7.2	Warning signs	o	x	x	x	o	x	x	x	x	x	o
o = AKI x = authorised installer												

4.3 Acceptance regulations for installers

reg. 4.3.1 The installation of pressure equipment that falls under the scope of the Pressure Equipment (Commodities Act) Decree may only be carried out by approved installers. See Annex D of NPR 2578.

Note:
For LNG there is not yet any acceptance regulation available for installers and while there is not, NPR 2578 is used.

4.4 Maintenance and registration

4.4.1 Maintenance and inspection

The whole installation shall always be in a good state of maintenance and falls under the responsibility of the user (duty of care).

On starting work on the LNG delivery installation the required safety measures shall be set down by the user in writing (work permit).

Additional requirements to the Pressure Equipment (Commodities Act) Decree:

- delivery hose;
- fire extinguishers;
- high level alarm for the liquid level;
- overfilling protection devices (independent of the high level alarm).

The user ensures maintenance, checking and inspection of the LNG delivery installation.

reg. 4.4.1 Maintenance shall be carried out by an approved installer according to NPR 2578.

reg. 4.4.2 Gaskets, lubricants and other products used in an LNG delivery installation shall be suitable for the application.

reg. 4.4.3 Before the LNG delivery installation is taken into service, the LNG storage tank, accessories and pipework shall be internally clean. In particular weld spatter, grease, oil and other organic material shall be carefully removed. After cleaning the installation shall be dried if necessary.

reg. 4.4.4 The LNG delivery installation shall be taken into/out of service according to the instructions of the supplier/fabricator of the LNG installation in the instruction manual.

reg. 4.4.5 If applicable, any cathodic protection shall be inspected annually according to the standard applicable for this an accredited inspection body according to an accreditation schedule (for example AS 6801).

reg. 4.4.6 Leak detection systems shall be inspected annually.

4.4.2 Registration

Introduction
An LNG delivery installation is supplied with an installation book.

Installation book

reg. 4.4.7 Every LNG delivery installation is supplied with an installation book that contains at least the following basic information:

- description of the installation (process and installation schedules);
- instructions for use;
- log book.

This documents may also form part of or be included in a central computerised information system.

reg. 4.4.8 The instructions for use together with the description of the LNG delivery installation shall give information on the way the LNG storage tank is installed, the location of the LNG piping, the place, function and operation of the accessories included in the installation and the method of operation.

reg. 4.4.9 The installation book also contains a log book, which among other things includes information on work, maintenance, testing and inspections carried out and any malfunctions and irregularities.

reg. 4.4.10 The current situation of the installation shall be set out in the installation book (log book). Certificates, measurement and test reports and other records shall be present, such as:

- the certificate of putting into service (VVI), reports of the AKI or KVG of the periodic inspections, repairs and modifications;

- any installation certificates for modifications or repair work;
- any additional certificates for example for a leak detection system or application of internal cladding;
- if applicable a registered report of ground resistivity measurement or installation certificate in which the ground resistivity measurement is indicated;
- if applicable, the annual reports of the cathodic protection control measurement;
- if applicable, the soil survey report for determining the zero situation (NEN 5740);
- the two-yearly certification of the inspection of fire extinguishers (for fire extinguisher present);
- any report(s) of reinspection(s); any report of tightness test(s);
- a report of the two-yearly check on the operation of the temperature detection system in the delivery installation;
- a drawing on which the location of the tank(s), piping and accessories is indicated;
- any modifications shall be directly updated on this drawing and dated;
- an LNG safety information sheet;
- a copy shall be included in the installation book of all testing, inspections and checks that are applicable.

reg. 4.4.11 The installation book and all corresponding records shall at all times be available for inspection by the competent authority. For unmanned filling stations, in consultation with the competent authority it shall be determined where and how the installation book is kept.

reg. 4.4.12 The log book shall at least contain:

- all reports relating to inspections, testing and checks indicating date and results. If these reports are filed at a central point, the report numbers and their date shall be indicated in the installation book. This indication shall bear the signature of the person who has carried out the inspections;
- a plan drawing on which the installation with the corresponding hazard zones are indicated (see also 5.4 and 5.5);
- official documents (or a copy of these), including:
  - certificates of materials, components and accessories used;
  - declaration of verification of the installation;
  - licenses;
  - an emergency plan;
- particulars:
  - deviation from the normal operation laid down in the operating manual;
  - hazardous situations that have occurred;
- other particulars.

4.4.3 Storage periods

(Re)inspection data shall be stored, such that the full period between (re)inspections is covered. After this a new interval begins with the result of the last reinspection as starting document. The inspection body notes on the notes page with the certificate of taking into service all special events such as inspections and repairs on the installation. The notes page remains present in the installation as long as the installation is in use or is ready for use. As a result the history of the installation can always be checked.

4.5 Enforcement

Enforcement based on the Pressure Equipment (Commodities Act) Decree requires the following documents:

- valid VvI;
- certificate of reinspection with validity date;
- modifications to reports of AKI relating to repairs and modifications.

The following documents shall be present at the LNG delivery station for the licensor:

- valid VvI or certificate of reinspection according to WBDA;
- documents relating to periodic maintenance;
- incident report;
- installation book (log book).

As long as there are no regulations for LNG, please refer to NPR 2578 for acceptance conditions for installers of LNG delivery installations.

5 Safety measures

5.1 Introduction

This clause covers the regulations with additional safety requirements in addition to the general installation requirements, requirements for use and maintenance requirements. This concerns among other things requirements for internal safety distances, the electrical installation, measures aimed at preventing fire and explosion hazard, and other measures.

5.2 General

reg. 5.2.1 The general layout of installations for the storage and delivery of fuel shall be as clear as possible, both from the point of view of unhindered access and exit for customers and delivery of LNG, and from the point of view of safety, where attention shall be paid to:

- good overview of the installation for the operating staff both from the operating building and from the LNG delivery installations;
- clear arrangement of access roads, exits and site surfacing with a view to collision hazard;
- well thought-out measures and provisions to promote safety and environmental protection;
- the provision of a good stand for the LNG delivery tanker so that it causes no or minimal obstruction to traffic on the public highway and so that during the delivery (filling of tanks) this does not adversely affect the proper operation and the overview of the whole installation;
- good accessibility to installation components for operation and maintenance;
- good accessibility to the installation in case of fighting any fire;
- evacuation facility in case of incidents.

5.3 Internal safety distances

5.3.1 Introduction

The safety distances to be maintained between components of the LNG delivery installation and other objects within an establishment are not laid down in legislation. For this reason the necessary internal safety distances are set out in this PGS.

An internal safety distance is the minimum separation between a hazard source (an installation component with a hazardous substance) and the potential victim of the hazard (a person, vulnerable installation component or building within the establishment), with the purpose of preventing or limiting the harmful effect as a result of a foreseeable accident and hence preventing an escalation to a bigger accident (domino effect). A foreseeable accident in one installation component may not lead to the (partial) failure of another installation component. An internal safety distance therefore prevents a relatively small incident developing into a big

accident. Adequate internal safety distances are hence a condition for safe execution of the LNG delivery installation.

The information in 5.3 is based on the background document, see Annex K: ref. [2]. In this report you can find the background data (factors and scenarios) relating to the internal safety distances.

A foreseeable accident is an accident that may occur during normal operation with a certain, relevant frequency for example leaks (in the order of 10^{-3} to 10^{-5} per year). That possibly also applies for accident scenarios such as a motor vehicle that collides with the LNG delivery installation).

On the other hand, accident scenarios that (very) rarely occur (with a frequency of in the order of 10^{-6} per year), such as the complete and immediate failure of an installation, are taken into consideration. In spite of the fact that such an accident may lead to a much greater harmful effect. An internal safety distance is therefore not intended to offer protection from the consequences of big accidents. Measures other than internal safety distances are then necessary to reduce the effect of, or the chance of, such accidents to an acceptable level.

