

LNG ASSISTANCE SCHEME

Incident handling in LNG transport accidents

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PREPARED IN COLLABORATION WITH THE DUTCH NATIONAL LNG PLATFORM



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LIST OF ABBREVIATIONS

AGS	Hazardous Substances Advisor (Adviseur Gevaarlijke Stoffen)
COPI	Forward Command Post (Commando Plaats Incident)
GRIP	Coordinated Regional Incident Management Procedure (Gecoördineerde Regionale Incidentbestrijdings Procedure)
IBGS	Hazardous substance incident response (IncidentBestrijding Gevaarlijke Stoffen)
ICE	ICE is an internationally standardised scheme for assistance with transport accidents involving hazardous substances. http://www.ice-chem.net/Source/Home.aspx
LIOGS	National information point for accidents involving hazardous substances (Landelijk Informatiepunt Ongevallen Gevaarlijke Stoffen)
LNG	Liquefied Natural Gas
ROT	ROT = Emergency Operations Centre (Regionaal Operationeel Team)

1 INTRODUCTION

Cleaner fuels are becoming increasingly important in the Netherlands. This is to limit CO₂ emissions resulting from traffic and transport in the Netherlands. Fuels that are more sustainable than diesel and gasoline, such as CNG (Compressed Natural Gas), hydrogen, electrically driven vehicles (incl. HDBs - High Density Batteries) and LNG (Liquefied Natural Gas), are therefore on the rise. These and other more sustainable fuels have their own specific properties that affect how incidents are managed (IFV & Wolbers, 2015).

This Assistance Scheme looks specifically at LNG in incident situations. The use of LNG has undeniably positive environmental consequences but, in emergency response, specific issues arise due to specific LNG hazards (IFV, 2016) (IFV & Wolbers, 2015):

- Highly flammable gas (fire can be invisible, intense heat radiation).
- Heavier than air (when heated it mixes with air and rises until the vapour-air mixture is as heavy as air).
- Very low temperatures: -162°C (cold burns and effects on structural components: becoming brittle).
- Danger of explosion in an enclosed environment.
- Asphyxiating in high concentrations.
- If heated (> -162°C), invisible (white cloud of water vapour depending on LNG temperature and environmental factors such as outside air temperature and humidity).
- Odourless.

Because of such specific hazards, the emergency response needs to be carefully considered when LNG is introduced in case LNG is involved in incident situations.

Because controlling incidents is primarily a task for the government, reports of incidents involving hazardous substances, with or without the intervention of the police, must be received by the fire service. That does not mean that the fire brigade is always able to limit the consequences on its own. Certainly not when it occurs less frequently and when it concerns special incidents such as with LNG. It is precisely in such situations that the business community and other bodies specialised in LNG can contribute to mitigate the consequences. This contribution concerns the provision of knowledge in the field of LNG and LNG-specific equipment and resources. This must be clearly organised in advance, in terms of alarming, knowledge, expertise, experience and resources.

This LNG Assistance Scheme is the organisational interpretation of how specialist knowledge and tools can be used in responding to LNG incidents. This Assistance Scheme was prepared through the collaboration of industry experts, namely Broadview Energy Solutions, Chr Vermeer Transport, Gate Terminal, Jongeneel Transport, Nijman/ Zeetank, PitPoint Clean Fuels, Rolande, Schenk, Shell, Van Amerongen Berging, Veiligheidsregio Rotterdam-Rijnmond (Rotterdam Safety Region), LIOGS (National information point for accidents involving hazardous substances, the Dutch implementation of the European ICE - Intervention in Chemical transport Emergencies), IFV and FPC Risk.

2 PURPOSE AND TARGET GROUP OF THE LNG ASSISTANCE SCHEME AND THE SCOPE OF OPERATION

2.1 PURPOSE

The primary purpose of the LNG Assistance Scheme is to provide public emergency services responding to an LNG incident with insight into which organisations (companies, governments) have which knowledge, expertise, equipment and resources and how these can be used in LNG incidents, as well as providing action perspectives for incident responders.

2.2 TARGET GROUP

The target group of the Assistance Scheme is the fire service (Duty Officer and Hazardous Substances Advisor, LIOGS), the safety region (Emergency Service Control Centre and crisis management: mayor and spokespersons), the LNG branch (in particular On-call duty, operators and drivers) and recovery personnel.

The table below gives an overview of the sections relevant for each target group:

Section \ Target group	3	4	5	6	0	Appendix 1	Fout! Verwij-zigshraan niet	Appendix 3	Appendix 4	Appendix 5	Appendix 6	Appendix 7
Duty officer	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Hazardous Substances Advisor (AGS)	✓	✓	✓			✓	✓			✓	✓	✓
LIOGS	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Emergency Service Control Centre	✓	✓		✓		✓	✓	✓	✓			✓
Spokesperson		✓			✓	✓						✓
On-call duty	✓	✓		✓		✓		✓	✓		✓	✓
Operator		✓		✓		✓		✓			✓	✓
Driver		✓				✓					✓	✓
Recovery company									✓		✓	✓

Table 1 - Reading guide

2.3 SCOPE

The scope of the Assistance Scheme covers, in principle, the entire LNG chain in the Netherlands up to and including the end user. It therefore covers both stationary installations and transport applications.

It is, however, primarily aimed at LNG incidents in the public domain, starting with road transport. Unlike the situation with LNG installations, the location of accidents on the road involving LNG (whether as cargo or fuel) is unknown in advance or could happen "anywhere" on the road. Consequently, any emergency service, anywhere in the Netherlands may have to deal with LNG road accidents. Experience with, knowledge of and equipment for LNG emergency response will, naturally, differ throughout the country. Consequently, the (local)

emergency services might lack the resources or experience and knowledge to deal with the LNG incident. This is where the Assistance Scheme can help.

LNG road transport can involve bulk transport of LNG in transport units (tankers/ tank containers/ trailers) and vehicles powered by LNG (e.g. trucks). This Assistance Scheme contains scenarios for bulk transport that can be downsized to LNG-powered trucks.

It is possible that over time this Assistance Scheme will be extended to cover applications on other transport modalities as well as in the industrial (private) environment.

Emergency services will not "tinker" with the installations/ vehicle. The variations in vehicles and safety systems are too numerous and too complex for a "general" emergency service to have sufficient knowledge and experience of. Therefore, if necessary, specialist expertise, experience and material will be needed, and this can be called in via the Assistance Scheme.

The Assistance Scheme is run on a national basis. This means that it must be useful to all safety regions. This does not alter the fact that, due to more experience, knowledge and expertise with regards to LNG emergency response, there may be specific safety regions that have organised their own LNG emergency response.

The basic principle of the Assistance Scheme is, instead, to overestimate the required effort, expertise and resources at first, rather than to underestimate it. In doing so, the intention is indeed to provide a mechanism for proportional action and upscaling.

3 LNG INCIDENT SCENARIOS AND THEIR RESPONSE

3.1 INCIDENT TYPES

Broadly speaking, three types of LNG incidents can be distinguished:

1. A fire or explosion resulting from the release of LNG.
2. An unintended and uncontrolled outflow of LNG.
3. An incident in which LNG is involved or may be involved, with a realistic risk of a) a fire or explosion or b) an (uncontrolled) outflow.

