Guidelines for set up & operation of stations

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Executive Summary

LNG stations for the refueling of trucks are quite new as a technology. In order to promote the uptake of this technology, the LNG Blue Corridor project supports construction of new stations along the European transport axes.

It is crucial that this introduction happens in a standardized and safe way. Therefore, in this deliverable, we focus on the best practices for the setting up and the operation of new stations for Liquified Natural Gas or Liquified Bio Gas.

In the first part, we address the requirements for the set up of the stations, before they go into service. This relates to the design of the equipment, lay-out of the station, the compliance with the regulation and all the tests and checks at the commissioning.

In the second part, we describe the guidelines for the safe and efficient function of the station, once it goes into operation. Here we focus on the roles of the operator, the end-user and last but not least the maintenance and periodic inspections.
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1 Introduction

1.1 LNG Blue Corridors project

The LNG Blue Corridors project’s aim is to establish LNG as a real alternative for medium- and long-distance transport—first as a complementary fuel and later as an adequate substitute for diesel. Up to now the common use of gas as fuel has been for heavy vehicles running on natural gas (NG) only for municipal use, such as urban buses and garbage collection trucks. In both types of application, engine performance and autonomy are good with present technologies, as they are well adapted to this alternative cleaner fuel.

However, analyzing the consumption data, the equivalence in autonomy of 1 liter of diesel oil is 5 liters of CNG (Compressed Natural Gas), compressed to 200 bar. Five times more volume of fuel prevents the use of CNG in heavy road transport, because its volume and weight would be too great for a long-distance truck. This opens the way for LNG (Liquefied Natural Gas), which is the way natural gas is transported by ship to any point of the globe. NG liquefies at 162º C below zero, and the cost in energy is only 5% of the original gas. This state of NG gives LNG the advantage of very high energy content. Only 1.8 liters of LNG are needed to meet the equivalent autonomy of using 1 liter of diesel oil. A 40-ton road tractor in Europe needs a tank of 400 to 500 liters for a 1,000 km trip; its equivalent volume with liquid gas would be 700 to 900 liters of LNG, a tank dimension that could easily be fitted to the side of the truck chassis. LNG therefore opens the way to the use of NG for medium- and long-distance road transport.

LNG has huge potential for contributing to achieving Europe’s policy objectives, such as the Commission’s targets for greenhouse gas reduction, air quality targets, while at the same time reducing dependency on crude oil and guaranteeing supply security. Natural gas heavy-duty vehicles already comply with Euro V emission standards and have enormous potential to reach future Euro VI emission standards, some without complex exhaust gas after-treatment technologies, which have increased procurement and maintenance costs.

To meet the objectives, a series of LNG refueling points have been defined along the four corridors covering the Atlantic area (green line), the Mediterranean region (red line) and connecting Europe’s South with the North (blue line) and its West and East (yellow line) accordingly. In order to implement a sustainable transport network for Europe, the project has set the goal to build approximately 14 new LNG stations, both permanent and mobile, on critical locations along the Blue Corridors whilst building up a fleet of approximately 100 Heavy-Duty Vehicles powered by LNG.

This European project is financed by the Seventh Framework Programme (FP7), with the amount of 7.96 M€ (total investments amounting to 14.33 M€), involving 27 partners from 11 countries.

This document corresponds to the 4th deliverable within work package 3. It is a document describing the best practices guidelines for setting up and operation of LNG/LBM stations. This document will be available at the project website: http://www.lngbluecorridors.eu/.
1.2 Aim of this deliverable

The aim of this deliverable is to draw attention on the best practices when setting up and operating an LNG or LBM station. The technology is in no way comparable to traditional fuels and especially the cryogenic aspects of the LNG or LBM call for specific attention.

Projects can only be successful if all aspects are managed in a proper way. It is absolutely important for the future of this technology that early projects are state of the art, and do fulfill all the necessary requirements on safety, ecology and economy.

This deliverable is intended to share knowledge on the procedures to follow when setting up and operating an LNG station for road transport. We will refer to some of these regulations of Spain, Sweden and the Netherlands, as they can be used as ‘best practice’ guidelines in the countries where these regulations are not compulsory.
2 Guidelines for the set up

In this deliverable, we will refer to the 3 standards:

- Spanish standard UNE 60210:2011 (abbrev. UNE)
- Swedish standard ‘Tankstationer förmetangasdrivna fordon’ published by MSB. (Abbrev. TFF)

These documents provide a checklist for the inspection of gas stations prior to the operational start. Please beware that only PGS 33 is specifically for LNG refueling stations. UNE 60210:2011 is in fact the “LNG satellite plants” regulation that it is being used for stations, as well. And the Swedish documents is set up for CNG stations, but can also help for LNG (or L-CNG) stations.