5.3.2 Basic assumptions for internal safety distances

Table 5.1 gives a summary of accident scenarios used to determine the internal safety distances for LNG delivery installations

Table 5.1 — Considerations for internal safety distances

Accident scenario		Decisive effect	Protection	Protection value	Condition(s)
Scenario 1	**1 mm leak in flange, piping or stationary vessel (perceptible, no pool formation). This corresponds to 10 g/s source strength at 18 barg.** Direct ignition. Flare fire.	Heat radiation due to flare fire.	Prevent failure of neighbouring installation/ domino effect.	Max 35 kW/m^2 heat radiation to neighbouring LNG installation (protected by twin-walled design).	Use of technical measures to minimise the chance of the accident scenario. Use of self-closing filler coupling, break-away coupling delivery hose. Twin-walled design and insulation material offer extra protection against heat radiation.
Scenario 2	**1 mm leak in flange, piping or stationary vessel (perceptible, no pool formation). This corresponds to 10 g/s source strength at 18 barg.** Direct ignition. Flare fire.	Heat radiation due to flare fire.	Prevent failure of neighbouring installation/ domino effect.	Max. 10 kW/m^2 for other neighbouring (unprotected) installations.	Use of technical measures to minimise the chance of the accident scenario. Use of self-closing filler coupling, break-away coupling delivery hose. Twin-walled design and insulation material offer extra protection against heat radiation.

Scenario 3	5 mm leak from offloading hose (10% of 2 inch diameter) at 18 barg during LNG transfer at filling point/ parking space LNG tanker. Direct ignition. Flare fire.	Heat radiation due to flare fire.	Prevent failure of neighbouring installation/ domino effect.	Max 35 kW/m^2 heat radiation flux to neighbouring LNG installation (protected by twin-walled design).	Use steel or composite hoses.
Scenario4	5 mm leak from offloading hose (10% of 2 inch diameter) at 18 barg during LNG transfer at filling point/ parking space LNG tanker. Direct ignition. Flare fire.	Heat radiation due to flare fire.	Prevent failure of neighbouring installation/ domino effect.	Max. 10 kW/m^2 for other neighbouring (unprotected) installations.	Use steel or composite hoses.

5.3.3 Internal safety distances from an LNG delivery installation (as a hazard source) to a vulnerable object

Primarily it is determined what internal distances are required between a component of the LNG delivery installation as a hazard source and the vulnerable objects to be protected within the establishment. The potential hazard sources of an LNG filling station are:

- the LNG storage tank;
- the LNG delivery installation;
- the LNG dispenser including the vehicle being refuelled;
- the LNG filling point of LNG storage tank;
- the LNG tanker in the parking space intended for it.

In addition to people, the following objects are vulnerable:

- buildings in which people may be present, or hazardous substances may be present;
- installation components for the delivery of fuels such as petrol, diesel, propane, LPG, CNG or LNG (an LNG installation may therefore be both a hazard source and a vulnerable object);
- other installation components with hazardous substances.

The vulnerable people and objects mentioned within the establishment are protected for the selected decisive accident scenario against a maximum heat radiation of 10 kW/m^2. The LNG carrying components of the LNG filling station form an exception to this. Because of the twin-walled design with vacuum, filled with insulation material such as perlite, these installation components are deemed to be able to cope with a sufficiently lengthy heat load of 35 kW/m^2.

Point for attention:
An internal safety distance also applies from the boundary limit of the establishment, because vulnerable objects of others may be placed directly against them, without the establishment holder having any influence over this.

The decisive accident scenario assumed is a leak in an LNG carrying installation (often level with a flange) with a leak size of approx. 1 mm and a source strength of approx. 10 g LNG/s. This scenario is therefore regarded as a foreseeable accident for which internal distances to vulnerable objects are required to prevent a domino effect.

Internal safety distances may also be necessary between another hazard source within the establishment and an LNG installation as a vulnerable object. Hazard sources other than an LNG installation may be:

- installations for the delivery of fuels such as petrol, diesel, propane, LPG and CNG;
- buildings with flammable materials;
- other hazard sources with hazardous substances.

For the required internal safety distances between these hazard sources and an LNG installation in the first instance please refer to the PGS publications drawn up for the relevant hazard sources, such as PGS 16 for LPG filling stations, PGS 19 for storage tanks for propane or PGS 25 for CNG filling stations.

In this clause internal safety distances resulting from the PGS publications mentioned are applied without change to LNG delivery installations as a vulnerable object.

Internal safety distances that result from the PGS guidelines mentioned, in principle also apply for LNG installations as a vulnerable object. These internal safety distances for the accident scenarios pool fire and façade fire primarily result from a maximum heat radiation load on the exposed object of 10 kW/m^2.

As previously stated, it is considered that LNG installation components of a twin-walled design can cope with a heat radiation load of 35 kW/m^2. The internal safety distances between another risk source and an LNG installation component (as a vulnerable object) can be adjusted for the 35 kW/m^2 standard or a conservative approach selected by using for the other risk sources the internal safety distances that apply without change for a maximum heat radiation load of 10 kW/m^2.

Table 5.2 below sets out the internal safety distances that have been determined based on the significant accident scenario as included in Table 5.1 of:

- a leak of 1 mm at flange, piping or stationary vessel (perceptible, no pool formation) that corresponds to a source strength of 10 g/s at 18 barg (scenarios 1 and 2);
- a leak of 5 mm from the offloading hose (10% of 2 inch diameter) at 18 barg during LNG transfer at filling point/parking space of the LNG tanker (scenarios 3 and 4).

For each distance between brackets the damage criterion used is indicated. Unless otherwise indicated, the safety distances are deemed to be the distances to be adhered to.

An internal distance of 0 m means that for the significant scenario chosen the exposed installation component will not be able to fail (due to heat radiation effects).

Table 5.2 — Internal safety distances for the different scenarios

Accident scenario	Scenario 1 (35 kW/m^2)	Scenario 2 (10 kW/m^2)	Scenario 3 (35 kW/m^2)	Scenario 4 (10 kW/m^2)
Risk source / Risk victim	LNG installation[a], except for LNG filling point/parking space for LNG tanker	LNG installation[a], except for LNG filling point/parking space for LNG tanker	LNG filling point/parking space for LNG tanker[c]	LNG filling point/parking space for LNG tanker[c]
LNG installation[a]	0 m	N/A	10 m	N/A
LNG dispenser/truck refuelling with LNG	N/A	0 m	N/A	0 m [e)]
Sales premises/shop within establishment	N/A	3 m	N/A	15 m
Other vulnerable components of the establishment [b, d]	N/A	3 m	N/A	15 m
LNG filling point/ parking space for LNG tanker	Is determined by accident scenario 3 from LNG filling point to LNG installation component	N/A	N/A [a]	N/A
Boundary limit	N/A	3 m	N/A	3 m[f]

Notes Table 3:

a. LNG installation is in any case understood to mean the above-ground LNG storage tank and the LNG dispenser. The basic assumption is that an LNG filling station has a maximum of one (main) LNG storage tank. So the simultaneous offloading of two LNG tankers cannot take place. With the presence of two LNG storage tanks (reservoirs) the BRZO threshold value is probably exceeded. Companies that fall under BRZO 1999, can determine internal safety distances based on a specific risk analysis. 0 m continues to apply for the distance from the main LNG storage tank (the main LNG reservoir) to an LNG buffer vessel or another intermediate reservoir. An underground LNG storage tank is not considered.

b. Among other things vulnerable components of the establishment cover for example the storage of hazardous solid, liquefied and gaseous substances or a building/company flat within the boundary where people may be present.

c. To determine a safety distance between the parking space of the LNG tanker and other LNG installation components the connection of the offloading hose to the LNG tanker is used as a reference point. To optimise the manageability of the offloading operation by the tanker driver and to minimise the chance of external interference during the offloading operation, the distance between the connection of the offloading hose to the LNG tanker and the LNG filling point of the LNG storage tank shall be a maximum of 5 m.

d. If another vulnerable object may also be a risk source, for which internal safety distances also apply (such as burning buildings, LPG installations, propane tanks etc.), the greatest applicable distance shall be kept to.

e. This value is based on the small capacity of the LNG dispenser and the fact that the effect on the car refuelling with LNG is not taken into account.

f. This value shall be determined for specific situations. Depending on the risks outside the boundary limit specific measures shall be taken or the distance to the boundary limit increased based on a risk analysis.

