GIIGNL Technical Study Group Report

Guidelines for Reloading of LNG Carriers at Importation Terminals

September 2019

Foreword

Content Disclaimer

The purpose of these guidelines is to assist readers to understand the technical risks and challenges related to the reloading of LNG carriers at LNG importation terminals. The following report is neither a standard nor a specification and should be viewed only as a summary of observations within the industry.

Although the guidelines may contain much useful information, they are not specifically intended to work out procedures for LNG transfer and do not substitute to existing applicable regulations, guidelines and standards. No proprietary procedure, nor particular manufacture of equipment, is recommended or implied suitable for any specific purpose in this report. Readers should ensure that they are in possession of the latest information, standards and specifications for any procedures and equipment they intend to use.

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Any questions or comments should be directed to GIIGNL Central Office: central-office@giignl.org

Acknowledgements

With more than 80 member companies headquartered in 26 countries and with the main objectives to promote cooperation between LNG importers and enhance the safety and efficiency of activities related to LNG, GIIGNL was ideally suited to review the challenges and risks associated with LNG reloading operations at import terminals. The GIIGNL Technical Study Group (TSG) who is responsible for reviewing, investigating and reporting on technical issues associated with the operation of LNG facilities worldwide created a dedicated Task Force composed of experts of National Grid, Gate Terminal and Sempra LNG and led by Mr. Goke Philips (National Grid) who were entrusted with the preparation of this report.

GIIGNL would like to express special thanks to Mr. Goke Philips (National Grid), Mr. Terje Iversen (Shell), Mr. Daan Velter (Gate Terminal) and Mr. Yovannis Mierez (Sempra LNG) for their commitment and work to produce this document. Also, GIIGNL would like to express special thanks to Jonathan O'Gorman, Heema Unadkat and Pablo Vega Perez for providing technical engineering support to the task force.

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List of Abbreviations

BOG	Boil-off Gas
DSEAR	Dangerous Substances and Explosive Atmosphere Regulation
ESD	Emergency Shut Down
HAZCON	Hazards in Construction
HAZID	Hazard Identification
HAZOP	Hazard and Operability Analysis
HRA	Human Reliability Assessment
GCU	Gas Combustion Unit
IMO	International Marine Organisation
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
NRO	Non-Routine Operating Procedure
NRV	Non-Return Valve
PERC	Power Emergency Released Coupling
QualRA	Qualitative Risk Assessment
QRA	Quantitative Risk Assessment
SIMOPS	Simultaneous Operations

1 INTRODUCTION

1.1 Background

Purpose-built LNG importation terminals are designed to unload LNG into their storage tanks prior to the LNG being regasified and injected into pipeline networks. In the last 10 years market conditions have changed and now require LNG importation terminals to offer new services. One of the services being offered is the ability to reload LNG carriers which provides more flexibility in the LNG market. Reloading LNG involves addressing the challenges of the transfer of LNG from purpose-built importation terminals onto LNG carriers berthed at a jetty.

These guidelines have been developed to set out the key technical and operational requirements for carrying out reload operations safely at purpose-built importation terminals designed for unload service. Each element of the importation facility involved in the reloading operation must be carefully evaluated. This can be achieved through formal design reviews, process safety assessments, management of change, operational and maintenance procedures review, and terminal operator's competency review. These activities will help ensure safe operations and provide clearer understanding of the technical and logistical challenges of the service.

1.2 Purpose and Scope

The purpose of this document is to serve as a reference guideline in supporting terminal operators understand the technical risks and challenges in performing reload operations at purpose-built LNG import terminals.

This document is designed to complement the requirement from the existing applicable regulations, guidelines, standards and terminal procedures. This document does not consider commercial or contractual aspects of reloading operations.

In particular, the following items are covered within this document:

- Typical importation terminal lineout for reloading operations
- Required formal process safety assessments
- Risk Assessments for the suitability of unloading terminal for reloading operations
- Technical assessments of adapting import facilities for export
- Responsibilities of different stakeholders involved in LNG reloading

2 TYPICAL PLANT LINEOUT OF A PURPOSE-BUILT IMPORTATION TERMINAL

The following sub-sections demonstrate, by means of text and illustrations, the different potential lineouts used for LNG transfer at a purpose-built LNG importation terminal.

2.1 LNG Carrier Unloading only

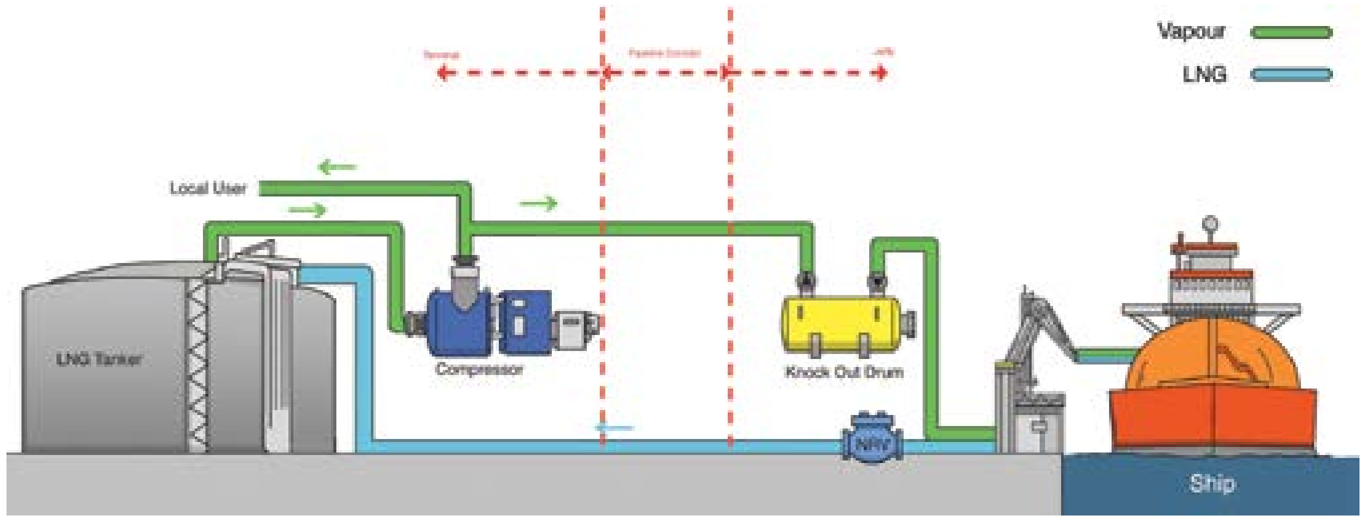


Figure 2.1 Illustration of a typical unloading operation at a purpose-built importation terminal