For the set-up of LNG stations, following activities are necessary:

- Visual inspection of the facilities
- Compliance with the regulation
- Functional testing of the auxiliary systems
- Simulation of anomalies
- Checking of permits and licenses

Note: Portuguese government ordinance nº 366/2013 establishes the trade, the legal regime and the filling stations building standards. Additionally, and as a complement for situations not covered in this ordinance, the European standard EN 13645 “Installations and equipment for liquefied natural gas — Design of onshore installations with a storage capacity between 5t and 200t” can also be followed.

2.1 Inspection of the facilities

After the construction of the station, the facilities should be checked to assure that all equipment is in good condition, and the safety measures are active.

A visual check of the facilities is carried out to make sure that the equipment and the components are well assembled, in agreement with the project and the ‘as built’ plans.

PGS 33 states that this check will consider corrosion, damage and contamination, and condition of the foundations by an authorized inspection body.

2.2 Compliance with current regulation

Obviously, the station needs to be in compliance with all the local regulations and legislation that are in place for the given application and territory.
It is very well possible that – due to the new and innovative character of the technology – no regulatory framework is available. In that case, it makes sense to use the regulation of other countries.

As stated, we will refer to Swedish, Spanish and Dutch regulations.

2.2.1 Inspection of the design and construction of the facility

2.2.1.1 Storage tank

- The LNG storage tank should comply with the PED (PGS)
- A suitable foundation shall be installed, of non-flammable material. (PGS)
- What is the MAWP of the tank? (UNE)
- Are the safety valves present? (PGS)
- What is the operating pressure of the tank? (UNE)
- Is there enough margin between operating pressure and MAWP? (UNE)
- Is there an economizer valve? (UNE)

2.2.1.2 Construction downstream of the storage tank

- Cryogenic purge valves should be connected to the central vent stack (UNE)
- Between two shut-off valves, there should be a safety valve (UNE)
- If there is a cryogenic pump, it should be certified to work in explosive atmosphere (UNE)
- If there is a pump, there should be an emergency button (UNE)

2.2.1.3 Level measurement

- The max. filling level of the tank is 95%, taking into account the density (PGS)
- The LNG storage tank should have 2 independent level measuring systems (PGS)
- A device shall be present to ensure that the 95% is not exceeded as a result of saturation. (PGS)

2.2.1.4 Vaporizers

- The design pressure should be at least equal to the highest predictable pressure. (UNE)
- Are there any additional heaters? (UNE)
- Is there a safety valve? (UNE)
- Is the venting in a safe area? (UNE)
- Are there any check valves? (UNE)

2.2.1.5 Shut down valve for low temperature

- The reset should be manual (UNE)
- The control signal is provided by a temperature sensor (UNE)
- The valve closes at a gas temperature of -10°C (UNE)
- The operation is guaranteed at all times, and the valve remains closed in case of power failure (PGS)

2.2.1.6 Piping, valves and fittings

- The design should take into account the dimensional variations due to temperature change (UNE)
- Measures should be taken to avoid galvanic corrosion between brackets and pipes.(UNE)
- All liquid connections to the tank are fitted with shut-off valves (PGS)
• The safety valves shall close if the servo-mechanism fails (PGS)
• It is advisable to use welded joints as much as possible (PGS)
• Underground piping shall be laid such that no material stress can arise as a result of mounting, settlement of temperature differences (PGS)
• Is the underground piping protected against corrosion (TFF)

2.2.1.7 Dispenser

• The dispenser shall be fitted both at the bottom and at the top with two ventilation openings located opposite one another (PGS)
• The dispenser shall have a dead man’s button (PGS)
• The hoses shall be no shorter than 3 meters, and no longer than 5 meters. (PGS)
• The hoses shall have break-away couplings
• The dispenser shall have clear operating instructions, and protection against collision. (PGS)
• Are the fuel hoses protected against damage? (TFF)