Note 1:
Sewer and cellar openings: In case of the decisive accident scenario of a leak with a source strength of 10 g/s there is no formation of an LNG pool. The discharge quantities are too small for this. With the presence of low-lying sewer and cellar openings it is however desirable as a precaution to limit the chance of ingress of liquefied natural gas as far as possible. For this reason – as a departure from the approach followed –the accident scenario 'discharge of LNG from a (delivery) hose not (no longer) connected' is taken into account. Between an LNG installation component and a low-lying sewer and cellar opening as a minimum an internal safety distance of 5 m should be adhered to. This distance is taken from other PGS publications.

Note 2:
Equivalence principle: In specific situations the internal safety distance may be reduced if with (extra) measures an equivalent protection level is obtained as when using the specified spatial separation.

5.3.4 Additional regulations for safety distances

reg. 5.3.1	The LNG delivery installation shall be at least 10 m away from the closest high voltage line, according to NEN-EN 13458-3. In addition it may not be positioned under high voltage masts and/or lines.

reg. 5.3.2	The LNG delivery installation may not be positioned within 5 m from a pipeline route for hazardous substances.

reg. 5.3.3	Suitable measures shall be taken to prevent damage that may be caused in the direct vicinity of the LNG delivery installation by planting and/or other objects.

Note:
If in the direct vicinity of the LNG delivery installation planting is present, whose roots may damage the compartments and/or cause nuisance to the operation, measures shall be taken to prevent root growth.

5.4 External safety distances

LNG delivery installations and related activities within an LNG filling station have consequences for the external safety. This means that safety distances shall be adhered to between (components of) an LNG delivery installation and:

- vulnerable objects located outside the establishment;
- limited vulnerable objects.

For LNG delivery installations when applying for a license it will probably have to be demonstrated using a quantitative risk analysis (QRA) that the limit value for the place-related risk of $1 \cdot 10^{-6}$/year is met. The distance to be observed to (limited) vulnerable objects follows from this.

Note 1:
This obligation shall be regulated in the REVI. Here in Article 1b additional establishments are mentioned that fall under BEVI and for which a quantitative risk analysis shall be carried out. It is certain that LNG filling stations fall under BEVI. In early 2013 the Ministry of I&M has not however yet made any statement on the way in which LNG filling stations will be included in the BEVI. This may be via a QRA obligation or via generic risk distances.

The National Institute of Public Health and the Environment (RIVM) has developed a calculation method based on which the risks of LNG delivery installations shall be determined. This calculation method shall among other things be made available via the RIVM website to authorities and consultancy firms that have to draw up a QRA for LNG filling stations, see Annex K: ref. [4].

Note 2
This calculation method is at present (June 2013) available as a final draft.

5.5 Electrical installation and explosion safety

5.5.1 Electrical devices

reg. 5.5.1	Every LNG delivery installation shall be fitted with a switch with which the electrical installation of the LNG delivery installation can be switched off. The electrical installation in and on the LNG delivery installation shall comply with the provisions set out in NEN 1010, NEN 3140, NEN-EN-IEC 60079-14 and NEN-EN-IEC 60204 and shall where necessary withstand the effects of the weather.

5.5.2 Electrical installation

reg. 5.5.2	The pipework, storage tank, pressure relief equipment and vent stacks shall be independently earthed.

reg. 5.5.3	Electrical and electronic equipment in a zoned area shall be of an explosion safe design according to the ATEX regulations and bear a certificate from an independent certification body showing that the equipment used is suitable for application in premises where explosion hazard may prevail.

Note:
In places where an explosion hazard may prevail, the general provisions for electrical equipment according to NEN-EN-IEC 60079-0 shall be considered.

reg. 5.5.4	The LNG storage tank and other components of the LNG delivery installation shall have a connection point for an earthing conductor. Components of the LNG installation shall be fitted with potential equalization to prevent static electricity according to NEN-EN-IEC-62305.

reg. 5.5.5 The LNG storage tank shall be tested according to NEN-EN-IEC-62305 for possible lightning strike.

Note:
In case of possible lightning strike the components within the area of influence determined according to NEN-EN-IEC-62305 shall be earthed according to NEN 1014. This also applies for the potential equalisation.

5.5.3 Marking of zoned area

reg. 5.5.6 In an ATEX zoned area a sign shall be affixed in a sufficient number of places: 'SMOKING AND NAKED FLAMES PROHIBITED'. The letters indicated shall be at least 50 mm high. It is also possible to affix safety signs (pictograms) according to NEN 3011 in a sufficient number of places. In these areas smoking is prohibited, and naked flames or heated objects with a surface temperature of more than 573 K (300 °C) may also not be present. In those areas of the site where under normal operating conditions there is a danger of fire or explosion as a result of ignition of escaping gases and/or vapours no combustion engines, machines and appliances may be located or installed, unless the design of these devices meets the requirements that are laid down for the relevant zone in NPR 7910 or NEN-EN-IEC 60079-10.

5.6 Fire (hazard/fighting)

5.6.1 Fire hazard/hazard characteristics

For an extensive description of the hazard characteristics of (L)NG please refer to Annex D.

In case of a leak of LNG from the LNG delivery installation part will evaporate (flash) directly because the LNG stored was under increased pressure and temperature. The remaining LNG will, in case of discharges that are not too large, immediately form NG upon first contact with the warm environment (installation components, soil, air).

All LNG released will ultimately evaporate to form gas that spreads into the atmosphere. The cold gas is in the first instance heavier than air and will move low over the ground, but on warming up the gas will then gradually become lighter than air and rise.

A cold gas cloud released may create its own microclimate, which inhibits warming of the gas cloud and the cloud can spread low over the ground for a long time.

Upon ignition of the flammable gas cloud this can theoretically flash back to any LNG pool formed, resulting in a pool fire. An (L)NG fire also generates more heat per unit time than a normal hydrocarbon fire (petrol).

The cryogenic temperature of the liquid and the vapour released form an additional hazard for people and material. Since every litre of LNG evaporates to around 600 litres of NG, oxygen may also be displaced.

5.6.2 (Fire) fighting

It is virtually impossible to extinguish an (L)NG fire with water and this may even be undesirable as after extinguishing a gas cloud may form that may ignite again with all the consequences this has. Contact between extinguishing water and the LNG fire shall therefore be avoided.

This does not however take away the fact that the presence of an extinguishing water supply is necessary for example to extinguish a vehicle fire or a fire in the shop or to cool the objects on which the fire has radiated. Articles 6.27 and 6.30 of the Building Decree 2012 state the requirement that a building shall have a sufficient extinguishing water supply. Since an LNG filling station is a building, in agreement with the competent authority and depending on the situation, it shall be determined what a sufficient extinguishing water supply is.

With specifically designed stationary installations for the addition of light foam (that shall be specifically and demonstrably suitable for use on LNG) it is possible to reduce the heat radiation from an LNG (pool) fire in a catch pit by 90% to allow this to burn out under controlled conditions. NEN-EN 13645 gives consideration to adding a catch pit and a light foam installation for installations of greater than 50 ton.

An LNG pool fire can theoretically be extinguished with a suitable powder extinguisher, but radiated objects may be so hot that reignition may occur. Furthermore the use of extinguishing powder requires so close an approach to the seat of the fire that this cannot always be done in case of an LNG fire.

reg. 5.6.1 A fire extinguisher shall be suitable for fire classes B and C according to NEN-EN 2 and also meet the requirements included in NEN-EN 3. The characteristics, performance requirements and test methods for the fire extinguisher are based on NEN-EN 3-7, which shows that it is suitable for fighting fire classes B and C. Fire extinguishers shall have an extinguishing capacity of at least 43A / 233B according to NEN-EN 3-7. Fire extinguishers shall be protected from or resistant to the effects of the weather.

5.7 Emergency shutdown devices

5.7.1 General

To signal that inadmissible gas concentrations are occurring near an LNG installation, there shall be at least two continuously operating gas detectors present by the LNG installation. These shall be positioned in locations where the chance of a gas leak is the greatest, such as upon the disconnection and connection of vehicles (dispenser, filling point, pump) in consultation with the competent authority. Continuous measurements are also carried out to determine the temperature at further locations to be determined in consultation with the competent authority. In case of measurements above 70°C and under 30 °C measures shall be taken as in the case of a gas leak and fire in the direct vicinity (automatic activation of emergency shutdown, activation of lockdown systems, immediate stopping of the delivery of LNG and acoustic and optical signalling and reporting to the establishment manager).

reg. 5.7.1 Upon the activation of the emergency shutdown device all main components shall automatically be put into safe mode. All liquid piping shall be locked down, so that supply and discharge is closed.

reg. 5.7.2 After operating the emergency shutdown device the installation may not be made ready for use again until the reason for the operation of the emergency shutdown device is known and the cause of this has been eliminated. The installation can and may only be put back into operation after a full inspection and diagnosis on the spot.

reg. 5.7.3 An emergency shutdown shall be designed such that once pressed it is impossible to restore an emergency shutdown device on the spot and without tools, to put the installation back into operation. Incidents are noted in the log book.