The key assets required for unloading operation at a purpose-built importation terminal are as follows:

- **LNG Carrier -** (carriers equipped with tanks and submerged pumps)
- **Marine arms -** (transfer arms with swivel joints; typically three or four to unload liquid and one to return vapour to the carrier. Usually non-return valves are installed downstream of the liquid arms)
- **Ringmain -** (looped transfer lines between the facilities and jetties. The lines are kept cold and in a state of readiness by recirculating LNG from the storage tanks when a ship is not unloading)
- **Vapour return line** - (during ship unloading, a portion of the boil-off gas at the terminal is returned to the carrier to maintain the pressure of the carrier's tanks).
- **Jetty facilities** - (as a minimum, a desuperheater and a knock out drum at the end of the vapor return line, as the gas is cooled down at the jetty head.)
- **Terminal facilities -** (including storage tanks and pumps, boil-off gas compressors (LP and HP), recondenser and vaporisers)

2.2 LNG Carrier Reloading only

This section describes the line-out for a reloading operation by utilising or modifying the facilities and infrastructure already present for unloads.

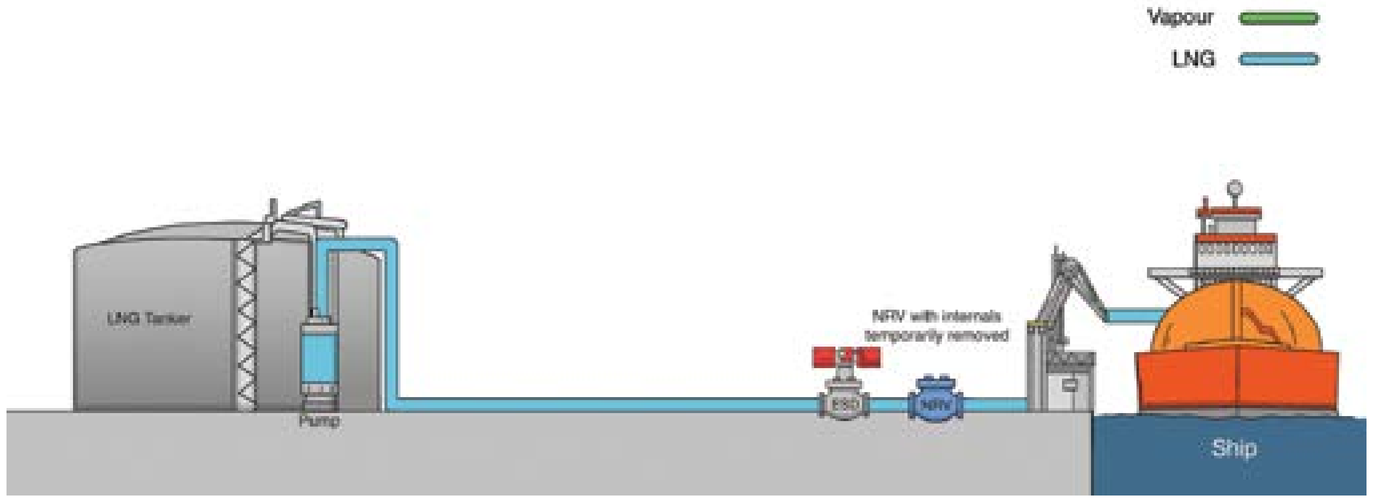


Figure 2.2 Illustration of a typical reloading operation at a purpose-built importation terminal

Note 1: Jetty Vapour Compressor may not be required depending on:

- Availability of LNGC high duty compressor;
- Distance between jetty and terminal.

In this mode of operation, typically a LNG carrier is reloaded using LNG from the terminal's storage tanks, via in-tank pumps which drive the LNG around the process, back flowing through the liquid arms to the ship's tanks. The LNG flow is bled off the ringmain and controlled preferentially at the jetty head.

A major consideration is the return of warm vapour from the ship due to:

- LNG flashing (LNG contacting and cooling warm ship tanks, different vapour pressures between the stock being loaded and the LNG stock on the LNG carrier)
- Heat being added to both LNG & BOG through terminal pipework, ship pipework, tank insulation, LNG pumping and BOG compression;
- The positive gas displacement in the ship cargo tanks due to the liquid being filled;
- Atmospheric pressure swings.

The vapour is sent back to the terminal through the original vapour return line and routed to the terminal's boil-off gas management system. If the jetty is at a considerable distance from the terminal, dedicated compression facilities using compressors or blowers, may be required at the jetty. The carrier may also manage some boil-off through its own facilities.

Some of the key challenges associated with LNG carrier reloading are:

- **Vapour Return Rate:** The reloading rate may be limited by the vapour return system (Section 4.2 and Section 4.3).
- **Use of in-tank pumps for reloading:** An assessment of in-tank pumps operating conditions against the carrier's design limits should be conducted (Section 4.2.2).
- **LNG Conditioning:** The generation of boil-off gas at the ship may be reduced by reducing the terminal tank pressures in the lead up to a carrier loading operation. This process is known as LNG conditioning.
- **Reverse flow in LNG transfer arms:** As the liquid arms have been designed to unload LNG from the cargo ships to the tanks in one flow direction only, typically non-return valves (NRVs) are fitted in purpose-built LNG importation terminals. The modifications required to enable flow through (or around) the NRVs are discussed in Section 4.2.3.
- **Surge:** The ringmain and transfer lines will have been assessed for surge (hydraulic studies) under Emergency Shut Down (ESD) events during unloading; these would require evaluation for reloading operations. (see Section 4.1).
- **Avoidance of stratification:** The maximum heel limitation of the ship should not be exceeded prior to performing a reloading operation. This prevents the possibility of stratification and rollover of the LNG in the tanks.

2.3 LNG Carrier Reloading plus Regasification and Export

The final step of a traditional LNG value chain involves LNG regasification and distribution as vapour. Figure 2.3 depicts the scenario of a terminal performing a reload and simultaneously exporting gas.

Figure 2.3 Illustration of a typical reloading operation with export into local infrastructure

An additional challenge associated to this simultaneous operation is the design of the in-tank pumps for both send-out mode (requiring a relatively low flow but a moderate discharge pressure) and reloading mode (requiring a relatively high flow but a low discharge pressure).