2.2.1.8 Filling point of the storage tank

• Shall be above ground, and protected from collision (PGS)
• Can the operator see tank filling level and pressure from unloading point? (PGS)
• Is there a non-return valve in the liquid line? (PGS)

2.2.1.9 Safeties

• All piping between shut-off valves should have safety valves. (PGS + UNE)
• The working pressure should be below the MAWP (UNE)
• The LNG storage tank should have 2 independent level measuring systems (PGS)
• A device shall be present to ensure that the maximum level is not exceeded. (PGS)

2.2.1.10 Fitting and construction

• The welding is according to procedures (UNE)
• All welders should be certified (PGS)
• Contractions and expansions have been considered (PGS)
• Vent lines and drains are provided (UNE)
• Vent line shall (PGS):
  o Not collect rainwater
  o Not be possible to be closed
  o Have discharge in vertical direction
  o Have liquid detection

2.2.1.11 Controls on site

• A manometer should be present (UNE)
• A level indicator should be present (UNE)
• The maximum filling level should be indicated (UNE)

2.2.1.12 Remote controls

• If the station is in operation and unattended, an alarm or notification system should be active
• Parameters that need to be controlled: (UNE)
  o Tank pressure
  o Filling level
• Gas temperature at the dispensers
• Power supply
• Damage to the vaporization system
• Gas detection
• Liquid gas leaks (detection by low temperature)

2.2.1.13 Electrical installation

• Classification of the zoning (ATEX)? (UNE + PGS + TFF)
• Compliance to local electrical regulations (UNE + PGS + TFF)
• Inspection of the grounding of all metallic parts (PGS + UNE)
• Inspection of the grounding of the tanks (UNE)

2.2.1.14 Firefighting equipment

• Dry powder extinguishers available? (TFF)
  o 10 kg / 1000 kg product (UNE)

2.2.1.15 Odorization equipment

• Is it in place? Only in case of CNG supply.

2.2.2 Inspection of the location

2.2.2.1 General conditions

• Is there a proper metallic fence with opposite doors for safe exit? (TFF+UNE)
• Is there an easy access for vehicles and staff? (TFF+UNE)
• Is it protected from unauthorized persons (PGS)
• Depending on the type of installation, specific safety measures can be recommended (UNE)

2.2.2.2 Containment against spills, according to UNE

• If there is more than one tank, the capacity per tank should be less than 270m³.
• There should be at least 1.5 meters between the tank and the bund walls.
• There should be at least 2 meters distance between the tanks.
• The minimum distance between 2 adjacent bunds is 4 m.
• The volume of the containment of a single tank is equal to the geometric capacity of the tank.
• The volume of the containment with more than one tank, if safety measures are in place, is equal to the geometric capacity of the largest tank.
• The volume of the containment with more than one tank, without safety measures in place, is equal to the sum of geometric capacities of all the tanks.
• The volume of the containment of the vaporisers, pipelines and equipment should be at least equal to the volume that could be expected during a 15 minutes spill.
• For installations with a tank of more than 270m³, there should be a cryogenic valve with remote control (control outside containment area).

2.2.2.3 Containment according to PGS

• A containment does not have the effect of increasing safety and so is not required.
2.2.2.4 Safety distances according to UNE

- The safety distances are according to following categories of (totally installed) capacity (valid in Spain):
  - A  From 1 m³ to 5 m³.
  - B  From 5 to 20 m³
  - C  From 20 to 60 m³
  - D  From 60 to 200 m³
  - E  From 200 to 400 m³
  - F  From 400 to 1000 m³

The actual distance in meters to the following elements is:

<table>
<thead>
<tr>
<th>Openings in buildings, basements, sewers, drains</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<tr>
<th>Motors, switches (non ATEX), storage of flammable materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<th>High voltage power lines</th>
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<th>D</th>
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<tr>
<th>Property border, public roads, railways.</th>
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<th>B</th>
<th>C</th>
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2.2.2.5 Safety distances according to PGS 33

In PGS 33, the internal safety distances are considered according to different scenario’s.

The biggest internal distance is between the storage filling point and shops or other vulnerable parts on site. This distance is 15 meters. The distance between the LNG storage tank and dispenser on one hand and the offloading point should also be 10 meters.

The external safety distance is advised to be demonstrated by a QRA (Quantitative Risk Analysis).