5.7.2 Detection systems

reg. 5.7.4 At least two gas detectors shall be present, of which one is near the dispenser and one is in the installation. At 10% LEL an automatic preliminary warning to the manager/driver of the installation shall go off. At 20% LEL the emergency shutdown circuit shall be activated.

reg. 5.7.5 At least 2 temperature detectors shall be present, one of which is near the dispenser and one is in the installation or near the LNG storage tank. At -30 °C or +70 °C the emergency shutdown circuit shall be activated.

reg. 5.7.6 Temperature detection shall be present in the blow-off line. These shall activate the emergency shutdown circuit upon liquid detection.

5.7.3 Signalling

If the gas detection system measures a concentration of natural gas of at least 10% of the lower explosive limit (LEL), a warning signal is activated that a high but not yet hazardous concentration of gas is present. A preliminary signal shall also be given to the manager.

Upon measurement of at least 20% of the LEL value for LNG the emergency shutdown shall automatically be activated and immediately a message sent to the manager or a person appointed by the manager of the establishment. Any delivery of LNG shall immediately be stopped. Measures shall be taken to deal with the leak.

In the following emergency shutdown scenarios signalling shall take place:

- on exceeding the gas detection limit of 20% LEL;
- exceeding or falling below the temperature limits;
- detection of low temperatures;
- pressing emergency shutdown device;
- maximum level monitoring 95%.

reg. 5.7.7 Upon activation of an emergency shutdown scenario an acoustic and illuminated signal shall be given and at the same time a direct signal shall be sent to the establishment manager.

6 Incidents and disasters

6.1 Introduction

This clause covers regulations with measures to limit incidents and disasters. This concerns among other things the emergency plan and the action to be taken in case of leakage.

6.2 Instructions in case of incidents and disasters for customer, user and supervisor/manager)

6.2.1 Action in case of incidents and disasters

In case of leakage or fire an attempt shall be made to bring this under control as soon as possible and if necessary help shall be offered to those who find themselves within the establishment and to those living around. In the light of the storage capacity, the nature of the products stored and the nature of the establishment, in consultation with the competent authorities a suitable emergency plan shall be drawn up. At the LNG delivery installation emergency instructions (arising from the emergency plan) shall be present. Annex H includes an example of emergency instructions.

reg. 6.2.1 At the dispenser of the LNG delivery installation clearly visible and legible instructions shall be affixed about the measures to be taken in the case of disasters.

Note:
These instructions should include the names and telephone numbers of bodies and people who shall be contacted in case of disasters. In the case of unmanned filling stations the establishment holder should provide 24 hour accessibility for the bodies and people mentioned above.

reg. 6.2.2 The following action shall in any case be taken in case of an incident and/or disaster:

- activate the emergency shutdown devices present to stop transfer and lock down the installation.;
- notify the emergency services and the user/manager of the filling station;
- every fire, LNG and gas leak shall be notified immediately to the fire service;
- ensure the surrounding area is notified and evacuated.

6.2.2 Emergency plan and assistance

reg. 6.2.3 Staff working within the establishment shall be informed of the content of the emergency plan and shall be familiar with the use of the available equipment, so that in case of disaster the staff are able to take as effective action as possible. See also reg. 3.4.24 d).

reg. 6.2.4 The emergency plan shall be directly available and accessible without hindrance for the staff.

Note:
The emergency plan must be kept in a place made known to the staff, which is directly accessible to them without hindrance.

6.3 Other safety aspects

6.3.1 Confirmation of leakage

reg. 6.3.1 As soon as it is confirmed that an installation is leaking, the emergency shutdown shall be activated and this shall be notified to the fire service immediately.

6.3.2 Prohibition of smoking and naked flames

reg. 6.3.2 Clearly legible operating instructions shall be affixed to the dispenser, or which are visible from the delivery point, as well as the sign 'TURN OFF MOTOR, SMOKING AND NAKED FLAMES PROHIBITED' or the corresponding safety sign (pictogram) as described in NEN 3011.

6.3.3 Collision protection

reg. 6.3.3 Every component of the LNG delivery installation, in particular the dispensers, filling points, pressure relief equipment and vent piping as well as the blow-off safety device, shall be located such that there is no increased collision hazard upon loading and offloading, nor is there any other fear of hazard or damage from the surrounding area.

reg. 6.3.4 In places where a collision hazard exists, installation components shall be protected in a suitable way in the direction from which collision may come.

Note:
This may for example be by a suitable guide rail structure according to the guidelines ROA VII of the Department of Public Works (edition of November 1974), or by steel tubes filled with concrete with a diameter of at least 0.1 m and a height of at least 0.6 m above ground level. The tubes must be firmly fixed into a base that is tiled or surfaced or in a similar way elevated to at least 0.1 m, which extends at least 0.1 m outside the tube protection. The distance between the tubes may not be more than 1 m. The installation shall only be protected from collision on the side(s) where a collision is reasonably possible. Other equivalent protection against collision is also permitted.

Annexes

Annex A Terms and definitions

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

Authorised inspection body (Aangewezen keuringsinstelling – AKI)
A 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. A list of authorised inspection bodies can be found in the section Veilig Werken – Drukapparatuur (Safe Working – Pressure Equipment) on the website of the Ministry of Social Affairs and Employment (SZW) (http://www.rijksoverheid.nl/ministeries/szw).

Natural gas
A substance that is in the gaseous state at a temperature of 15 °C and a pressure of 101.325 kPa (1.01325 bar) and consists mainly of methane or another substance that because of its characteristics is equivalent to methane (definition of the Gas Act).

Blow-off line
A pipe through which natural gas can be safely evacuated to the atmosphere.

Blow-off safety device
A device that prevents the pressure limit value being exceeded by blowing off gas.

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.

Dispenser
see dispenser.

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

Shut-off valve
A mechanism to regulate the flow of a medium (gas, solid, slurry, or liquid), by (partly) opening or closing one (or more) flow openings; there are manually operated and remotely controlled shut-off valves.

Note
The remotely controlled shut-off valves may have a function both for the operation of the installation and also the function of a safety shut-off valve.

Manager
The person who is responsible for the operation of the filling station and has an agreement with the user/owner; the user may also be the manager.

Assessment
Checking the design against PED, WBD, ATEX, PGS 33-1.

Competent authority
A 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; a situation with one side wall and a roof is regarded in this guideline as an outside air situation.

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).

Dispenser
The assembly of components through which the natural gas is dispensed to the vehicle, beginning at the end of the pipe(s) counting from the compressor and/or buffer storage.

Owner
See user.

Operator
See manager.

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

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

Hazard zone classification
A classification of hazardous areas into zones, depending on the probability of the presence of an explosive atmosphere.

Lock down system
A repression system to isolate (a part of) an installation to prevent (further) discharge.

Establishment (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).

Lower Explosive Limit (LEL)
The lower explosive limit expressed in volume percent with respect to the total quantity of air.

Liquefied biomethane (LBM)
Liquefied biomethane.

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

(L)NG
Methane in both liquefied and gaseous state.

Automatic LNG dispenser
A device for the delivery of LNG without direct supervision.

LNG delivery installation
An installation including the LNG storage for the delivery of LNG to vehicles/boats that use LNG as a motor fuel or for the delivery of CNG from evaporated LNG.

LNG delivery station
An LNG delivery installation including the structural provisions.

LNG dispenser
See dispenser.

LNG customer
The person who purchases LNG by refuelling from the delivery installation.

LNG installation
Assembly of components that (may) contain LNG.

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

LNG filling point
The filling point of the LNG storage tank via which re-supply is carried out.

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

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

SS
Stainless steel.

SAFETI-NL
Software program for performing QRA calculations in the Netherlands.