LNG road transport incidents have numerous variations on these 3 main types of scenarios. Variations due to the specific properties of LNG and its transportation (extremely cold, special safety systems on vehicles). Due to the responders' unfamiliarity with LNG incidents, emergency services and the business community have already jointly developed special protocol cards for variations of LNG transport incidents (IFV, 2016) (available in Dutch only).

Each of the protocol cards include a number of variations on the main theme. For example, for incidents with an LNG transport unit, a distinction is made in the protocol cards according to the radiant heating of the transport unit, leakage, an LNG fire and a tilted transport unit (IFV, 2016). We used these protocol cards as the basis for this Assistance Scheme, specifically on those aspects where the LNG sector can offer support.

3.2 SCENARIOS

In the reconnaissance phase, an idea will have been gained of the options to move the LNG transport unit and the state of the vacuum of the tank. In broad outline, LNG transport incidents can be classified according to whether the transport unit is still mobile/ no longer mobile and whether the vacuum is intact/ broken and whether or not there is a fire in the immediate vicinity.

Five main scenarios, summarised below (see Table 2), then arise with increasing complexity:

1. Transport unit still mobile, vacuum intact.
2. Transport unit still mobile, vacuum broken.
3. Transport unit no longer mobile, vacuum intact.
4. Transport unit no longer mobile, vacuum broken.
5. A combination of scenarios 1, 2, 3 or 4 with fire in the immediate vicinity of the LNG.

An additional scenario was also evaluated during the development of this Assistance Scheme. This is the scenario of an incident with an LNG-powered truck (LNG as fuel, approx. 600 litres, max, 300 kg) with a damaged tank. This scenario was deliberately not included in the above list of five scenarios. A scenario like this can be thought of as one of the variants of scenarios 1 to 4 (and in particular Scenario 2) but with smaller equipment and smaller effect areas.¹ The transporter must therefore have good agreements with the (on-call service of)

¹In fact, this is a 'normal' incident for the fire service. The fire service will concentrate on (IFV, 2018): rescuing victims, identifying the product released, determining the unsafe area and mitigating the effects. See

the supplier of the truck (e.g. IVECO, Scania, Volvo, Mercedes) about maintenance and repair work (see Appendix 3).

By distinguishing these five scenarios, it is possible to formulate the incident progress and action perspectives for emergency response. We then add which emergency response expertise and equipment is available from each organisation.






Vacuum Transport unit	Intact	Broken	Fire
Mobile	 <p>1</p>	 <p>2</p>	 <p>5</p>
Immobile	 <p>3</p>	 <p>4</p>	

Table 2 - Overview of Scenarios

<https://www.ifv.nl/kennisplein/Documents/20160527-Brandweer-Nederland-Protocolkaart-LNG-Brandstoftanks.pdf>

3.3 RESPONSE TACTICS

After reconnaissance and assessing the situation, it is crucial to know which LNG emergency response tactics are practical. Broadly speaking, there are four possible emergency response tactics:

- Keeping the LNG in the transport unit and moving the transport unit to a safe place.
- Moving the LNG by the application of pressure to another transport unit (see Section 0).
- Draining off or venting the LNG gas (see Section 0).
- Flaring-off the LNG (see Section 3.3.2).

Depending on the loaded volume and the orientation of the transport unit or ISO container, the gas and liquid drains for the LNG will not necessarily be in the gas or liquid phase of the LNG (see Figure 1) (Leroux & Van den Akker, 2013).

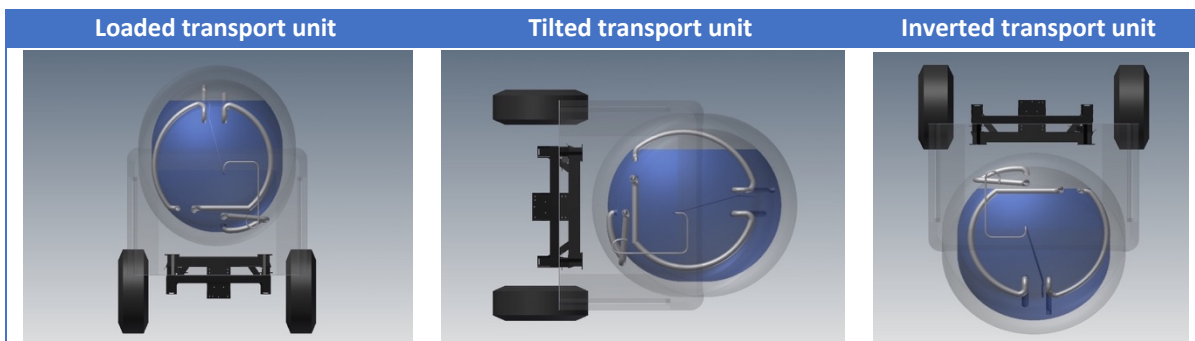


Figure 1 - Gas & liquid phases in relation to the orientation of the transport unit

Matters for special attention:

- Content meters that depend on measuring pressure difference usually do not work with a tilted truck.
- Pressure gauge readings can deviate from reality (the gas and liquid phases might have changed places). Use the degree of filling given on the loading documents.
- The vacuum might be broken (ice formation, blow-off disc is damaged or open), which can cause a pressure rise and heating of the LNG.
- Safety valves and other safety features may not be operational due to damage or obstruction. The blow-off pipe might be blocked.
- Sudden blow-off of LNG due to pressure rise and heating of the LNG (with damaged vacuum).

3.3.1 VENTING

When venting, the gas is released from the tank into the atmosphere until there is a safe pressure in the tank. 1 to 2 bar below the Maximum Allowable Working Pressure (MAWP).

The following points for attention must be taken into account:

- Use the safest connection in the gas phase (use the P&ID for this²).
- Stop the procedure as soon as liquid is released from the connection (skin burns).
- Remove all sources of ignition in the area.

See the procedure in Appendix 6 .

3.3.2 FLARING

During flaring, the gas is burned-off at a safe distance from the transport unit.

The following points for attention must be taken into account:

- Use the safest connection that is closest to/ in the gas phase (use the P&ID for this).
- Make sure the flare stack is set up safely (location, wind direction, effect area, anchoring).
- During the procedure, continually re-assess the placement of the flare stack.
- Approach the ignition area from the upwind direction and light the gas with a burning torch from a safe distance.

The flaring procedure is described in more detail in Appendix 6 .

Figure 2 shows the possible connections:

- ①, ② and ③ the options available for each connection.

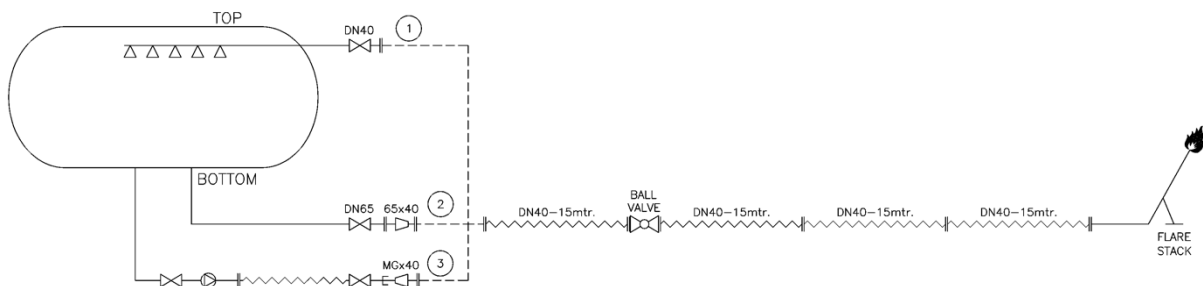


Figure 2 - Connections for flaring

² P&ID = Piping & Instrumentation Diagram

3.3.3 PRESSURE DECANTING

During pressure decanting, the LNG is transferred to another tank by pressure.