2.4 Simultaneous Operations on Multiple Jetties

The following modes involve simultaneous operations at multiple jetties:

- Tank to multiple ships
- Ship to ship transfer (or transhipment).

4

TECHNICAL ASSESSMENTS

There are a number of key technical assessments to ensure that reload operations can safely be implemented at unloading terminal facilities. The following sections describe a non-exhaustive list of technical studies which should be performed to enable reload operations:

4.1 Surge (Hydraulic) Studies

If there is a considerable distance between the LNG terminal and the ships berthed at the jetties, it is prudent to perform surge analysis on the LNG transfer pipework from the terminal up to and including any ship piping systems that may be subjected to a surge condition during reloading operations.

The closure time of the Powered Emergency Released Couplings valves (PERCs) on the jetty liquid transfer arms is typically significantly faster than the closure time for the ESD valves in the pipeline corridor. This is one of the main contributors to surge issues for both unload and reload operations.

It may be the case that an unloading surge analysis was already performed for the purpose-built LNG importation terminal. A key difference between an unloading surge analysis and a reloading surge analysis is the action of the pumps in the event of an ESD trip of the operation. Typically, the following behaviour would be observed:

- ESD trip of unloading operation: The ships pumps trip upon initiation of an ESD event. This can cause areas of low pressure vapour pocket collapse which will cause a sudden increase in pipeline pressure and forces.
- ESD trip of reloading operation: The pumps used for reloading operation are typically in-tank pumps which are used for exporting LNG. Upon an ESD event in the pipeline corridor between the tanks and the jetty, it is unlikely that the in-tanks pumps will trip as they will still be required for export; If the in tank pumps are not tripping, the maximum reloading flow will decrease significantly. This leads to a more gradual build-up in pressure.
- Flow control: In unloading mode, the terminal requests the ship to adjust the discharge flow at the pump discharge valve (reducing therefore the normal unloading pressure) whereas the terminal is usually adjusting the reloading flow at the end of the (long) unloading line.

In addition to ESD valves, a reloading surge analysis should consider the action of any control valves in the transfer line downstream of the reloading pumps (typically in-tank pumps), upon triggering ESD. Control valves that are configured to open upon ESD initiation will lead to pressure equalisation over the valve as it opens. Consequently, the high upstream pressure may propagate around the system before the ESD is complete.

4.2 Terminal Facilities

4.2.1 BOG Facilities (Compressors / Desuperheaters / Coolers)

The unloading terminal will have a gas processing system that will have been originally designed to:

- Manage boil-off gas (BOG) from the facility's LNG storage tanks;
- Manage vapour returning from the terminal to the ship at the jetty during unloading operations (the vapour is returned to the ship to fill the void left by removing LNG from the ship's tanks).

For reloading operations, BOG is generated on the ship and returned to the terminal via a ship vapour return line where it mixes with BOG from the LNG storage tanks prior to compression and sendout. The BOG from the jetty may be significantly warmer than the BOG from the tanks due to:

Use of the Ship HD compressor or/and jetty compressor adds heat to the BOG

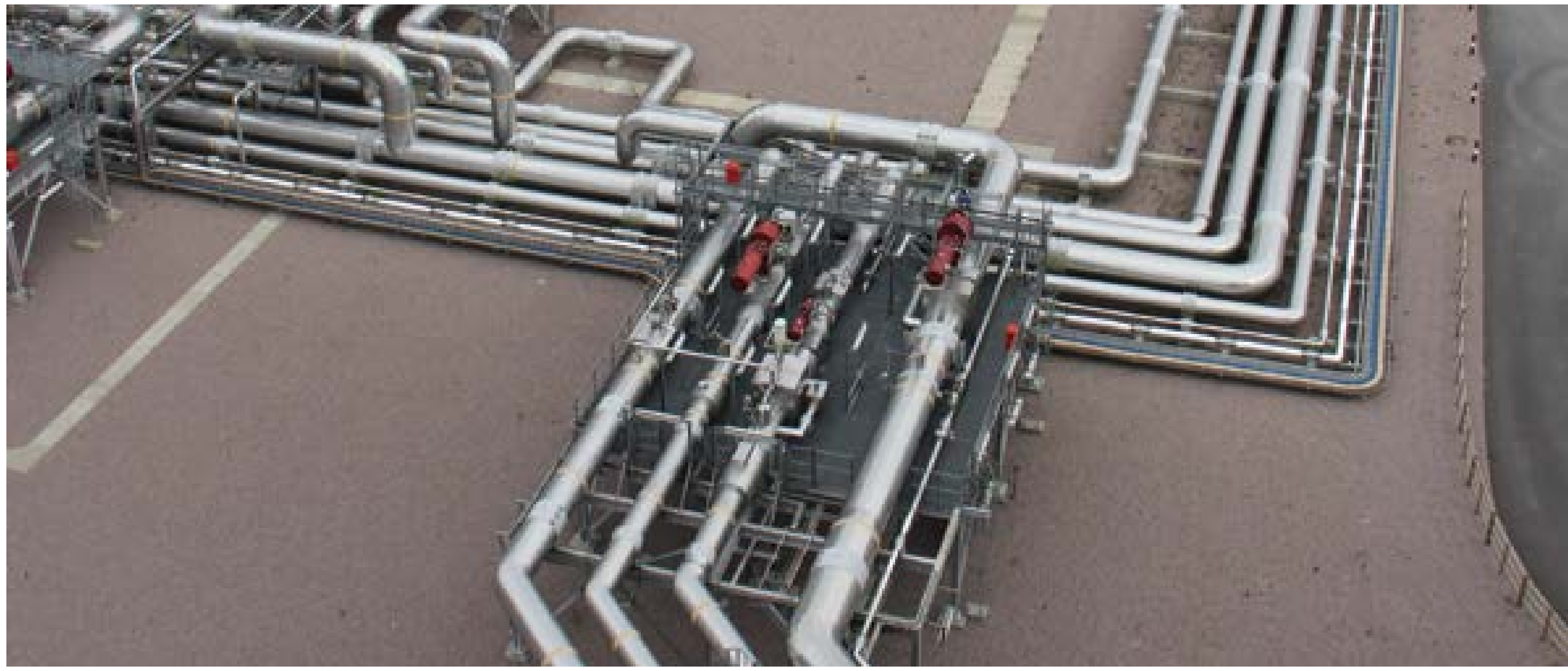
There may be a long length of pipework between the jetty and the terminal compressors which is not insulated. Therefore, the BOG will gain heat from the ambient conditions.