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

Supervising person
Person that 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 establishment manager or a customer, for example a driver. The condition is that this person has received instructions on the safe operation of the delivery installation and the execution of the emergency plan in case of disasters.

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

Note:
If the customer of the LNG or the driver of the vehicle being refuelled has followed instruction, specifically for a location, he can be seen as a supervising person. If this person leaves the site, delivery shall also no longer be possible without identifying a new supervising person.

Safe position safety shut-off valve
A shut-off valve that is designed such that upon failure of the servo-mechanism it automatically takes the safe position.

Licensor
See user.

Filler connection (nozzle)
A part of the delivery hose with which the connection between the delivery hose and the vehicle can be created.

Annex B Relevant legislation and regulations

B.1 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.nl.

B.2 General

Environmental Licensing (General Provisions) Act (Wet algemene bepalingen omgevingsrecht – Wabo)
The Wabo came into effect as of 1 October 2010, with the corresponding Ambient Law Decree (Besluit omgevingsrecht – BOR) and with the corresponding Ministerial Regulation on Ambient Law (Ministeriële regeling omgevingsrecht – MOR). The Wabo has replaced a large number of existing licensing systems, including those of the Environmental Management Act (Wet milieubeheer) and the Housing Act (Woningwet). This means that for an establishment 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 establishment (environmental activity). Annex 1 of the BOR indicates the establishments that require a(n environmental) licence.

Best Available Technology (BAT)
According to Article 9.2 of the MOR the competent authority when awarding a license shall take into account the best available technology (BAT) that is suitable for the establishment. Table 2, Annex 1 Indication of BAT documents in the MOR lists the PGS publications that are considered as Dutch BAT documents.

Activities Decree (Activiteitenbesluit)
The Decree on general rules for environmental management of establishments (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 establishments for which a licence is compulsory. By ministerial regulation or in the license the legislator refers to specific PGS regulations for certain activities.

The Activities Decree makes a distinction between three types of establishments: A, B and C. Type A and B establishments fall fully under the general rules of the Activities Decree, where for type A establishments, because of their low environmental impact, the 'light regime' and no

reporting obligation applies. Type B establishments are establishments for which the licence obligation is lifted but who do have a reporting duty. Type C establishments shall have a license, where for certain activities the regulations from clause 3 of the Activities Decree and a few other regulations of the Activities Decree are directly applicable and for this reason may not be included in the license.

B.3 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 in the Netherlands. The requirements of the European Directive for design and new build are further interpreted in harmonised European standards.

The Pressure Equipment (Commodities Act) Decree (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.

Certain things are not however regulated in the Pressure Equipment (Commodities Act) Decree. For example it does not apply for components of installations with a pressure of 0.5 bar (0.5 atm positive pressure with respect to the atmospheric air pressure) or lower. This means that in the Netherlands the rules of the Health & Safety legislation are applicable for a general duty of care of the employer and for the safety of work equipment and workplaces. In cases where neither the Pressure Equipment (Commodities Act) Decree nor the Working Conditions Act apply, the product liability which a fabricator has towards his customers shall suffice.

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

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.

B.4 Operation

Legislation on explosive atmospheres (ATEX 137)
Within businesses where an explosion hazard exists, ATEX 137 (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 the following measures:

– 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 as well as what measures have been taken. This explosion safety document may form part of the RI&E based on the Working Conditions Act.

Pressure Equipment (Commodities Act) Decree
In addition to requirements for technical integrity the Pressure Equipment (Commodities Act) Decree 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.

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 set down in writing.

Working Conditions
The Working Conditions Act (Arbeidstomstandigheden Wet) 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 for companies, but also for 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 with descriptions of techniques and methods, good practice examples, standards and practical guidance.

If a branch does not take the initiative to draw up a Health & Safety catalogue for the relevant branch, the Labour Inspectorate (AI) can take the initiative to draw up a Branch Health & Safety brochure.

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

In-house fire service (Bedrijfsbrandweer)
On 1 October 2010 the Safety Regions Act (Wet veiligheidsregio's) came into effect. After this date the appointment of establishments that are obliged to have an in-house fire service is a competence of the administration of the safety region.

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

The Safety Regions Decree contains a description of the procedure that government and company shall follow to arrive at an opinion on any in-house fire service obligation. The decree specifically states which type of establishments are eligible for an assessment into in-house fire service obligation. In relation to LNG filling stations this will be the case if the establishment falls under the BRZO 1999 as a result of the quantities of LNG present.

The Safety 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 Safety Regions Decree the administration of the safety region shall only lay down requirements in the appointment order on:

- staff;
- provisions;
- equipment;
- protective equipment;
- alarm and cooperation;
- scope of the in-house fire service:

The In-house Fire Service Guide (werkwijzer Bedrijfsbrandweren) 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;
- 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. Examples are the Occupational Health and Safety Assessment Series (OHSAS) 18001 for OHS management systems and the Dutch Technical Agreement NTA 8620 for safety management systems of BRZO companies.

B.5 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:

1. hazard zones around electrical installations;

2. distances between components of installation, storage and flammable objects on the site;

3. distance requirements relating to buildings outside the establishment.

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 build) that buildings shall be divided into fire compartments with an area of use of no more than 1000 m² and in a number of cases – industrial functions – up to 2500 m² (for storage facilities for packaged hazardous substances PGS 15 has the limit of 1000 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 does however require 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 (Establishments) 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 establishments with specific risks for people outside the site of the establishment. 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 establishments up to a set limit.

Since October 2004 the BEVI has obliged the competent authority when granting licenses 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 in a ministerial regulation (REVI) the distances to be maintained are specified for a number of industrial sectors. For other companies, for example BRZO companies, the distance to be maintained shall be determined with a risk calculation from the calculation rules mentioned 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 for the group risk. With this municipalities and provinces can determine safety distances around risk companies;
- when companies are located too close for example to housing, extra safety measures are necessary. In the most extreme case municipalities and provinces can have a company move or demolish housing;
- If an establishment falls under the BEVI, it is a Type C establishment under the Activities Decree.

B.6 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:

Accord européen relatif au transport international des marchandises Dangereuses par Route (ADR) for road transport.
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.

Annex C Standards

[A]	NEN-EN 3-7	Portable fire extinguishers – Part 7: Characteristics, performance requirements and test methods
[B]	NEN 1010	Safety requirements for low-voltage installations
[C]	NEN 3011	Safety colours and safety signs in workplaces and public areas
[D]	NEN 3140	Operation of electrical installations – Low voltage
[E]	NEN 6064	Determination of the non-combustibility of a building product
[F]	NEN 6088	Fire safety of buildings – Escape route signs – Characteristics and determination methods
[G]	NEN-EN 287-1	Qualification test of welders – Fusion welding – Part 1: Steels
[H]	NEN-EN 473	Non-destructive testing - Qualification and certification of NDT personnel – General principles
[I]	NEN-EN 1160	Installations and equipment for liquefied natural gas – General characteristics of liquefied natural gas
[J]	NEN-EN 12434	Cryogenic vessels – Cryogenic flexible hoses
[K]	NEN-EN 13458-2	Cryogenic vessels – Static vacuum insulated vessels – Part 2: Design, fabrication, inspection and testing
[L]	NEN-EN 13458-3	Cryogenic vessels - Static vacuum insulated vessels – Part 3: Operational requirements
[M]	NEN-EN 13501-1	Fire classification of building products and building elements – Part 1: Classification using data from reaction to fire tests
[N]	NEN-EN 13636	Cathodic protection of buried metal tanks and related piping
[O]	NEN-EN 13645	Installations and equipment for liquefied natural gas – Design of onshore installations with a storage capacity between 5 t and 200 t
[P]	NEN-EN 13766	Thermoplastic multi-layer (non-vulcanised) hoses and hose assemblies for the transport of liquid petroleum gas and liquefied natural gas – Specification
[Q]	NEN-EN-IEC 61310-1	Safety of machinery – Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile signals
[R]	NEN-EN-IEC 60079-0	Explosive atmospheres – Part 0: Electrical equipment – General requirements
[S]	NEN-EN-IEC 60079-14	Explosive atmospheres - Part 14: Electrical installations design, selection and erection

[T]	NEN-EN-IEC 60204	Safety of machinery - Electrical equipment of machines
[U]	NPR 2578	Management and maintenance of LPG, propane and butane installations
[V]	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
[W]	NEN-ISO 3864-1	Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs and safety markings in workplaces and public areas
[X]	NEN-EN-ISO 7010	Graphical symbols – Safety colours and safety signs - Registered safety signs
[Y]	ISO 16923:	Compressed natural gas (CNG) vehicle filling stations (in preparation)
[Z]	ISO 16924:	Liquefied natural gas (LNG) vehicle filling stations (in preparation)

Annex D Information on liquefied natural gas (LNG)

D.1 LNG production

In the following the different steps of the logistics chain for LNG are explained.