The following points must be taken into account:

- If the vacuum of the damaged transport unit is damaged, the entire contents of the transport unit must be transferred before recovery.
- The recovery transport unit meets the requirements for the transport of LNG and is preferably (already) cold.
- The condition of the transport unit and the safety devices (tank, pressure gauges, cylinders, tubes, manifold, etc.). Stable/ unstable, safety devices intact?
- Pressure transfer is only possible if the liquid can be transferred via a fixed connection.
- Never try to transfer LNG if the transport unit is not secured in a stable condition!

In the various phases of the recovery, transfer of part of the LNG can be considered. For example, after the transport unit has first been lifted using air cushions until a drainage system becomes accessible and before the transport unit is fully back on its wheels. You can then consider transferring the rest of the LNG.

You can find the procedure for pressure-forced transfer in Appendix 6 .

Figure 3 shows the possible connections:

- ①, ② and ③ the options available for each connection.
- A and B are ways to build up pressure in tank A.

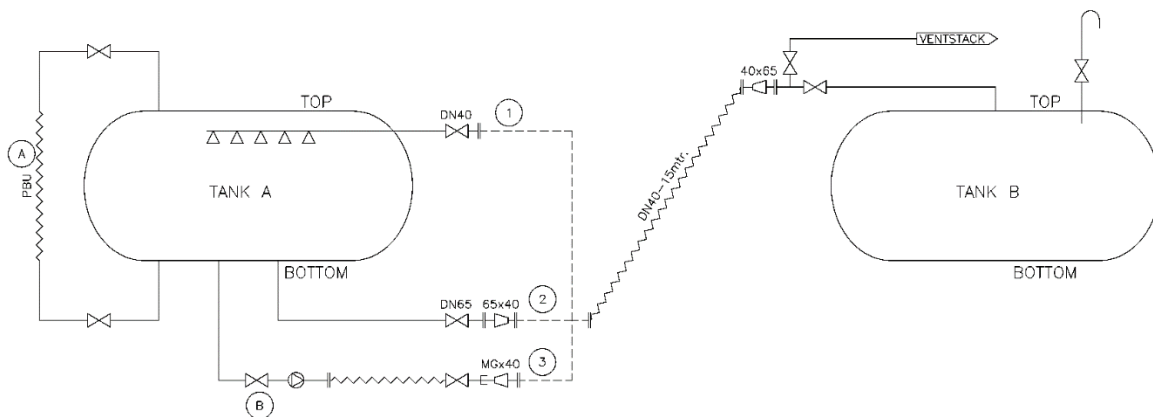


Figure 3 - Connections for pressure decanting

During the transfer, the safety devices in the recovery transport unit can go off because the gas pressure rises. To speed up this procedure without emission of LNG, a flare stack can also be set up at a safe location.

See the pressure-forced transfer and flaring procedures in Appendix 6 .

Figure 4 shows the possible connections:

- ①, ② and ③ the options available for each connection.
- A and B are ways to build up pressure in tank A.

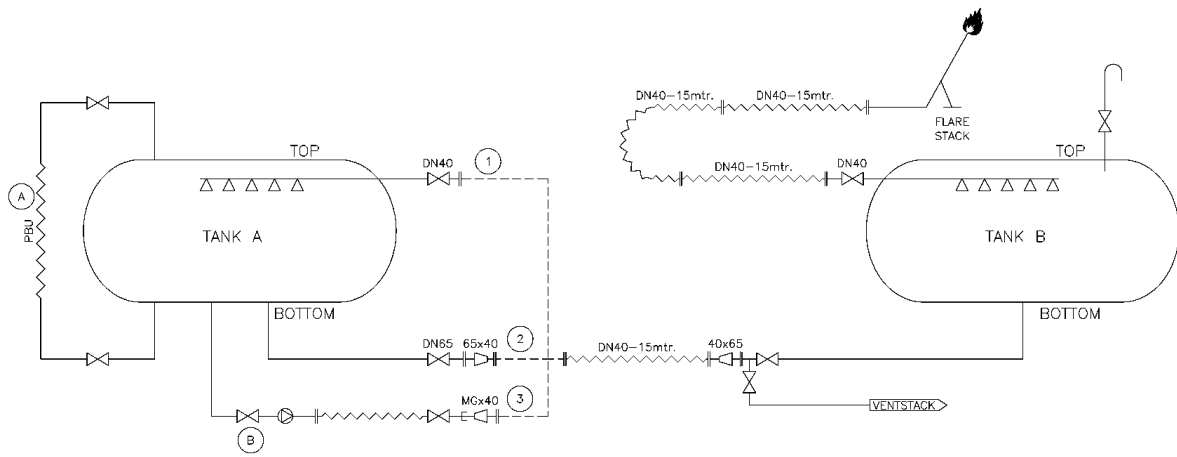




Figure 4 - Connections for pressure decanting with flaring


3.4 EMERGENCY RESPONSE ACTIONS

Table 3 shows the main aspects for each scenario, as well as the **actions** proposed for this purpose.


No.	Scenario	Visual	Characteristics	Actions
1	Transport unit on its wheels (still mobile).		<p>Stable incident, Normal pressure relief.</p> <p>For the first few hours there is little to be concerned about. If in doubt, contact a company expert.</p>	<p>On site</p> <ul style="list-style-type: none"> Record the pressure and consider the pressure development. Check for ice formation. <p>AGS</p> <ul style="list-style-type: none"> Contact the transport unit owner. Contact the LNG Assistance Scheme expert (LIOGS/ expert advice via telephone). Relieve the pressure safely to 1 or 2 bar below the MAWP (see Section 0).

No.	Scenario	Visual	Characteristics	Actions
2	Transport unit is on its wheels (and still mobile); the vacuum is possibly no longer intact.		<p><u>Unstable incident</u>, possibly stable <i>with</i> working pressure relief.³</p> <p>The transport unit can begin blowing off within 30 minutes (safety system).</p>	<p>On site</p> <ul style="list-style-type: none"> Start small hazmat response (IBGS). <p>AGS</p> <ul style="list-style-type: none"> Contact the transport unit owner. Contact the LNG Assistance Scheme expert (LIOGS/ telephone expert advice). If no liquid is present in the transport unit: see actions for Scenario 1. If liquid is still present: <ul style="list-style-type: none"> Relieve the pressure safely to 1 or 2 bar below the MAWP (see Section 0) and repeat. Also remove liquid by pressure-forced transfer (see Section 0) and/or flaring (see Section 3.3.2).

³Similar to gas leakage in residential area (local distribution network; 8 bar, effect radius of 20-25m).