Processing the vapour returned from the ship may exceed the operating envelope of the terminal gas handling system, hence the following aspects may need to be considered:

Terminal BOG compressor capacity

Terminal BOG compressor design temperature limits

Terminal BOG compressor suction, interstage and discharge cooler capacities



The key considerations for the terminal BOG handling facilities are shown in Figure 4.1

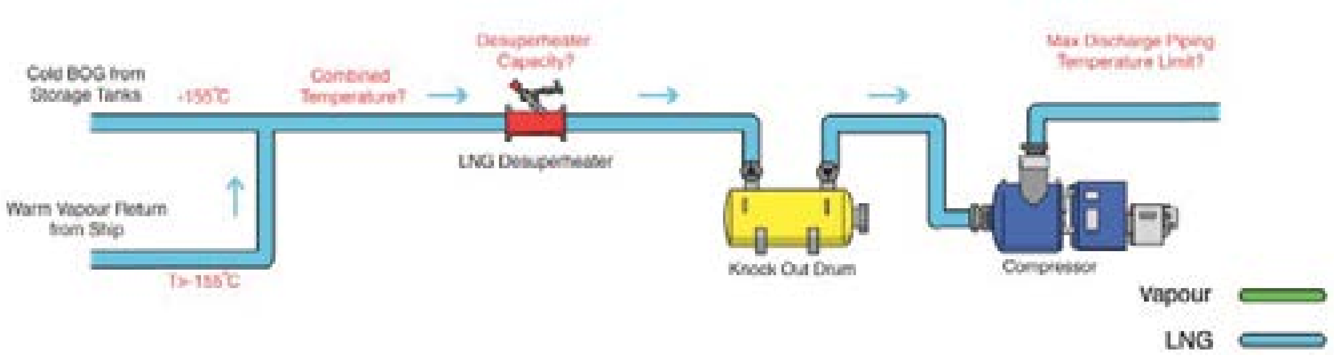


Figure 4.1 Illustration of typical factors to consider for terminal gas handling facilities

4.2.2 Pumps

LNG for carrier reloading will be sourced from the terminal's LNG storage tanks, and is typically supplied using existing in-tank pumps. For a typical LNG importation facility, the original design intention for these in-tank pumps fall under the following categories:

- Provide LNG for recirculation around the transfer lines to keep them cold, in readiness for a ship to unload;
- Supply LNG to a re-condenser for liquefaction of BOG
- Supply LNG to high pressure export pumps as part of a re-gasification plant.

As the in-tank pumps were originally not designed for reloading operations, there may be the potential for a mismatch between the maximum operating pressure of the in-tank pumps (typically ~ 19 barg) and the design pressure of the pipework on a LNG carrier (typically ~10 barg). This creates the potential for over pressurisation of the ship pipework for several different operating scenarios (e.g. blocked outlet).

Consequently, the following factors must be assessed when considering using existing in-tank pumps for reloading operations:

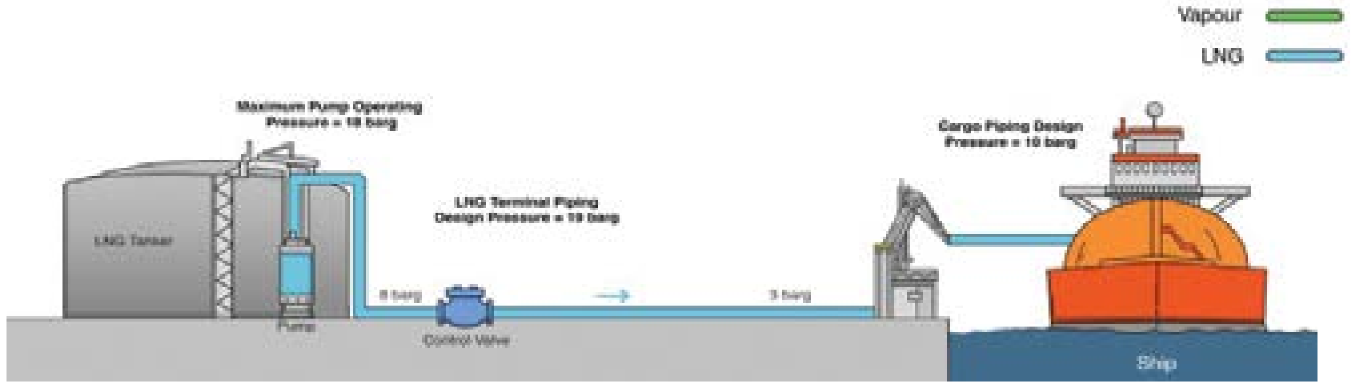
LNG storage in-tank pump maximum operating pressure (i.e. shut-off pressure) and tank-ship differential elevation vs. carrier pipework design pressure

Terminal instrumented protection system trip settings (compared to carried pressure relief pressure settings).

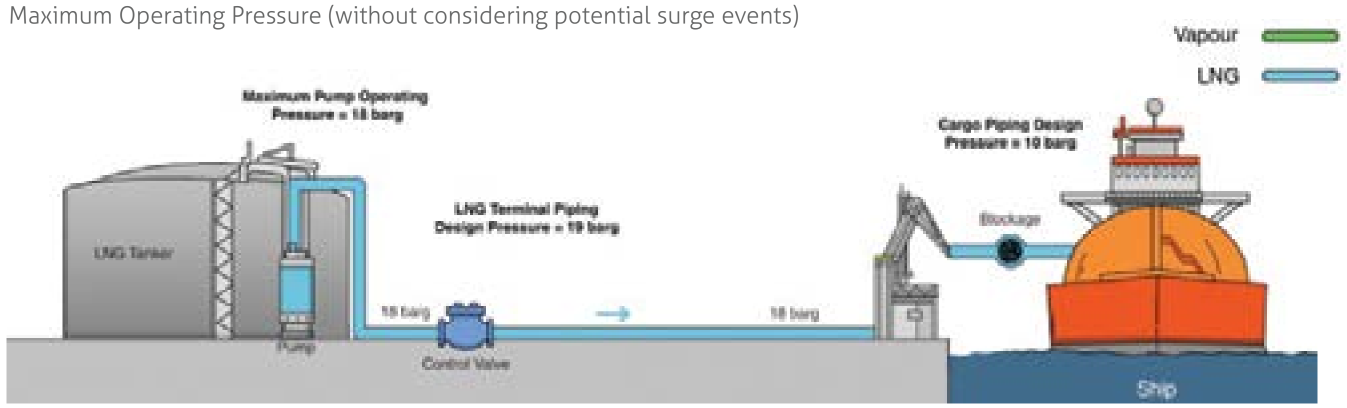
Carrier pressure relief system capacities (i.e. check adequacy of the carrier pressure relief system to safely relieve the pressure generated by the in-tank pump)

Potential installation of a high-pressure trip on the in-tank pumps used for reloading operations.