Gas production
Natural gas is a fossil fuel which is produced in the same process that leads to the formation of petroleum. It is therefore often found together with petroleum, although there are also fields that consist only of gas. Gas for which there is no local demand (also called “stranded gas”), can be transported to consumers located further away by a pipeline or by ship. To make transport by ship more efficient, the gas is temporarily liquefied, which reduces the volume by a factor of 600. This is done in an LNG plant.

Liquefaction
LNG is normally produced in plants with a capacity of several million tonnes per year. Before the gas is liquefied, impurities such as carbon dioxide, hydrogen sulphide, water and mercury are removed. Heavier hydrocarbons, that would otherwise freeze during the cooling process or are valuable as a separate product, are also extracted from the gas. The gas is then cooled, as a result of which it is ultimately liquefied. During this process the nitrogen concentration is minimised. The LNG has a temperature of -162 ºC at atmospheric pressure.

Sea transport
Special LNG ships take the LNG round the world. These ships have a double hull, to reduce the chance of a leak. These hulls are also designed so that as little LNG as possible evaporates during transport. Conventional LNG carriers use vapour produced by the LNG cargo (boil off) as a fuel.

Evaporation
An LNG ship is offloaded at the pier of an LNG terminal. The LNG is stored temporarily in a tank after this. Ultimately the LNG in the terminal is evaporated using water under controlled conditions. This gas can then be transferred into a pipeline.

Transport by road tanker or boat
Another option is to transfer the LNG after receipt in an import terminal into a road tanker or smaller ship. In this way the LNG is transported in small quantities to end users e.g. small industrial users or transport equipment. In the latter case local storage of the LNG is necessary in a filling station, as a buffer.

Local liquefaction
It is also possible to produce LNG locally. This is done in particular in the case of unconventional gas (CBM, shale gas), pipeline gas that is stored as a reserve in a peakshaver and biogas. This biogas is obtained from the rotting process of organic material and then consists primarily of natural gas and carbon dioxide. After treatment liquefied gas, or LBM, can also be made from biogas. This is often done on a small scale. After production the LNG can be transported by road tanker or boat to the (small) users.

D.2 The composition of LNG

The composition of LNG may vary, depending on the gas field or other source from which it is extracted. CNG and LNG consist primarily of methane. In addition both contain higher hydrocarbons (such as ethane) and inert gases (such as nitrogen). LNG does not contain any significant quantity of carbon dioxide (< 50 ppm).

Table D contains information from a GIIGNL report (2009) with the composition and characteristics of LNG from different locations.

The composition may change somewhat during storage and transport of LNG as a result of boil-off of lighter components (methane, nitrogen).

The composition of LNG is decisive for its combustion characteristics.

An important combustion characteristic is the energy value that indicates the energy content of the fuel. The Wobbe index is used for this to determine the degree of interchangeability of different gases in the same burner. The methane number is also relevant for the use of LNG as a fuel for motor vehicles. This number, for which various definitions exist, indicates the degree of knock resistance.

D.3 Toxicity and suffocation hazard

Natural gas is not very toxic, no limit value is set, but it creates a suffocation hazard in high concentrations.

D.4 Explosion limits, perceptibility and ignition temperature

Explosion limits
A natural gas/air mixture is flammable under atmospheric conditions between a volume percent of 5.9% and 16% natural gas in air.

Perceptibility
Natural gas is odourless by nature. LCNG and CNG also need an odorant; LNG does not. The ignition temperature for spontaneous combustion in air is around 893 K (620 °C).

Relative vapour density
Natural gas is lighter than air under atmospheric conditions and will therefore rise and evaporate if it is released. The relative vapour density is 0.64 (air = 1.0).

Boil-off rate
When LNG is released on a substrate or in a liquid this will affect the rate at which LNG expands to gas form. An intensive boiling process will take place where the LNG touches the surface. The rate of boil-off will quickly be reduced to a constant value that is determined by the thermal characteristics of the surface such as ground or liquid and the heat that is extracted from the environment.

This boil-off rate may be significantly reduced by thermally insulating the surface where the leak may possibly occur.

See Table D for different types of surface in relation to expansion.

Table D.1 – Type of material in relation to boil-off rate

Material	Steady-state boil-off rate after 60 s in kg/m²h
Aggregate	480
Wet sand	ET S
Dry sand	195
Water	190
Standard concrete	130
Colloidal concrete	65

These figures were determined from experiments with LNG leaks on different types of substrate (NEN-EN 1160).

Small quantities of LNG may therefore be converted into large quantities of gas when a leak occurs. One unit of LNG is converted into 570-590 units of gas all depending on the gas composition (% CH_4 in gas) at a temperature of 0º C and an atmospheric pressure of 101,325 Pa.

When the leak/discharge takes place on the water surface, the convection in the water will be so intense that the boil-off rate related to that area is constant.

When two liquids, with two different temperatures, come into contact with one another explosive forces may occur. This phenomenon, called ‘rapid phase transition’ (RPT), may occur when LNG and water come into contact with one another. Although combustion does not occur, this phenomenon has all the characteristics of an explosion. An RPT may be defined as a rapid boil-off of a liquid. This boil-off takes place in a very short time with the result of an enormous increase in volume. This increase causes a local pressure increase that is able to cause an air or water shock wave.

BLEVE

BLEVE is an abbreviation for ‘boiling liquid expanding vapour explosion’. This is a type of explosion that may occur if a holder (tank) of a liquid cracks open under pressure.

A BLEVE may occur in a holder filled with a substance that under atmospheric conditions is a gas but under pressure is a liquid, such as LNG. The holder then contains a layer of liquid with a layer of gas above it. A holder may crack open for example due to corrosion, metal fatigue or an influence from outside, such as fire. Due to the high pressure the holder may also fail under explosive conditions. Here parts of the holder or even the whole holder may be hurled a great distance. Due to the rapid decompression the liquid will immediately boil very vigorously as a result of which large quantities of gas are formed. The expanding gas cloud will take any remaining liquid with it and spread as a cloud of vapour and a finely atomised liquid.

Flammable liquid or gas is not necessary for a BLEVE, in that case there is also no chemical explosion. However, if the substance is flammable then it is highly probably that the substance released will catch fire, resulting in a fireball.

D.5 Cryogenic characteristics

The extremely low temperature of LNG requires special attention during handling. Since the LNG is stored under pressure, in case of a leak a jet or splashes of cold vapour or liquid are released. The following dangers are present when handling leakage of cryogenic media.

Cold, LNG (-162°C) released has a specific density of around 1.8 at atmospheric pressure. This means that when it is released, the vapour is heavier than air and will remain on the ground. It will accumulate in low-lying and poorly ventilated places, in doing so displace the ambient air and cause suffocation. Depending on the ambient and weather conditions this effect may occur at a very great distance from the leak.

Due to the low temperature the skin will freeze (so-called cold burn) on contact with the cold liquid or vapour. The effect is the same as for a normal burn. The severity depends on the temperature of the vapour and the duration of exposure. Also on touching cold surfaces (piping, shut-off valves etc., but also clothing that has cooled) a freezing hazard is present. When touching these surfaces the skin may freeze to the cold surface due to moisture freezing. When pulling away, skin or muscle tissue may come away.

Splashes of liquid that get in the eyes may cause immediate serious injury.

Inhalation of the cold vapour may cause freezing of the lungs and airways. In case of longer term exposure diseases such as pulmonary oedema or lung infection may occur.

Long term cooling may cause hypothermia.

Materials may become brittle at low temperature and lose their strength and hence functionality. It is therefore very important to choose the right materials for the storage of LNG.