No.	Scenario	Visual	Characteristics	Actions
3	Tilted transport unit (no longer mobile), vacuum intact.		<p>Stable incident, Gas and liquid phase have changed places or both connections are in liquid.</p> <p>For the first few hours there is little going on.</p>	<p>On site</p> <ul style="list-style-type: none"> • If in doubt, contact a company expert. • Record the pressure and consider the pressure development. • Check for condensation formation. • Look for damage: tank, cabinet, pressure gauge, capacity gauge (by definition no longer reliable due to tilt). <p>AGS</p> <ul style="list-style-type: none"> • Contact the transport unit owner. • Contact the LNG Assistance Scheme expert (LIOGS/ telephone expert advice). • Always call on site for an LNG expert. • Request equipment on site via LNG Assistance Scheme. • If no liquid is present in the transport unit: see actions for Scenario 1. • If liquid is still present and the pressure is 1 to 2 bar below the MAWP, safe recovery can be considered. • In all other cases, consider whether liquid can be safely transferred by pressure and/or flared-off. <p>Draw up a recovery plan with a recovery company.⁴ After the salvage operations, scenario 1 or 2 comes into play again.</p>

⁴The recovery plan is put together at the site of the incident by those involved in emergency response with input from the transport unit owner, salvage operator, ILT, the Duty Officer-B, the Hazardous Substance Advisor and the road authority.

No.	Scenario	Visual	Characteristics	Actions
4	Tilted transport unit (no longer mobile), vacuum no longer intact.		<p><u>Unstable incident</u>, possibly stable <i>with</i> working pressure relief in the liquid phase, risk of liquid outflow.</p> <p>The effect area may be large due to the risk of a combustible cloud.</p>	<p>On site</p> <ul style="list-style-type: none"> Stay at a distance (50m) upwind. Evacuate the area up to approx. 350 m (due to risk of ignition of flammable cloud). Record the pressure and consider the way the pressure is changing. <p>AGS</p> <ul style="list-style-type: none"> Contact the transport unit owner. Contact the LNG Assistance Scheme expert (LIOGS/ telephone expert advice). Always call on site for an LNG expert Request equipment on site via LNG Assistance Scheme If no liquid is present in the transport unit: see actions for Scenario 1. Assess whether the blow-off pipe is in the gas phase. If liquid is still present and a drain pipe is in the gas phase (Section 4.1): Relieve pressure as quickly as possible by venting (see Section 0) and repeat. In addition, remove the liquid by flaring (see Section 3.3.2). Assess when the liquid can be safely transferred by pressure (see Section 0). If all drain pipes are in the liquid phase (Section 4.2): <ul style="list-style-type: none"> Drain the liquid as quickly as possible to a drain pipe close to the gas phase. As soon as gas comes out of the drain pipe, see Section 4.1. <p>Draw up a recovery plan⁴ with the recovery company. After the salvage operations, scenario 1, 2 or 3 comes into play again.</p>


No.	Scenario	Visual	Characteristics	Actions
5	In combination with fire nearby, scenario 1, 2, 3 or 4.		The combination of one of the above scenarios with a fire in the vicinity mainly leads to a decrease in the recognisability of LNG involvement. The flames and smoke can obscure signs that LNG is involved (stickers, advertisements, vehicle characteristics, etc.). Recognisability thus forms an additional "problem". <u>We assume that the vacuum is intact.</u>	On site <ul style="list-style-type: none"> • Extinguishing the nearby fire. • Further actions as given in scenario 1 or 3 above.

Table 3 - LNG scenarios and first actions

The management of these scenarios is further described in Table 4 on p. 18. This links the primary emergency response tactics to the scenarios, along with the equipment and knowledge available from the LNG sector and the name of the LNG company that can provide it.

4 SCALING UP WITH LNG EMERGENCY RESPONSE

In order to control the consequences, it is important to decide whether to focus on the source and/or the effect area. This will depend on which command structure, and therefore which upscaling, seems to be appropriate. In Table 4 the Dutch upscaling levels (GRIP⁵) are linked to the LNG incident scenarios. Upscaling levels depend on the source and the effect area. A rough outline of how the LNG scenarios relate to the upscaling levels is given below.

No.	Scenario	Emergency response	LNG company	Fire service	Consultation type	GRIP ⁵
1	Transport unit is on its wheels (and still mobile); the vacuum is still intact.	-	Duty officer Mechanic (if relevant)	Officer-in-charge Duty officer Hazmat advisor	On scene	0
2	Transport unit is on its wheels (and still mobile); the vacuum is no longer intact.	Source	Duty officer Mechanic (if relevant) Higher Safety expert/ ADR safety adviser operator	Officer-in-charge Duty officer Hazmat advisor	On scene	0
3	Transport unit is tilted, vacuum intact.	Source + effect	Duty officer Mechanic (if relevant) Higher Safety expert / ADR safety adviser	Officer-in-charge Duty officer Hazmat advisor	CoPI ⁶	1
4	Transport unit tilted, risk of fluid outflow.	Source + effect	Duty officer Mechanic (if relevant) Higher Safety expert / ADR safety adviser Operator management	Officer-in-charge (Chief) Duty officer Hazmat advisor	ROT ⁷	2 or above
5	Combination: Fire nearby, scenarios 1 to 4	Source + effect	Duty officer Mechanic (if relevant) Higher Safety expert / ADR safety adviser Operator (management)	Officer-in-charge (Chief) duty officer Hazmat advisor	CoPI ROT	1 or above

Table 4 - LNG incident scenarios and corresponding upscaling

⁵ GRIP = Coordinated Regional Incident Management Procedure (Gecoördineerde Regionale Incidentbestrijdings Procedure).

⁶ CoPI = Forward Command Post (Commando Plaats Incident)

⁷ ROT = Emergency Operations Centre (Regionaal Operationeel Team)

5 AUXILIARY EQUIPMENT AND RESOURCES FOR LNG EMERGENCY RESPONSE

The organisations named in this Assistance Scheme can help in various ways to limit the consequences of LNG incidents (in accordance with the three levels in the ICE scheme⁸ - VGS alert hosted by Sitech at Geleen).

Important: This Assistance Scheme has a number of recommendations that must be taken into account by the fire service on site. The final responsibility for emergency response, however, remains with the fire service, which can always overrule these recommendations after consulting an LNG expert.

1. Advice by telephone

The aforementioned organisations can provide practical advice remotely for limiting and combating either an LNG incident or one involving LNG in some way.

2. Advisor on scene

Advice can be given at the scene of the incident by an LNG expert.

An expert is someone with general theoretical knowledge, skills and practical experience in the field of LNG. They must be able to assess the consequences of incidents during the storage, transport and use of LNG. The LNG expert must also know the options for engaging experts in specific fields⁹.

3. Technical assistance (equipment and resources) on site

Organisations can make means of transport, auxiliary equipment and resources available.

Means of transport and auxiliary equipment and other types of equipment required for limiting and combating an LNG incident can be distinguished as follows (not exhaustive):

Addendum 1. Means of transport

- Transport units that can load and unload the product independently are also fitted with adapters for connections that are common in the Netherlands.
- Transport units that can only load product with the help of separate compressor units.

Addendum 2. Auxiliary equipment & resources

- An LNG emergency trailer/emergency response kit (Appendix 4) that is equipped to allow an emergency repair to be performed on an LNG installation or for the installation to be safely put out of operation. This emergency response kit is available, for example, from Wilchem¹⁰ (contact details in Appendix 1).
- Flare stack unit.

⁸ ICE is an internationally standardised scheme for assistance with transport accidents involving hazardous substances. <http://www.ice-chem.net/Source/Home.aspx>

⁹ There is an idea to include a requirement for the expertise - for example, to have successfully completed a certain course such as the EIGA course and training (cryogenic branch).