A schematic of how an LNG unloading carrier could potentially be over pressurised due to the mismatch in design pressure between the in-tank pumps and the tanks is shown in Figure 4.2.



Maximum Operating Pressure (without considering potential surge events)



Maximum operating pressure following a surge event initiated by the ship

Figure 4.2 Schematic of potential over pressurisation of LNG carrier

4.2.3 LNG Loading/Vapour Return Arm Arrangements

Typically, LNG will be transferred to the carrier using the existing terminal process pipework and connecting arms. During a reload operation, both LNG and vapor flow direction will be reversed compared to the original design intention. If non-return valves (NRVs) are installed on the liquid transfer arms, particular consideration should be given to ways of achieving flow through (or around) the NRVs.

NRVs may have been originally installed to prevent back-flow of LNG under the following two operating modes and failure scenarios:

a) During unloading and in case of a carrier pump trip which may cause loss of pressure and reverse flow potential.

b) During recirculation as an additional layer of protection (after isolation valves) to prevent LNG leaks to the environment.

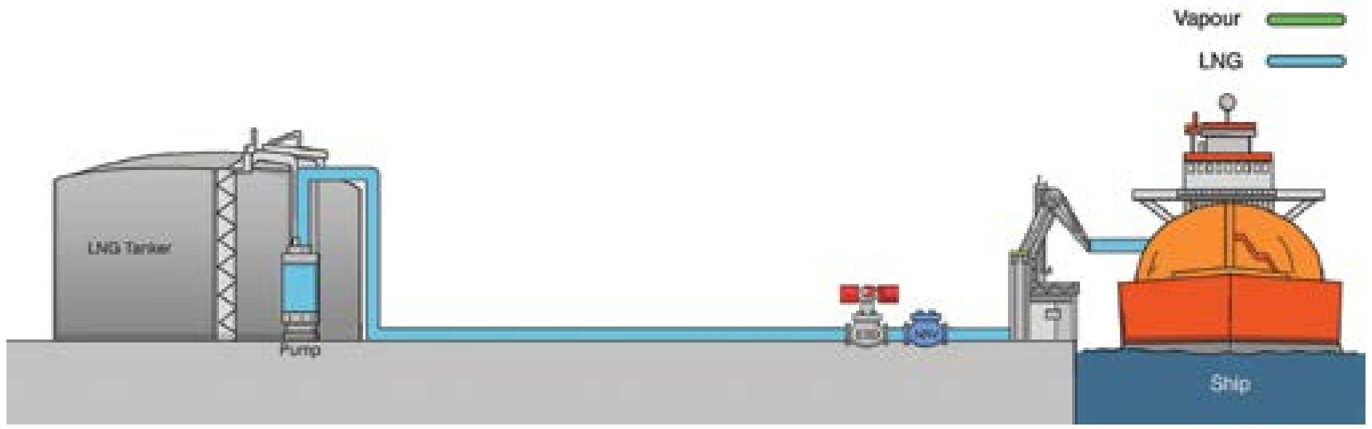
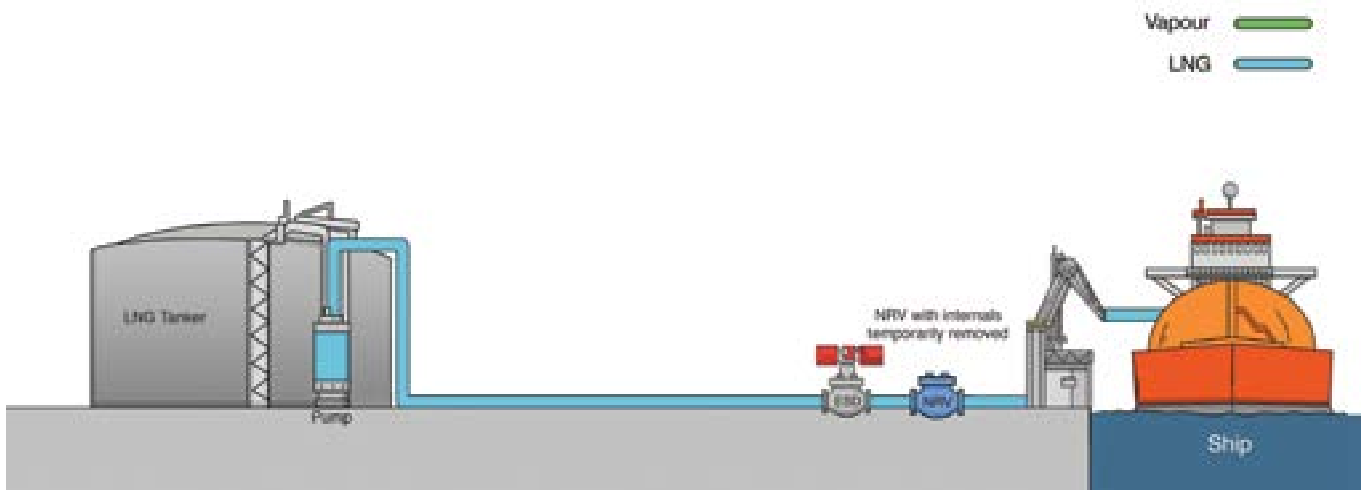