During boil-off of larger quantities of LNG the cold vapours condense into water in the outside air. This is accompanied by the formation of a white cloud, until the gas heats up, dilutes and dissolves in the outside air. The cloud will meantime obscure a (part of) the installation or the surrounding area from view.

The visibility of the LNG cloud depends on the air temperature and air humidity. Also significant is whether the LNG vapour comes from a pool or is caused by an LNG liquid jet. In case of an air humidity higher than 50% the inflammable cloud is entirely within the visible cloud. With a lower air humidity the inflammable cloud will spread to outside the visible cloud. This means that the vapour may be ignited if the ignition source is outside the visible cloud. The size of the vapour cloud depends on the wind speed, wind direction and other weather conditions and may be easily predicted with the right calculations. The cold vapour will start to rise if it is heated by the outside air to above – 110°C.

For the above reasons it is recommended that when working with cryogenic media the right clothing, face protection and gloves resistant to cold be worn. Those who come to fill the stock tank shall be trained in this and familiar with this. This cannot be said for the LNG customers. This shall be taken into account in the design and use of the installation. Clear instructions which shall be followed in case of need, shall be affixed in a visible place for end users.

Annex E Procedure for filling the storage tank at an LNG delivery installation

For offloading the LNG tanker, the driver shall follow the following procedure:

1 Park the LNG tanker in the direction of driving away, according to the specified distance to the reservoir to be filled (LNG storage tank), or as close as possible to the filling point.

2 Put on hand brake.

3 Check no other tanker is offloading fuels within 25 m of the offloading point and that offloading can take place safely.

4 The employees involved in offloading shall use suitable PPE.

5 Establish the contents of the stationary LNG storage tank and on this basis determine the maximum permissible quantity to be topped up.

6 Check the pressure in the LNG storage tank. This may not exceed the maximum filling pressure of the offloading pump. If possible the necessary steps shall be taken to obtain a feasible pressure (reduction).

7 The driver of the LNG tanker shall keep to the maximum filling capacity, as indicated in the filling instructions corresponding to that specific station. If these instructions are not present, filling may not take place.

Note:
Practical explanation in line with ADR 4.3.5 TU18.

8 Open the doors of the valve compartment of the LNG tanker, which enables the remote controlled shut-off valves and the pump to be put into operation.

9 Attach the cable to make a connection with the LNG filling station with the functions of making an equipotential connection and coupling the tanker emergency shutdown system with the emergency shutdown system of the LNG installation to be restocked.

10 Remove the blind flanges or blind couplings of the necessary shut-off valves of the LNG tanker and the filling point.

11 Couple the offloading hose between the shut-off valve of the LNG tanker and the filling point of the stationary reservoir (LNG storage tank) using flanges or hose couplings. Non-sparking tools shall be used for this.

12 Check the connections and open the necessary shut-off valves of the LNG tanker and of the filling point and/or the LNG storage tank and then check the tightness of connections.

Note:
The remote controlled shut-off valves on the reservoir connections of the LNG tanker may be opened in different ways (there is no standard for this yet). If these operations are not carried out properly the pump drive cannot be switched on.

13 Take measures so that the pump can be started and then start the pump.

14 Tighten connections, following shrinkage occurring because of the low temperature.

15 Continue to check constantly that offloading is taking place safely and in particular that the permissible filling capacity of the LNG storage tank is not exceeded.

16 Stop offloading upon reaching the maximum permissible filling capacity by stopping the pump and closing the shut-off valves of the LNG tanker.

17 Establish when the maximum permissible filling capacity is reached from the maximum level indication; a preliminary alarm can be given by setting the liquid level indicator at a lower level.

Note:
If the driver uses an approved remote control for pump and shut-off valves it is permitted to check the filling capacity of the stationary LNG storage tank on the spot.

18 Close the shut-off valves of the filling point and/or the LNG storage tank.

19 Degas the offloading hose according to the procedure for the LNG filling station.

Note:
When disconnecting the hose a small quantity of (L)NG is released. Connection and disconnection shall not be carried out during a thunderstorm.

20 Disconnect the hose and fit a blind flange or blind coupling to the hose shut-off valve.

21 Disconnect the earth connection and secure the filling point shut-off valve against unauthorised use.

22 Determine the quantity delivered.

23 Close the valve compartment of the LNG tanker which interrupts the servo-mechanism of the driving off alarm system, the remote controlled shut-off valves and the pump.

24 Check both the stationary LNG storage tank and the LNG tanker for irregularities or leakage and inform the customer of the delivery made by handing over or leaving the delivery note and report any irregularities to him and the client.

25 After closing the valve compartment of the LNG tanker, PPE, specifically for handling LNG, is no longer necessary.

26 Release the hand brake and leave the parking space.

Annex F Example of checklist for work on LNG storage tanks

This checklist shall be present at the works and updated during the work.

1. General details

Place and nature of the work:	
Client: name of company: officer: signature of officer:	
Carried out by:	
Name of responsible employee on site:	
Signature of responsible employee:	

2. Part to be filled in daily

General

Date:	
Weather conditions: - windy/windless - clear/misty - temperature (°C)	
Number of people involved in the work:	
Qualifications of the people involved in the work:	

Safety measures

☐	No flammable material or ignition sources are present within 15 m
☐	Warning notices have been put up
☐	Extinguishers present type: _____ number: _____ capacity:_____
☐	Explosion meter present and tested
☐	Oxygen meter present and tested

3. Progress of the work

A. Gas removal

☐	Part 1 and 2 of this checklist completely filled in
☐	Reservoir pumped empty as far as possible
☐	Combustion engines stopped, electrical installation turned off and power disconnected and naked flames put out
☐	Reservoir and piping depressurised
☐	Hoses and piping flushed with inert gas
☐	Reservoir completely filled with water or flushed effectively with inert gas
☐	Reservoir completely ‘vented’
☐	Measurement of LNG in LNG storage tank (reservoir) _____volume percent LNG
☐	Gas test at pipe outlets _____ LEL (lower explosive limit)
☐	Measurements carried out by: _____

☐	Reservoir free for entry of people: measurement: _____ volume percent LNG checked by (name): _____ signature and date: _____

B. Putting into operation

☐	All fittings checked and fitted with new gaskets
☐	First fill with LNG carried out by: name: _____ date: _____
☐	Reservoir pressurised with LNG, with nitrogen, air or other inert gas
☐	Tightness test carried out
☐	Installation released for use for issue (signature + date): for receipt (signature + date):

Annex G Explosion-safe equipment (ATEX 95)

The rules relating to explosion-safe equipment are laid down in the European Directive 94/009/EEC (ATEX 95). This directive relates to technical integrity and contains target regulations for equipment and protective systems used in potentially explosive atmospheres. In the Netherlands ATEX 95 has been transposed in the Explosion-safe equipment (Commodities Act) Decree (Warenwetbesluit explosieveilig materieel), with corresponding Regulation concerning further rules with respect to explosion-safe equipment (Regeling houdende nadere regels ten aanzien van explosieveilig materieel) and the Decree on electrical explosion-safe equipment (Besluit elektrisch explosieveilig materieel). The requirements are particularly important for fabricators and importers of explosion-safe equipment.

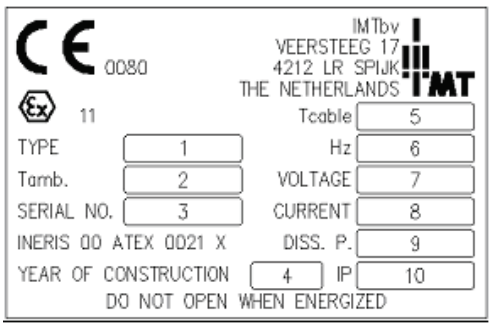
For all people using and/or carrying out activities on an LNG delivery installation, it is important that the work equipment and the electrical installation material used within the hazard zones cannot cause ignition.

In concrete terms, this means that material shall be designed according to the requirements of the Explosion-safe equipment (Commodities Act) Decree, and that smoking and naked flames, as well as the presence of objects with a surface temperature higher than 300 °C (the spontaneous combustion temperature of propane and/or butane is higher than this maximum for temperature class T2) is not permitted within the zone.