¹⁰No contract with Wilchem had been concluded when this Assistance Scheme was set up. This is part of the implementation process.

Finally, this Assistance Scheme itself provides an overview of expertise, assistance equipment and resources to first- and second-line responders and how these files are kept up to date. The aforementioned organisations intend to organise regular meetings by and for experts and with public and private emergency services to share their experiences of LNG emergency response.

6 RECOVERY PROCEDURE

Before starting the recovery, evaluate whether the situation is stable and is likely to remain so. This means:

- Liquid present + vacuum intact + normal pressure level (1 to 2 bar below the MAWP).
- OR
- No liquid present + normal pressure (vacuum not relevant).

If this is not the case, the emergency response must first be completed.

If the transport unit is immobile, it must first be put back on its wheels.

An expert must always be consulted before starting the recovery operations (see Appendix 1 and Appendix 4).

Always perform the required risk analysis before starting the recovery and continue to assess the risks during the recovery.

The recovery procedure is similar to a normal transport unit recovery and consists of the following steps:

- Prepare recovery procedure
- Salvage
- Transport
- Storage

Matters for special attention:

- All valves and safety vents must be closed before the recovery starts.
- Inner and/or outer tank mounting is damaged. The outer tank can be damaged during the recovery.
- The weight of the transport unit requires adapted recovery equipment.
- Avoid cold spots on the outside of the tank when attaching hoists or hoisting equipment.
- Possible instability due to sudden movements of the liquid during recovery.
- If the transport unit is put in quarantine, ensure that the necessary measures have been taken for long-term storage. For example: always in the open air and with working safety devices.

See procedures (EIGA, 2006) and (GOFA).

7 CRISIS COMMUNICATION

During the communication on an emergency situation, a number of services immediately take action. Therefore it is crucial that the services know where they can get the necessary information and who they can contact. As part of this LNG Assistance Scheme, a list with contact details of experts, manufacturers, operators, owners of vehicles/ filling stations and specialist recovery companies is provided in Appendix. During a press conference it is therefore recommended that a mayor or a spokesperson be assisted by an experienced expert from the Safety Region, such as a hazmat expert (AGS), and/or an LNG expert.

This information can be found in the contact details Appendix, 1 to 4. These are therefore the contact lists that must be used by the emergency services for support.

The National information point for accidents involving hazardous substances (LIOGS) has a number of experts who can provide support in the event of an incident. In addition, there are a number of private companies that can provide experts and whose contact details can be found in Appendix 1.

The LNG product properties and useful information in crisis communication are listed in **Fout! Verwijzingsbron niet gevonden..**

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APPENDIX 1 CONTACT DETAILS EXPERTS

Company	Location	Zipcode	GSM N°	Landline N°	Expertise								Comments
					Expert can go to incident location	LNG Product	Trailer	ISO – container	Retail station	LNG powered truck	Emergency response	Salvage	
LIOGS (Dutch implementation of European ICE scheme)	Schiedam	3112 NA	+31 10 - 2468642		Y	N	N	N	N	N	Y	Y	The local fire brigade is in charge of the incident, they can request support for substantive and operational expertise from experienced Hazmat Advisors (AGS) of the Rotterdam Rijnmond region. Through LIOGS contact can also be made (24/7) with (national) public/private organisations, which are required for incident handling.
Chart Ferrox	Decin. Czech Republic	405 30	+42 724 719 858	+42 412 507 228	N	N	N	Y	N	N	N	N	Chart Containers
Chr Vermeer Transport BV	Dongen	5107 RB		+31 162 312 138	N	Y	Y	Y	Y	Y	N	N	
Cryovat	Nijkerk	3861 RJ	+31 332 455 959	+31 332 471 490	N	N	N	Y	N	N	N	N	Cryovat Containers
DEMI	Heienoord	3274 LH	+31 653 173 616	+31 186 605 144	Y	N	N	Y	N	N	N	N	Cryogenic Maintenance
Gascon	Capetown, South Africa	7480	+27 21 590 5280	+27 21 590 5280	N	N	N	Y	N	N	N	N	Gascon Containers
Gate terminal	Gate terminal Rotterdam Maasvlakte	3199 LZ	+31 623 527 519	+31 181 799 022	N	Y	N	N	N	N	Y	N	The shift supervisors are available 24/7 and have knowledge regarding the product and the related incident response. Unfortunately, they are unable to go to the location of the incident. They do have expertise about filling up tankers, crash cooldown etc.

Company	Location	Zipcode	GSM N°	Landline N°	Expertise								Comments
					Expert can go to incident location	LNG Product	Trailer	ISO – container	Retail station	LNG powered truck	Emergency response	Salvage	
Gets Van Loon	Antwerp	2030	+32 478 825 315	+32 3 542 50 25	Y	N	N	Y	N	N	N	N	Cryogenic Maintenance
Jongeneel Transport	Valkenburg	2235 SH	+31 629 034 629	+31 715 322 530	N	Y	Y	Y	N	Y	Y	N	
Kees in 't Veen Transport	Rotterdam	3198 LS	+31 611 263 777	+31 181 233 530	Y	N	N	Y	N	N	N	N	Container loading / unloading
Osono Projects BV	Nijmegen	6666 MK		+31 641 237 658	?	Y	N	N	Y	Y	Y	N	LNG Trucks
PitPoint B.V.	Nieuwegein	3433 PG	+31 618 228 382	N/A	Y	Y	Y	Y	Y	Y	Y	N	
PitPoint LNG B.V.	Nieuwegein	3433 PG	+31 657 459 767	N/A	N	Y	N	N	Y	N	N	N	
PitPoint LNG B.V.	Nieuwegein	3433 PG	+31 624 711 343 +31 623 809 707	N/A	N	Y	N	N	Y	N	N	N	Design refuelling station
Rolande B.V.	Tilburg	5026 RB	+31 651 088 137	+31 183 583 456	N	Y	N	N	Y	N	N	N	
Rolande B.V.	Tilburg	5026 RB	+31 651 939 120	+31 183 583 446	Y	Y	Y	Y	Y	Y	Y	N	
Shell	Den Haag	2596 HR		+31 70 377 49 25	?	Y	N	N	N	N	N	N	
Van Amerongen Berging	Arnhem	6827 BH	+31 620 430 010	+31 263 545 212	N	N	N	N	N	Y	N	Y	

APPENDIX 2 CONTACT DETAILS EMERGENCY RESPONSE

Company	Resource Location	Zipcode	Tel N°	24/7 available	gaskets, bolts	gas measuring equipment	empty (cryogenic) trailer	hoses, pipes + flanges	Tools	Mobile torch	PPE	Nitrogen	Setup time (excl. turn up time)	Comments
Rolande B.V.	Almkerk	4286 ZH	+31 183 583 446	Y	Y	Y	N	N	Y	N	Y	N		
Broadview Energy Solutions	Heinenoord	3274 LH	+31 800 690 7000	N	N		Y	Y	Y	N				
Broadview Energy Solutions	Kallo, Belgium	9130	+31 800 690 7000	N	N		Y	Y	Y	N				
Chr Vermeer Transport B.V.	Dongen	5107 RB	+31 162 312 138	N	N	Y	Y	N	N	N	N	N		Empty Tank container/ Trailer is owned by Rolande
Gate terminal	Maasvlakteweg 991 Rotterdam	3199 LZ	+31 181 799 000	N	Y	Y	N	N	N	N	N	N		Only available on site
Jongeneel Transport	Rotterdam	3198 LB	+31 71 532 2530	N	Y	Y	Y	Y	Y	N	N	N		
PitPoint LNG B.V.	Nieuwegein	3433 PG	+31 304 100 800	N	N	N	N	N	N	N	N	N		Can activate help desk
PitPoint Pro B.V.	Nieuwegein	3433 PG	+31 900 227 34 27	Y	Y	Y	N	N	Y	Y	Y	Y	2 hours	Nitrogen available in bottles
Wilchem	Papendrecht	3352 AR	+31 800 870 20 20	Y	Y	Y		Y	Y		Y			To be validated contractually