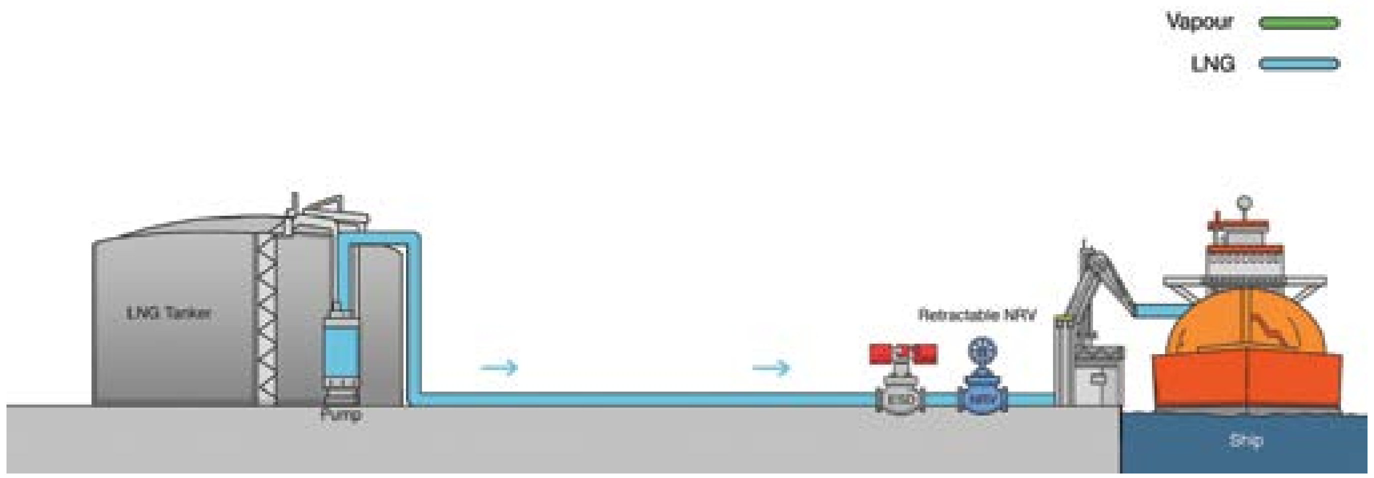
Figure 4.3 Typical NRV installation in a LNG transfer line

The following options may be considered when dealing with NRVs:

- Temporary removal of NRV internal components during reloads.



- Use of retractable NRVs which may be mechanically held open during reloads.



- Installation of NRV by-pass line to be utilised as the LNG flow path during reloads.

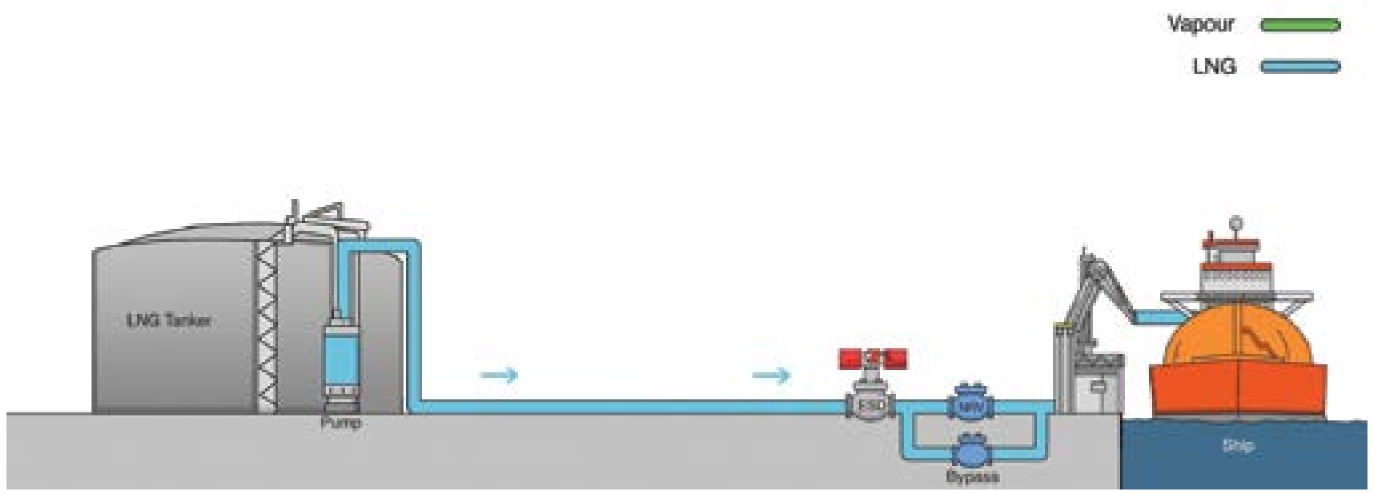


Figure 4.4 Options for achieving reloading flow for LNG terminals with NRVs present in the liquid transfer lines

4.3 Assessment of Jetty for Increased Usage

Typical durations for carrier loading may be much longer compared to carrier unloading durations due to the much lower flowrates achieved for carrier loading operations compared to carrier unloading operations. A carrier berthed at the jetty for an extended period of time may impact the site risk assessment and impact on facilities at the jetty head. The following impacts due to extended durations (compared to unloading) should be considered:

4.3.1 Mechanical Failure

The longer period of time that a carrier is berthed at a jetty, the greater the probability for it to be exposed to abnormal sea levels. Excessive carrier movement could then create the potential for overstressing the connecting arms. In order to reduce the risk of mechanical failure, these events could be forecasted and warnings sought from the port authority.

If such an event is predicted and safe working parameters for the carrier could be exceeded, the terminal can either:

- Suspend loading and disconnect the arms as a precaution
- Move the carrier from the jetty until the event is passed.

The terminal should already have the capability to deal with these events during unloading.

4.3.2 Impact Damage

A longer berthing duration may reduce the possibility of impact damage. Compared to full terminal utilisation for unloading only, the inclusion of longer loading operations would reduce the frequency of berthing activities, thereby reducing the potential for damage to the jetties by collisions while berthing the carrier.

While the carrier is at berth, the terminal's existing exclusion zones may be in force and a guard tug present at all times. It is therefore considered that carrier loading could have an equal or lower potential for impact damage to the carrier or the jetties compared to carrier unloading.

Other positive impacts may be fewer arm connections/disconnections for a loading operation, and reduced flowrate in the pipework, which would result in equal or lower hazard distances than those based on unloading flowrates.

4.3.3 Availability

A terminal may have agreements in place to provide availability of the jetties to the LNG shippers, according to the nature of the contract. Reloading operations (especially with longer durations) would result in occupied slots, meaning that a terminal may not be able to provide a jetty on demand. A terminal would need to consider its commercial obligations to its shippers and balance the frequency and duration of loading operations on balance.

4.4 Transfer Measurement System

A traditional LNG import terminal will in most cases have in place equipment to measure LNG flow rate and composition. Equally, a carrier will already be equipped with a tank level measurement device, hence the transfer measurement system is expected to be achieved without problems. In essence, LNG transfer from terminal to carrier will rely on both parties to utilise their own existing custody transfer systems, to measure the following:

- Carrier tank static level measurement, fill rate, temperature and pressure
- Terminal flow rate measurement measurement of LNG and BOG (in alignment with the LNG Custody Transfer Handbook 5th Edition)
- Terminal composition analysis of LNG and BOG (in alignment with the LNG Custody Transfer Handbook 5th Edition)

During loading, transfer of LNG may be managed by the terminal monitoring the quantity of LNG transferred on a regular basis (e.g. hourly) and carrying out periodic inspections aboard the carrier. An independent surveyor may also be requested to be present to monitor the quantity and quality of LNG transferred. The carrier will have its own level measurement and custody transfer systems which may be verified as part of carrier approval prior to loading by the independent surveyor.