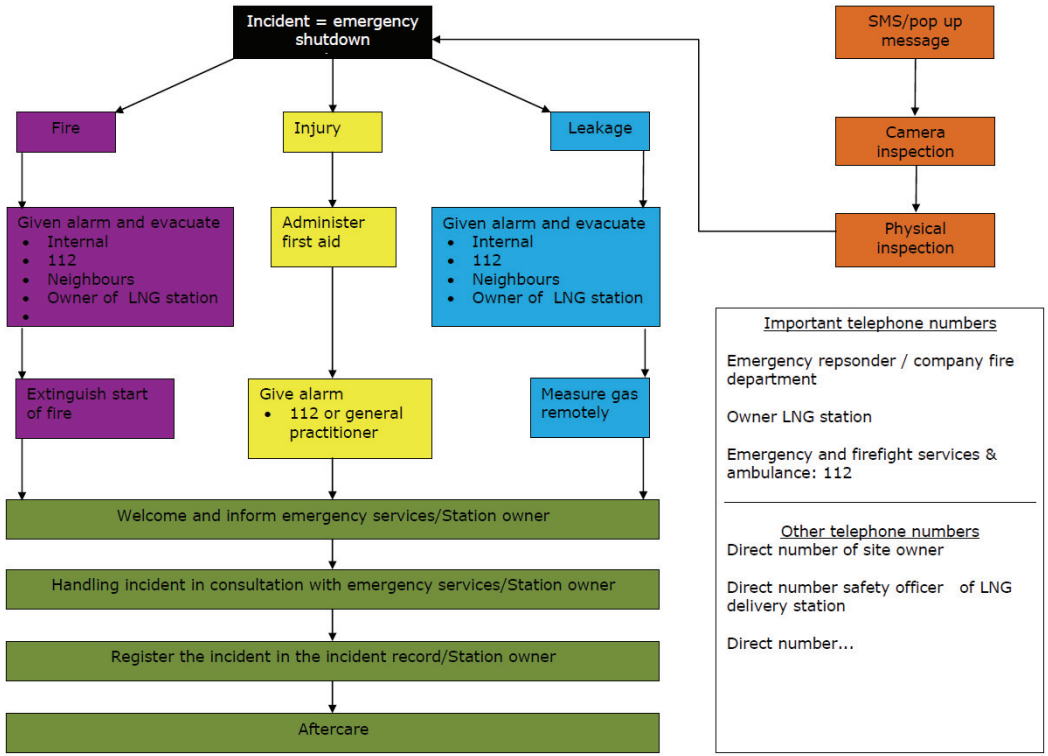
Electrical equipment that meets the standards for explosion safety can be identified by the ‘Єx’ symbol in a regular hexagonal. Should this not be visible, a document shall be present in the log book in which the supplier declares that the electrical equipment meets the normal standards for explosion safety. This then involves a so-called EC declaration of conformity that is accompanied by a CE marking. Cabling is regarded as a fixed electrical connection, free of sparking and is hence exempt from explosion safety criteria.

Finally in simple electrical installations cast-in components are often used that thereby meet the explosion safety requirement (and are regarded as compliant) without the housing in which they are placed bearing the ‘Ex’ mark.

Set out below are two examples of images where an ‘Ex’ marking is affixed. In this respect we would point out that the ‘Ex’ marking is not required based on the ATEX Directive, but results from a number of other standards.



Annex H Example of emergency instructions for LNG delivery installation



Annex I Calculation of maximum filling capacity

The starting point for determining the maximum filling capacity is the ADR Regulation that an LNG storage tank may not be filled more than 95% under any conditions.

The maximum filling capacity is calculated as follows:

$$\frac{\text{Density LNG at set blow-off pressure of safety valves}}{\text{Density LNG at 1 bar}} \times \text{max. filling capacity according to ADR}$$

Example calculation:

The setting of the blow-off pressure of LNG storage tank safety valve is 1000 kPa (10 bar)

Density of LNG at set blow-off pressure of safety valve at 1000 kPa (10 bar) is 359.6 kg/m3

Density of LNG at 100 kPa (1 bar) is 442.0 kg/m3

The maximum filling capacity of LNG storage tank according to ADR is 95%

The maximum filling capacity is then:

$$\frac{359.6}{442.0} \times 95\% = 77.2\%$$

Interpretation: This LNG storage tank may not be filled more than 77%. This shall be clearly indicated on the tank.

Annex J List of responsibilities and roles

The stakeholders in an LNG delivery installation each have their own tasks and responsibilities as regards safety, for example:

- fabricator;
- installer;
- inspection body (AKI);
- user (licensor/owner) of the LNG installation;
- manager of the LNG installation;
- supervising person;
- supplier of LNG;
- customer of LNG.

The following aspects are important for the safe operation of the LNG delivery installation:

- construction and installation;
- inspection and maintenance;
- use of the LNG delivery installation;
- management of the LNG installation;
- supervision of the use of the delivery installation;
- filling of the LNG storage tank.

The final responsibility for compliance with the regulations does however always lie with the user of the establishment see Table J for a list of the stakeholders and their responsibilities in which roles.

Table J.1 — List of responsibilities and roles of stakeholders in LNG delivery station

Responsible persons (for definitions see Annex A)	Corresponding term	Role(s)
Fabricator		Construction and supplier
Installer		Installation and maintenance
Inspection body (AKI)		Inspection
User/owner		Licensor
Manager	User/operator	Operation and management
Supervisor	Manager LNG customer (for example trained driver	Supervision of the use of the delivery installation
LNG customer		Supervision of the delivery installation during delivery
LNG supplier		Filling of the LNG storage tank

Annex K References

[1] Beoordelingsrichtlijn voor het Kiwa procescertificaat voor “Regeling Erkenning Installateurs tanks en leidingen voor drukhoudende opslag van LPG, propaan, butaan, DME en aardgas (REIP)” voor het Kiwa procescertificaat voor “Regeling Erkenning Installateurs tanks en leidingen voor drukhoudende opslag van LPG, propaan, butaan, DME en aardgas (REIP)”, BRL-K901/03, Concept 2011-05-01.
(Assessment guideline for the Kiwa process certificate for “Regulation on Authorisation of Installers of tanks and piping for pressurised storage of LPG, propane, butane, DME and natural gas (REIP)” for the Kiwa process certificate for “Regulation on Authorisation of Installers of tanks and piping for pressurised storage of LPG, propane, butane, DME and natural gas (REIP)”, BRL-K901/03, Draft 2011-05-01.

[2] Bepaling interne veiligheidsafstanden voor LNG-tankstations ten behoeve van de in ontwikkeling zijnde PGS 33 deel 1 (v.0.4), Edward Geus (RIVM) & PGS 33-1 WG 1, 2013-04-24. (Determination of internal safety distances for LNG filling stations for PGS 33 part 1 (v. 0.4) in development)

[3] http://www.arboportaal.nl/onderwerpen/veilig-werken/inrichting-werkvloer/explosieve-atmosfeer.html.

[4] QRA rekenmethodiek LNG-tankstations (QRA calculation method LNG filling stations) – RIVM – (available in draft).

Annex L Composition of PGS team 33

Name	Organization
Ad Matthijsen, Edward Geus	Ministry of Social Affairs and Employment (SZW)/ National Institute of Public Health and the Environment (RIVM)
Arjon Seesink	Rijngas B.V.
Bert Groothuis	Cofely/ GDF LNG Solutions
Edwin van Leeuwen	Cryonorm projects B.V.
Erik Büthker	PGS management organization, chairman
Evert van de Laar	Ministry of Economic Affairs (EZ)
Hans van den Boogert	Lloyd's Register Nederland B.V.
Jeroen de Groot	Shell Global Solutions International B.V.
Jeroen Knoll	Ballast Nedam
Kenny Vanlancker	K.V.G.B.
Koos Ham	TNO
Harold Pauwels	Interim Project Manager, PGS organization, NEN
Linard Velgersdijk	Gate Terminal B.V.
Luc Vijgen	DCMR
Maarten van Abeelen	Brandweer Nederland (Dutch Fire Service) / Rotterdam Rijnmond fire service
Matthé Bakker, Alex Bloemsma	DNV KEMA
Martin Meijboom	KIWA
Peter Hendrickx	BOVAG
Rinus Meulenberg	DOW
Shyreen Dahoe	Project Manager, PGS organization, NEN
Ton Janssen	VNG, DCMR
Wim Schouten	NOVE