APPENDIX 3 CONTACT DETAILS TRUCK MANUFACTURERS








Company	Telephone	Documentation	Comments
IVECO	00 800 0 4832.667 Service Centre		Service centre brings you in contact with the nearest ANS24 technician
Scania	No 24/7 tel n° available	https://www.scania.com/content/dam/scanianoe/market/master/pdf/rescue-information/w_wsm000108nl-NL02.pdf	
Volvo	0800 022 52 41 Action Service	https://www.volvotrucks.com/content/dam/volvo/volvo-trucks/markets/global/our-values/safety/emergency-information/Alternative-fuels-FM-FH-FE-Dutch.pdf	Action service can always transfer to the nearest LNG specialized dealership.











APPENDIX 4 CONTAC DETAILS SALVAGE

Company	Resource Location	Zipcode resources	Tel N°	Available resources					Comments
				24/7 available	Crane	Airbags	Low loaders	Other	
24- Seven Berging	Staphorst	7951 EE	+31 906 200 18 22			N	Y		
BCU Collewyn	Nuis	9364 TD	+31 594 631 678			Y	Y		
BCU Modern	Utrecht	3542 AC	+31 302 415 060			Y	Y		
Ben Heiltjes	Cuijk	5430 AB	+31 485 311 576			N	Y		
Berging Centrale Drechtsteden	Papendrecht	3356 LB	+31 786 183 378			Y			
Bergingsbedrijf Willem Keizer	Stadskanaal	9501 GA	+31 653 903 089			N	Y		
Boogaard, van den	Beverwijk	1948 NW	+31 251 272 325			N	Y		
Broekhuizen	Donkerbroek	8435 VT	+31 516 577 373			N	Y		
Dongen, van	Landgraaf	6372 BB	+31 455 330 000			N	Y		
Eijck, van	Gilze	5126 BD	+31 850 206 367			Y	Y		
Gerritse	Tiel	4000 HB	+31 344 625 050			N	Y		
Hendriks	Lottum	5973 PR	+31 773 662 952			N	Y		
Herpertz	Nederweert	6031 RV	+31 475 458 045			N	Y		
Hoogwout	Oostzaan	1511 JZ	+31 653 946 485			Y	N		
Houterman	Wijchen	6604 LG	+31 243 297 723			Y	N		
Jongeneel Transport	Dintelweg Rotterdam	3198 LB	+31 715 322 530	N	N	N		Y	
Kooijman	Vianen	4130 EB	+31 653 141 611			Y	Y		
Kuzee	Vlissingen	4389 WB	+31 650 612 084			N	Y		
Logicx	Apeldoorn	7320 AC	+31 553 694 000			Y	Y		
Steenhoven	Heenvliet	3216 AV	+31 181 611 242			N	Y		
Steenhoven Pernis	Pernis	3195 HG	+31 104 162 622			N	Y		
Stienen	Someren	5711 LE	+31 681 434 787			Y	Y		
Stouwdam	Oldebroek	8096 ZG	+31 525 633 131			N	Y		
Van Amerongen Berging	Arnhem	6827 BH	+31 263 546 212		N	Y	Y	N	
Vorgers	Borne	7622 AP	+31 742 661 263			N	Y		
Vreugdenhil	Den Hoorn	2635 BZ	+31 152 511 351			N	Y		
Wielsma	Apeldoorn	7325 WJ	+31 553 231 481			Y	N		
Wolves	Wierden	7642 ND	+31 651 851 402			N	Y		








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LNG Transport - Emergency Response Kit









Ln	Category	Description	Qty	Remarks	Comments	Photo	Approx. Weight per piece (kg)	Price (EUR)	Ref Molgas (Original)	Ref BNG	Ref Norway (eg Gasnd)	Ref Rolande	Ref Wilco
1	LNG	Antispark tool	1	Berilium-bronze equipment ATEX certificate <u>Including:</u> Hammer, fixed wrench set, wrench, stillson wrench.	Needed: 2 fixed double wrench 12-13, 2 fixed double wrench 17-19 2 fixed double wrench 22-24 2 fixed double wrench 27-29 (Tool pairs in order to tighten and loosen screws) 1 wrench of 14-24 mm 1 wrench of 30-40 1 stillson wrench of 20-30 1 bronze hammer 1 bronze cold chisel (to cut broken screws) 1 non ATEX metal shear		10	1500	Yes	No	No	Yes	Y
2	Tools	Pipe Wrench	1	Pipe Wrench 250mm Small Pipe Wrench 450 mm Big			1	80	No	Yes	Yes	No	Y
3	Tools	Wrench	1	Adjustable Wrench 10" / 30mm Adjustable Wrench 15" / 44mm			1	60	No	Yes	Yes	No	Y
4	Tools	Pliers	1	1x Universal Plier 1x Long Nose Plier			0,5	40	No	Yes	Yes	No	Y
5	LNG	Hook Wrench / Spanner	1	Messer Griesheim DN40 / TR69 Messer Griesheim DN65 / TR104	GS George Spingmann Germany		1	100	No	Yes	No	No	N
6	Tools	Fixed Double Wrench	1	2 fixed double wrench 13mm (M8) 2 fixed double wrench 19mm (M12) 2 fixed double wrench 24mm (M16)			2	100	Yes	Yes	Yes	No	Y
7	Tools	Fixed Double Wrench	1	1 fixed double wrench set 6-22mm			2	50	No	Yes	Yes	No	Y

8	Tools	Torx	1	Set			1	25	No	Yes	Yes	No	Y
9	Tools	Hexagon	1	Set			1	25	No	Yes	Yes	No	Y
10	Tools	Screwdriver	1	Set Philips (x) Set Flared (-) Set Pozi (x)			1	50	No	Yes	Yes	No	Y
12	LNG	ANTISPARK tools for hose adjustment (2 sets)	1	2 inch wrench 3 inch wrench Mace	ATEX bronze with certification Usual supplier is CIMASAN		10	200	Yes	No	No	No	Y
14	Tools	Spade	1	Spade			2	25	Yes	Yes	No	No	Y
18	Tools	Spotlight	1		They must include battery and charger		10	200	No	No	No	No	Y
19	Tools	Flashlight	1	ATEX flashlight with backup batteries. Included with the helmet. Include back up batteries. For manual use or attached to the helmet	Zone 1 ATEX with batteries 40 lumens minimum. Characteristics: II 2G Ex e Ib IIC T4 Gb		0,2	50	Yes	No	No	No	Y
20	Tools	Headlight	2	ATEX headlight			1	40	No	Yes	Yes	No	Y
21	PPE	Safety Reflecting Vest	2				0,5	5	No	Yes	No	No	Y
22	PPE	Fireproof personal equipment	2	Size depending on users	It is preferred if it also has anti-static properties (this model doesn't).		5	100	Yes	Yes	Yes	Yes	Y