Loading may be completed when the carrier notifies the terminal that it has transferred the commercially agreed quantity of LNG. The final amount transferred is determined on an energy basis. Utilising a metrology system which involves both parties ensures traceability, and minimises measurement uncertainties.

For more information, refer to the GIIGNL LNG Custody Transfer Handbook 5th Edition.

4.5 Carrier BOG Management

During loading operations, boil-off gas is generated at the ship due to LNG contacting and cooling warm ship tanks and displaced gas.

The boil-off gas may be managed via the following routes on board the carrier:

Gas combustion unit (GCU)

Power generation (if the carrier utilises boilers or gas fire generators)

Transfer to the terminal. The terminal may process the boil-off gas with its own gas management system. In this case, the shipper may be required to contribute to cost of processing the boil off gas.

Recondensing and liquefaction. For this to be feasible the ship must be able to provide enough power to run the cargo pumps and liquefaction unit. Power generation capacity is usually a limiting factor.

4.6 Carrier Assessments

The following considerations pertain to carrier assessment for safe loading operations.

Overfill

The risk of carrier overfill has become more apparent following an incident during carrier unloading at the Barcelona LNG terminal in June 2015. Whilst an LNG carrier was being unloaded from one tank, the fill valve to an adjacent tank was partially open in spite of being shown as closed on the DCS, due to a fault on the valve position indication mechanism. This allowed some LNG to flow into the adjacent tank instead of onshore. The high level alarms in the adjacent tanks sounded and the crew notified that the carrier's tank vents were releasing vapour (and eventually LNG). However as the carrier was being unloaded, the crew ignored the warnings. Also prior to unloading, the independent tank high level alarm was not switched from "sea state" "port state" which would have enabled it.

This incident occurred during the unloading of a carrier, when overfill was not considered credible. During loading, overfill has been regarded throughout the industry as a possible initiating event for LNG release, and hence more attention should be given to precautions to prevent overfill or detect impending overfill.

During the pre-loading meeting all protective systems must be confirmed functioning properly. The carrier high level alarms and trips should comply with marine standards and approvals by classification societies, and be tested according to manufacturers' recommended schedules. The usual certifications include Certificate of Class, International Ship Safety Construction Certificate and the International Certificate of Fitness for Gas Carriers. Typically these are a high alarm at 95% of maximum, 97% high-high, 98.5% very high (which closes the tank fill valves) and 99% which initiates a full ESD1 of loading.

Over-Pressurisation and Vacuum

Checks should be carried out to ensure that the carrier has protection against over-pressurisation of its tanks during loading. For instance, confirmation of the provision of high pressure alarms and pressure relief valves. The pressure relief valves must be suitable for all possible relief scenarios including a blocked in scenario during loading. Typically the pressure relief valves of the carrier are sized for the vapour generated during loading at the high flowrates used by production terminals, which is expected to be above the flowrates used for loading by a re-purposed LNG importation terminal; however this must be ascertained. Checks must also be made for the provision of a low pressure trip on the carrier in case of over-extraction of vapour (which may be possible if the carrier uses its own vapour removal compressor).

Crash Cooling

A concern for carrier loading is 'crash cooling' of plant and equipment due to the sudden introduction of large quantities of cryogenic fluid into warm systems. The following factors may provide mitigation:

Experience of the plant and carrier of the pipework and connecting arms operation with crash cooling during unloads, without resulting in major failure.

Small LNG leaks which may be caused by differential cooling across flanges and valve bonnets, tend to self-seal as temperatures equalise.

A check of the carrier tank temperature on arrival as part of pre-loading meetings and inspections. Typically, the tanks would have a 'heel' of LNG to maintain them in a cold state. The terminal should be notified in advance if a carrier is 'warm', so that appropriate arrangements (and additional time at berth) can be organised for cooldown.

Stratification and Rollover

The following mitigations should be taken to prevent the possibility of stratification and rollover in the LNG carrier tanks:

- The receiving LNG carrier should have a maximum heel specification prior to receiving new LNG cargo. This heel specification is likely set for naval architecture and ship stability requirements.
- If LNG is being taken from multiple tanks on site, the composition and density of the different LNG sources must be comparable.
- The LNG quality should be carefully monitored during the reload operation to ensure there is not significant variations in density.

4.7 Modifications to the Control and Emergency Shutdown System

A purpose-built LNG importation terminal may have certain safety instrumented systems (SIS) in place to mitigate against potential hazards for unloading operations (e.g. high pressure trip on the vapour return line to prevent carrier overpressurisation). There may be a need to change the set points of the safety systems to enable reload operations.

Some of the considerations involved in changing the set points are:

- DCS Software Modifications;
- Alarm Prioritisation;
- PLC Upgrades/Modifications;
- Formal Process Safety Assessments (refer to Section 3.2).

4.8 Carrier Vetting

A terminal may create inspection procedures and an auditable method for information gathering for carrier approval prior to loading, as part of a pre-loading meeting. For example, verification of override status (i.e. ensuring that the carrier level trip overrides are not in place), carrier tank temperatures, photographic evidence of the status of carrier safety systems, and signatures on confirmation that systems are in place. Additional details of boil off handing and other relevant equipment for LNG loading may also be included as part of the inspection. These assist terminal personnel in assessing whether all carrier safety systems are in place and set up correctly prior to transferring LNG. The agenda of a pre-loading meeting may include the following:

1. Operating Parameters

a. **Maximum ship tank pressure**
b. **Maximum ship tank operating pressure**
c. **Relief settings**
d. **Maximum LNG reload pressure at manifold**
e. **Operational LNG reload pressure at manifold**
f. **Ship stock management and LNG density**
g. **Removal of ship tank overrides**

2. LNG Transfer

a. **Number of tanks to be filled**
b. **Commercial ownership of reload e.g. who/when to stop**
c. **Configuration of tanks to be filled**
d. **Flow control of load (ship tank fill valves)**
e. **Plant configuration for transfer**
f. **Ramp down procedure**

3. Process Interruptions

a. **Discharge on Jetty**
b. **Ship event**
c. **Terminal event**
d. **Weather**

4. Boil off lineout and control

a. **Ship tank pressure management**
b. **Terminal vapour return line out**
c. **Ship compressor management**
d. **Ship GCU/Engine room management if applicable**

5. Arm cool down overview

6. Gas quality

7. Possible trip scenarios and appropriate actions

a. **Recirculation trip**
b. **Ship manifold trip**
c. **Ship compressor trip**
d. **Terminal boil off management trip**

4.9 Procedure and Work Instructions

Individual carriers may necessitate variations in procedures for reloading. A terminal may benefit from developing a non-routine procedure until it has confidence that the implications for plant and operations caused by the variability of incoming vessels has been understood and managed. The non-routine procedure would typically be more detailed than a work instruction. This may involve sign-off once each step in the non-routine procedure is completed. The non-routine procedure must allow for flexibility in incorporating variations throughout the learning process.