On-site testing

- A leakage test during 24 hours (UNE)
- Checking of the security systems (UNE)
- Checking of the sealing of the safety valves (UNE)
- Filling with liquid nitrogen (UNE)
- Leak tightness (PGS)
- Functional operation of the accessories (PGS)

2.2.3 Inspection of the Pressure Equipment Directive

According to PGS 33, Authorized Inspection Bodies or Authorized User Inspectorates should check the compliance of all pressure equipment with the European Pressure Equipment Directive 97/23/EC (PED)
2.2.4 Inspections of the explosion safety

PGS 33 also requires that all the 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.

2.2.5 Inspections of the working conditions

Also the working conditions for personal and staff on the LNG station need to be considered. (PGS) ATEX 137 describes how to work safely in an environment where there is an explosion hazard. An explosion safety document shall be drawn up according to the European Directive.

TFF states that the work instructions to work in explosive atmosphere should be present.

2.2.6 Inspection of the operations

2.2.6.1 General

- Installation diagram and instructions available? (UNE)
- Access restricted to authorized staff only? (UNE)
- Who is in charge of the operations (TFF)
- Does the manager have the necessary skills and training? (TFF)
- Is there a deputy appointed, with sufficient skills and power? (TFF)
- Absence of combustible materials? (UNE)
- Is all the relevant documentation available and in local language? (TFF)
- Are there instructions to notify the authority in case of incidents or accidents? (TFF)
- If the station is not opened, all shut-off valves shall be closed (PGS)

2.2.6.2 Procedures for filling the storage tank

- There should be a written procedure (PGS)
- There should be dead man’s button, with 3 minute interval. (PGS)
- Non-sparking tools should be used (UNE)
- There should be appropriate lighting (UNE)
- The tanker should be parked in a safe position, and should be able to drive away without manoeuvring (PGS)
- As soon as the maximum volume is reached the filling shall be stopped automatically. (PGS)
- No other fuels may be offloaded at the same time (PGS)

2.2.6.3 Methane emissions

- In case of regular operation, emission of methane is not permitted (PGS)

2.2.6.4 Delivery of LNG / dispenser

- Adequate personal protection equipment shall be used
- Fire extinguishers can be reached within 5 meters from the dispenser (PGS)
- There shall be a dead man’s button and ESD button at the dispenser. (PGS)
- The delivery and vapour return hose shall have break-away couplings. (PGS)
- The length of the hoses shall be between 3m and 5m. (PGS)
2.3 Functional Testing of auxiliary systems

All systems on the station should be tested for proper function. We recommend to check following systems:

- Remote control: record if all signals and alarms are received in the remote monitoring center
- Financial System: check if the fuel purchase transactions are carried out successfully, and that there is correspondence with the data recorded at the dispensers.
- Security: Check that the monitoring equipment (camera’s, ...) are properly working and data are transmitted to the remote monitoring center

2.4 Simulation of anomalies

Possible causes of anomalies should be simulated, in order to check the correct working of the safety devices:

- Power black-out
- Temperature out of spec
- Pressure out of spec
- Gas leakage
- Emergency shut-down
- Excess flow of CNG / LNG

2.5 Check of the permits and licenses

Before any operation starts, it should be checked if all necessary permits and licenses are available. Again, this can be different from one country to another.

Attention has to be drawn to following items:

2.5.1 Building license

The building license will be necessary in most cases, except for mobile stations. They are issued (in general) by the local government (city council), who will evaluate the viability and the impact on the neighborhood.

2.5.2 Operational permit

It is also necessary to obtain a permit for the operation. This can be obtained locally or on a regional or national level, depending on the country. It must specify the operation (LNG, CNG, or both), and this permit can contain additional obligations with regard to the operation. For example it can limit the throughput of the station, the opening hours, add safety obligations, etc.

2.5.3 Business license

In some countries, the distribution of LNG or CNG can be subject to a business license. It is clear that also this should be addressed. It could be issued by the regional or national ministry of economic affairs.

This item is specifically checked by the TFF.
2.5.4 Check by independent control authority

In Spain when the station is built, an independent and authorized control establishment (can be a notified body) will check if the station meets all the specifications and the legal requirement, both in business operation and safety.

Usually, this party evaluates all the facilities (electrical, gas, safety devices, ...) and at the end the complete station. It will also check the relevant permits, and if the requirements of those are fulfilled.

It could also check if the documentation of the station is complete, e.g. the CE certifications, the ATEX zoning, etc.