23	PPE	Safety Shoes / Boots	2	Size depending on users			1	60	Yes	Yes	Yes	Yes
24	PPE	Industrial firefighter's intervention helmet	1	Integral helmet Ear Protection Face Shield Recommended helmet is MSA, model DRAGER HPS7000 (Lighter and versatile). The helmet must include reflective elements and flashlight support. RED COLOUR	It must comply with Spanish law UNE EN 443. Must be a red colour integral helmet. Include reflective tape. Facial protection must be with a transparent shield (UNE EN 14458) included in the helmet. Include flashlight support. Recommended models: Drager HPS 7000 or Gallet F1XF from MSA		1	50	Yes	Yes	Yes	Yes
25	PPE	Intervention neck curtain (preferably) or headmask	1	Industrial firefighters Instead of full head mask, it is recommended to use a neck curtain	Head mask: compliant with EN 340; ISO 11612 y UNE-EN ISO 11611 Short, fireproof and anti-static. NOMEX headmask: compliant with EN 340; ISO 11612 y UNE-EN ISO 11611		0,3	25	Yes	Yes	No	No
26	PPE	Antistatic and fireproof harness	2	Life line needed. French technical team have this equipment. Hard to use.	Must be ATEX Compliant with laws EN 361 and EN 358 Include temporary life line and energy and break buffer (ATEX) Aluminium carabiner (23 kN) compliant with EN362 and safety lock with thread.		3,5	100	Yes	No	No	No
27	PPE	Life Vest	1	Automatic Life Vest (eg Besto) Buoyancy of the vest depending on users weight.			1	110	No	No	No	No
28	LNG	Cryogenic gloves	2	MORÁN gloves 105FV/FOICR/IMGTO 18 cms. Remark: Only for short term contact use (approx -40 Degrees Celcius).	IMPORTANT: size 9 & 10 Recommended to carry several pairs in the emergency trailer Compliant with UNE-EN 388 and UNE-EN 511 Over-sleeve length of 18 cm		0,2	20	Yes	Yes	Yes	No
29	PPE	Work gloves	2	Leather and protection against mechanic risks. Remark: Not for LNG contact use.	Recommended to carry several pairs in the emergency trailer Work gloves Leather fabric of 1,1 mm Compliant with EN 388:2003		0,2	3	Yes	Yes	Yes	No
30	PPE	Safety glasses (along with personal equipment)	2	Panoramic view and elastic adjustable band	Panoramic view and elastic adjustable band, Anti-fog, with ventilation, EN 166		0,1	12	Yes	No	Yes	No

34	LNG	20 tons slings (2 complete sets)	4	Must include 4 lifting shackles of 35 tons with screw Each sling weight is 75kg plus 2 kg for each shackle More slings can be supplied by towing company.	Sling: 4 bands polyester, 300 mm width x 16 m long, with loops (20 tn load) compliant with EN 1492-1 Shackle: steel, type G-209 of 2"		75	235	Yes	No	No	No
36	Tools	Wedges (2 sets)	2		Plastic wedges for > 7,5 tons trucks		1	30	Yes	No	No	No
41	Tools	Pliers and earth wire (25 m) (2 sets)	1	1 hose section (25 m) of wire earth with ATEX pliers (crocodile clip type) in each end Bronze pick to have the earth	ATEX pliers (crocodile clip type) Cable reel Earth wire (1x16)		10	131	Yes	Yes	No	No
50	LNG	Flexible stainless steel hoses for LNG (1,5" x 15 meters)	4	DN40 PN16 - DN40 PN16			24	770	No	No	Yes	No
51	LNG	Truck LNG Liquid Hose Set	1	LNG Truck Fill Nozzle -> SS Flex Hose > DN40 PN16	For Volvo LNG fueled trucks only. To safely vent the fuel tank of its BOG.		4	5000	No	No	Yes	No
52	LNG	Truck LNG Gas Return Hose Set	1	LNG Truck Gas Return Nozzle -> SS Flex Hose -> DN40 PN16	For non-Volvo LNG fueled trucks. To safely vent the fuel tank of its BOG.		2	1500	No	No	Yes	No
58	LNG	Set of cardboard and teflon seals (Several units)	1	10 pcs Gaskets DN25 (1") 10 pcs Gaskets DN40 (1,5") 10 pcs Gaskets DN50 (2") 10 pcs Gaskets DN65 (2,5")	Gylon Blue 3504		0,5	120	No	No	Yes	Yes

59	LNG	Bolts / Nuts	1	50 pcs M12x55 (DN25) 50 pcs M16x65 (DN40/50/65) 50 pcs Nut M12 50 pcs Nut M16			30	300	No	Yes	Yes	Yes
74	LNG	Joint Piece Block	2	DN65 PN16 -> DN40 PN16			6	155	No	Yes	Yes	Yes
75	LNG	Joint Piece Block	2	DN50 PN16 -> DN40 PN16			6	145	No	Yes	Yes	Yes
77	LNG	Flange	2	DN40 Flange -> LNG MESSER 40	Left wire trapezoid		6	250	No	No	No	Yes
81	Cryo	Clamp Connection	1	Clamp Connection to safely exhaust gas via the SV-outlet in case normal use of vent is impossible. Container : 1" NPT Trailer : to be defined		?	1	50	No	No	No	No
83	PPE	Multiple Gas Meter	1	Minimum sensors for CH4 / O2	Including Charger		0,75	200	No	No	No	Yes
85	Tools	Emergency Trailer	1	Maintenance of trailer must be organised			300	4000	Yes	Yes	Yes	No
88	LNG	Gas Flare	1	1,5" pipe ; DN40 flange	Include anchor possibilities with nails / weights.		30	500	No	No	No	No

89	LNG	Gas Flare	1	1,5"pipe ; DN40 flange			10	200	Yes	No	No	No
90	Tools	Propane Bottle	2	Propane Bottle			1	50	No	Yes	Yes	No
91	Tools	Propane Burner	1	Propane Burner			1	25	No	Yes	Yes	No
92	Tools	Spark Igniter	1	Spark Igniter			0,5	10	No	No	No	No
94	LNG	Ball Valve on support	2	Ball Valve with DN40 PN16 flanges on both sides			6	500	No	No	No	No
95	Tools	Crank Outrigger Trailer	1				1	25	No	Yes	No	No
96	Tools	Nitrogen Hose Set - Activate Actuators	1	High Pressure Hose 10mtr - 0,25" NPT Pressure Reducer Connections : 1x DN65 PN16 Flange -> 0,25" NPT Female 1x DN40 PN16 Flange -> 0,25" NPT Female 0,25" NPT Male -> 0,25" BSP Female 0,25" NPT Female -> 0,25" BSP Male 0,5" NPT Female -> 0,25" NPT Male Teflon Tape Non Return Valve to protect hose	In combination with N2 bottle (Item 98)		2	300	No	No	No	No
97	Tools	Nitrogen Hose Set - Push LNG into other Trailer / Container	1		In combination with N2 bottle (Item 98)		2	300	No	No	No	No

							(kg)								
98	LNG	Nitrogen Bottle	1	1x Nitrogen Bottle 300 bar / 50 liter 1x Nitrogen Bottle 300 bar / 10 liter			50	300	No	No	No	No			
99	Tools	Breathing Apparatus	2		Excluding the Air/O2 Bottle.		2	1000	No	No	No	No			
		TOTAL	161							51	39	37	14		

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Venting the unit.

("Unit" refers to an ISO container or the unit of a trailer)

Step	Check	Corrective action	Comments
<p>1. Secure the incident site.</p>			
<p>2. Is the standard vent stack of the unit usable?</p>			
<p>3. Determine the most suitable gas connection of the unit for venting.</p>	<p>Is a gas connection available?</p>	<p>Choose the liquid connection where the gas phase is reached first when the liquid level falls.</p>	<p>Attention: when connecting to the liquid phase, liquid comes out of the vent first!</p>
<p>4. Prepare the flange connection for the chosen connection point on the unit.</p>			
<p>5. Set up the vent outlet in a safe location and anchor it.</p>			
<p>6. Connect the transfer hose or hoses to the unit and vent.</p>	<p>Check the transfer hose for leaks</p>	<p>Close the leaks or replace hose.</p>	<p>When the hose becomes cold, leakage can occur in couplings and flanges due to shrinkage.</p>
<p>7. Partially open the unit valves and create a slow but audible gas flow.</p>			
<p>8. Regulate the size of the gas cloud and pressure of the unit by opening or closing the valve.</p>	<p>Pressure in unit <= 1 to 2 bar under MAWP?</p>	<p>Consider continuation of procedure versus alternatives (flaring-off/pressure-forced transfer)</p>	
<p>9. Disconnect everything safely.</p>			

Pressure decanting of the LNG to a recovery unit.

("unit" refers to an ISO container or the unit of a tanker vehicle, unit A = affected unit, unit B = recovery unit)

Step	Check	Corrective action	Comments
1. Secure the incident site.			
2. Determine the fluid connection location of unit A to transfer the liquid from there.			Consult P&ID for determining the valve to use: depending on the situation this can be any lowest connection.
3. Prepare the flange connection for the chosen connection point on unit A.			
4. Check the absolute pressure of the LNG in unit A.	<p>unit B is not cooled or pressure difference between MAWP of unit A and saturation pressure of the LNG < 3 bar.</p> <p>N</p> <p>Y</p>	5a. Use the top valve of unit B.	
6. Create a safe place vent and/or flare gas from unit B.		5b. Use the bottom valve of unit B.	See the flaring procedure
7. Connect the transfer hose to the selected valve of unit B.			If time and the situation permits, you could decide to flush with nitrogen gas. Otherwise preferably with LNG gas from the gas phase of unit A. Consult the P&ID for the correct connection. If not, use LNG liquid from unit A.
8. Open the selected valve of unit A.			
9. Briefly flush the hose via the flushing line of unit B. Close the flush valve after flushing.	Visible gas cloud or liquid from the vent stack.	Close the vent stack valve.	
10. If necessary and possible build up pressure in unit A by using the pressure build up unit (PBU) or external gas pressure.	Pressure in unit <= 1 to 2 bar below MAWP?	Close PBU.	PBU = Pressure Build-up Unit (part of the unit)
11. Open the bottom valve or valves and the vent stack of unit B. If top fill was chosen, open the top fill valve and do not use a vent stack.	Check the transfer hose for leaks	Close the leaks or replace hose.	When the hose becomes cold, leakage can occur in couplings and flanges due to shrinkage.
12. Maintain pressure difference between unit A and unit B.	Is the pressure difference too small?	Increase the pressure in unit A or reduce the pressure in unit B.	Take the MAWP (Maximum Allowable Working Pressure) of both tanks into account.
13. Stop the process when recovery unit is full or the affected unit is as empty as realistically possible.	Open the trycock of unit B.	Stop process if liquid emerges from the trycock.	
14. Disconnect all connections in a secure manner.	Are all the connection free of pressure?	Relieve pressure safely.	Preferably use the flushing line from Step 9.

APPENDIX 7 FREQUENTLY ASKED QUESTIONS AND ANSWERS

The following FAQ is adapted from (IGEM, 2017)

What is LNG?

LNG is Natural Gas (NG) that has been converted to a cryogenic liquid, it takes up about 1/600th the volume of NG in its gaseous state. When NG is cooled to below -162°C, it becomes a colourless and odourless liquid. As part of the cooling process (liquefaction), impurities such as water, carbon dioxide, nitrogen, oxygen and some sulphur compounds within the NG are removed with the remaining consisting mainly of methane.

Main product properties and risks

LNG is odourless, colourless, non-toxic and non-corrosive. Hazards include flammability in the gaseous state in air at 5% (LEL – Lower Explosive Limit) and 15% (UEL – Upper Explosive Limit). Other hazards include cold (cryogenic temperatures potentially causing cold burns, hypothermia etc) and asphyxiation.

An LNG fire is almost invisible and generates excessive heat radiation.

If LNG is released, for example comes in contact with air it will vaporise and form a visible (white) vapour cloud as water vapour particles in the air condense, however the visible vapour cloud is not indicative of the extent of potentially explosive atmosphere. As it continues to warm, the vapour cloud will become invisible and lighter than air as it disperses.

What is LNG used for?

LNG is re-gasified (for example, by heating) to return it to its natural gaseous state, it can then be used for both commercial and domestic applications where heating, cooking etc. is required.

LNG is also used as an alternative fuel for vehicle combustion engines as it has lower CO₂ emissions than traditional fuels and zero particulates. Vehicles that run on natural gas can either store it as a gas at high pressure, known as Compressed Natural Gas (CNG) or as LNG. LNG is used in a number of applications including road, marine and rail propulsion and power generation schemes.

How is LNG transported by road in the Netherlands?

LNG is transported in the UK by road in road tanker or International Standards Organization (ISO) containers with a payload of up to 25 tons. The road tankers and ISO containers are designed to maintain the product at a safe temperature and pressure during the transportation. Temperature of the product is maintained via a vacuum insulated double walled tank. The tank or tanker is fitted with Pressure Relief Valves (PRV) that will activate once the pressure reaches a pre-defined level.

How much product is stored in an LNG truck?

Depending on the desired action radius, an LNG truck has around 250 to 360 kilograms of LNG. To keep it cold (-130 degrees), the fuel tank is double-walled, subject to an inspection regime and extensively tested and tested for accidents and fire. The number of accidents involving an LNG truck is limited. In an accident in the Netherlands, where the tank was hit, it came out undamaged from the accident.

What are the risks of LNG?

LNG is cooled natural gas and has the same risks:

- Highly flammable gas (fire can be invisible, intense heat radiation).
- Heavier than air (when heated it mixes with air and rises until the vapour-air mixture is as heavy as air).
- Very low temperatures: -162°C (freezing injury and effects on structural components: becoming brittle).
- Danger of explosion in an enclosed environment (Attention: parking garages, workplaces and retail stations).
- Asphyxiating in high concentrations (take victim to fresh air and reanimate).
- If heated ($> -162^{\circ}\text{C}$), invisible (white cloud of water vapour depending on LNG temperature ($> -90^{\circ}\text{C}$) and environmental factors such as outside air temperature and humidity).
- Odourless.