2.5.5 Acceptance test

These tests are requested by the owner of the station and/or the operator to the engineering in charge of the construction, before the start-up of the station.

The tests involve the evaluation of some requested parameters in order to guarantee the correct operation of the station, both in normal and emergency situations.

This could be considered as the commissioning of the station.

In PGS 33, the acceptance test is according the schedule below:

![Acceptance test schedule of the PGS 33](image)
NOBO = Notified Body

AKI = Authorised Inspection Body

KVG = Authorised User Inspectorate

2.5.6 Government acceptance

It can be required in some countries, like Spain, that when the station has been finished and started up, technical documentation is taken to the government agency which evaluates and regulates industrial activities (e.g. Dirección General de Industria in Spanish government). This documentation includes licenses, permits and checks issued by the notified bodies, in order to guarantee that the station can operate under proper and safe conditions.
3 Guidelines for the operation

In this section, we will draw attention upon the principles of good management of the station in operation.

We will also include information from the PGS33, the Dutch guideline for LNG stations. The PGS 33 articles are printed in italic.

Also, Portuguese standard (NP 4524) about commissioning, maintenance and safety rules needs to be taken into account. This standard establishes all the technical requirements needed to a safe operation.

3.1 Guidelines for the operator

The operator of the station is the entity which is in charge of the daily operation and maintenance. This role could be performed by the owner or by a subcontractor.

Availability and supervision

The operator should be competent in resources (either own or subcontracted) in order to take charge of the control and maintenance of the station.

He should be available to act in case of emergency, either in a remote way or in person if required.

For example in PGS 33 reg. 3.4.16 is concluded: 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.

There is no agreement regarding the necessity of attended stations and neither a common regulation in the different countries about it. In any case, if the station is unattended; the operator should have a remote control center connected to the station, where the tele-information is received permanently as well as the alarms.

In PGS 33 reg. 3.7.1 it is stated: 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.

In PGS 33 reg. 3.7.2 it is concluded: For every station a responsible person shall be appointed who has the required competences 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).
3.1.1 Process control

The remote control center is managing the needs of the station.

It controls and regulates the pressure in the vessel, the odorant flow, the boil off, etc.

Boil off is generated as a result of the vaporization of the lighter compounds of the liquid phase of LNG. The generated vapor phase mostly contains methane and nitrogen. Issues due to boil off generation are both mechanical (pressure increase) and chemical (the LNG composition is changing, as is the quality).

Boil off management consists in avoiding the increase in vessel pressure beyond certain levels. It can be done by the production of CNG, by the cooling of the gas phase by liquid nitrogen, or other alternative methods. Increasing the throughput of the station (more trucks visiting the station) will also avoid boil-off.

Odorisation is another point to consider. It is recommended for CNG in order to have a safe detection of gas leaks on the vehicles. For LNG however, it is not (yet) possible due to the fact that odorant is not compatible with the service temperature of the LNG.

3.1.2 Logistics

The operator of the station should manage the logistics of the station. This means that he has to guarantee that there is sufficient product (LNG) at all times in order to refuel the vehicles in a safe and proper way. The next LNG delivery can be requested e.g. automatically if the actual level of the LNG storage tank is below a certain lever (about 15-20%). This level reflects a certain margin depending on the lead times for delivery and the fluctuations in the LNG consumption.

3.1.3 Payment system

Most LNG stations currently built are operating in an unattended way. This results in the need for electronic payment systems (payment terminal). In order to have the station operating in a public way, it is advisable to accept most common payment cards (credit card, fuel card, ...)

3.1.4 ESD system

Furthermore, the design of the safety system must reflect the fact that the competent people are not on site. So the customer should be able to activate the ESD at all times in case of any anomaly, and the ESD system should trigger an alarm to the station operator or the control center.

3.1.5 Training of maintenance and operation people

Before the opening of the station and the start of the operations, maintenance and operational staff must be trained. This should include a description of the facilities and all components, the normal operation of the station, failure detection and solving, maintenance operation and actions in case of emergency.
3.2 Guidelines for the end-user.

3.2.1 Education and training

The unattended nature of the station implies that the drivers that come to refuel, should receive a training in order to complete the refueling in a safe way. This training should inform them about the risks of LNG, the use of personal safety equipment and the correct use of the dispenser, hoses and couplings.

In PSG 33 is stated:

In 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. In 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

Refuelling procedures

Special attention is needed in case of multi-pressure LNG dispensers, in order to avoid refueling vehicles with LNG at the wrong saturation pressure. Preferably, this should be avoided through automatic systems (RFID, license plate recognition).

In PGS 33 reg. 3.4.18 is stated: 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.
3.3 Guidelines for maintenance

The station operator will plan the maintenance works in a programmed schedule to carry out following activities:

1. Depressurization Storage without loading vehicles.
2. Alignment of motors and compressors (in case of CNG)
3. Replacement of inner components of compressors (in case of CNG)
4. Reset of safety valves
5. High pressure tests
6. Regulatory inspections
7. Repair and reset of equipment related to the gas or electricity measurement.
8. Repair of safety components

PGS 33 states:

In 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.

Along with the regular maintenance intervention, tests will be carried out to check the service and safety. The operator must have the resources available in order to verify:

1. Compressor flow in m³(n)/h (in case of CNG)
2. Power consumption of the installation (motor + auxiliaries)
3. Oil consumption (in case of CNG)
4. Temperature and pressure of gas.
5. Vibration and sound pressure pipelines and compressor or pump.

6. Refueling time and adjustment of final pressure by temperature.

7. Safety systems

8. Overall state

PGS 33 also stresses the need of registration of all maintenance data:

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.

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

3.4 Periodic testing

In part 4 of PGS, the periodic inspections are explained according to the schedule below:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Inspection before taking into service</th>
<th>Routine inspections</th>
<th>Periodic reassessment</th>
<th>Routine inspections</th>
<th>Periodic reassessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leak Tightness</td>
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<td>1.1 Before taking into service</td>
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<tr>
<td>1.2 Annual visual check</td>
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<td>1.3 Gas tightness (connections)</td>
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<td>1.4 Functional operation of accessories</td>
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<td>1.5 Visual external inspection</td>
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<td>1.6 Corrosion</td>
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<td>1.7 Damage</td>
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<td>1.8 Contamination</td>
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<td>1.9 Support and foundation condition</td>
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<td>1.10 Blow-off pressure safety cut-out</td>
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<td>2. Functional protection</td>
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<td>2.1 Blow-off pressure safety cut-out</td>
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<td>2.2 Overfill protection</td>
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<td>2.3 Emergency shutdown devices</td>
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<td>2.4 Gas detection</td>
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<td>2.5 Dead man’s button</td>
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<td>2.6 Alarm or notification systems</td>
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<td>3. Documentation</td>
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<td>3.1 Inspection of log book</td>
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<td>3.2 Reports third parties</td>
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<td>3.3 Routine inspection reports</td>
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<td>3.4 Installation schedule approved</td>
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<td>4. Location</td>
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<td>4.1 According to local regulation</td>
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<td>5. Other</td>
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<td>5.1 Earthing</td>
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<td>5.2 Warning signs</td>
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</table>

O = Authorised Inspection Body  x = Authorised installer
Figure 3-1 Schedule of periodic inspections
4 Conclusions

4.1 Summary

In order to start up a new LNG station, it becomes clear that one should follow a systematic and clear process in order to assure safe and proper working.

This process can be imposed by national regulations, but in many European countries, this regulation is still not existing. So it makes sense to follow the procedures that are available in other countries with more experience when it comes to LNG.

The Spanish standard UNE 60210:2011, where LNG satellite plants are defined, can be used for refueling stations as well. UNE 60210:2011 provides a structure for the commissioning of an LNG station.

In this standard, the design of the station is examined, the location is checked as well as the operations of the station. Furthermore, it is needed to check if all the permits and licenses are available, certain anomalies should be simulated, and the auxiliary systems should be tested.

In Sweden, were there are also now about 5 LNG filling stations in use, there is a document called “Tankstationer förmetangasdrivna fordon” (Filling stations for NGV’s). Attached to this Swedish norm, there is a checklist for the inspection of new stations.

Also PGS 33, the Dutch guideline for LNG stations contains very useful information in this respect. It adds information of the operations, maintenance and inspections during the life time of the station.

We have also addressed these guidelines for the operation of the station. These should help him to keep the operations safe and efficient. They are about supervision, process control, training, logistics and maintenance.

(please, mention ISO working group is defining a draft of standardization for CNG and LNG stations (16923 & 16924)

4.2 Updates

This document is subject to updates, if during the course of the LNG Blue Corridors project, new information or insights are gathered
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