Also, in conjunction with the non-routine operating procedure, reloading safety instructions should be developed. They should include the following as a minimum;

- Action to take for loss of power/communication;
- Breaching of safety zones;
- Limits on ambient conditions for safe reloading operation;
- Loss of safety systems.

Temporary plant modifications (such as the removal on NRV internals) may also be managed by the initial procedure.

Once a satisfactory number of carriers have been loaded and the terminal has sufficient confidence and certainty in engineering requirements to design and install permanent plant and equipment for this activity, the process may be converted into a routine operation with modifications to plant and equipment as appropriate, and work instructions.

The non-routine procedure may comprise step by step instructions for carrying the following activities:

- Prerequisites (e.g. LNG conditioning, pre-ship arrival communications)
- Berth receiving Carrier onto jetty (e.g. carrier appraisal)
- BOG management to terminal (e.g. use of ship vapour return line, jetty blower, or ship compressor)
- Ship to shore ESD and safety system checks prior to cooldown
- Ship reloading operations (procedure for ramp-up from cool down flow rate to reload flow rate, regular recordings of ship tank levels etc.)
- Cool down of LNG arm and ship manifold (utilising recirculation flow)
- Process interruptions (procedure for managing interruptions due to e.g. adverse weather conditions, process upsets and conflicting commercial operations)
- Completion of ship reload operation (notice periods and ramp-down intervals)

5 RESPONSIBILITIES OF DIFFERENT STAKEHOLDERS

The following section can be used to provide a basis for the division of responsibilities among the key stakeholders involved in reloading operations. The section looks at the stakeholder responsibilities at both the initial planning stage and during reload operations.

5.1 Responsibilities During Planning

5.1.1 Reload Terminal

The following is a non-exhaustive list of actions which should be performed by the purpose-built LNG importation terminal prior to performing any reload operations;

The terminal should review all applicable regulations and guidelines identifying all technical information/accreditations required;

The terminal should develop a reload procedure that can be used for reloading a variety of different ship sizes;

The terminal should develop an emergency response plan, if any updates are required. This is discussed in 3.3 and should be done with the local authorities and emergency services. This plan should then be given to any ships which berth at the terminal for the receipt of LNG;

The terminal should carry out adequate formal process safety assessments of terminal facilities for performing reloading operations;

The terminal should ensure that all personnel are adequately trained and have a good working knowledge of the reloading procedure and emergency response plan;

The terminal should develop a carrier appraisal template which is to be completed in conjunction with the receiving ship operator for every new reload operation. This will ensure that there is adequate safety measures in place (on the ship and the terminal) to enable a safe reload operation;

5.1.2 LNG Carrier Operator

The following is a non-exhaustive list of actions which should be performed by the receiving ship operator prior to performing any reload operations;

The LNG Carrier should develop a reload procedure;

The LNG Carrier should review all applicable regulations and standards identifying all technical information/accreditations required

The LNG Carrier should carry out risk assessment and adequate formal process safety assessments of ship facilities for receipt of LNG from a purpose-built importation terminal;

The LNG Carrier should complete carrier appraisal in conjunction with the LNG reloading terminal;

The LNG Carrier should ensure that all personnel are adequately trained and have a good working knowledge of the reloading procedure and emergency response plan;

5.1.3 Port Authority Including Emergency Services or Any Other Relevant Authority With Jurisdiction Over the Reloading Operation

Once an LNG terminal has demonstrated compliance with all applicable regulations and standards, a competent authority will authorise reloading operations at the LNG terminal. The competent authority should perform the following actions as a minimum;

All relevant authorities should review and accept the level of risk assessment performed;

All relevant authorities should review and accept the emergency response plan;

All relevant authorities should consider applying restriction on certain type of operations.

All relevant authorities should assume overall responsibility for governance of LNG reloading facilities within the port;

All relevant authorities should develop procedures for adequate traffic control within the port;

All relevant authorities should ensure emergency response teams are adequately trained.

All relevant authorities should set boundary conditions in which LNG operations can be performed: e.g: (max wind speed).

5.2 Responsibilities During Operations

This section discusses the different roles and responsibilities of different parties during reload operations:

5.2.1 Ship Master

The ship master should perform the following actions as a minimum:

The ship master should have overall control for safe operations of the receiving ship;

The ship master should terminate the reloading process if the procedure deviates from the planned and agreed process.

The ship master should chair the pre-reload meeting to ensure compatibility between the terminal and the ship and that all key information between the terminal and ship is shared (e.g. quantity of LNG, operating conditions and safety procedures)

5.2.2 Reload Terminal

The reload terminal should perform the following actions as a minimum:

The reload terminal is responsible for operation of the shore-side facility in line with the reloading procedure;

Obtain agreement of the communication protocol to be used during the operations.

The reload terminal should appoint representatives to attend the pre-reload meeting to ensure compatibility between the terminal and the ship and that all key information between the terminal and ship is shared (e.g. quantity of LNG, operating conditions and safety procedures)

The reload terminal should be responsible for the connection/ disconnection of the transfer arms.

The reload terminal should terminate the reloading process if the procedure deviates from the planned and agreed process.

5.2.3 LNG Carrier Operator/Charterer

The LNG Carrier operator should perform the following actions as a minimum:

The LNG Carrier operator should inform the terminal in advance of requirement for reloading operation to ensure that the terminal has adequate time to prepare (e.g. perform LNG conditioning, see 4.2.3).

The LNG Carrier operator should appoint a representative to attend the pre-reload meeting to ensure compatibility between the terminal and the ship and that all key information between the terminal and ship is shared (e.g. quantity of LNG, maximum flowrate and safety procedures)

5.2.4 Port Authority

The port authority should perform the following actions as a minimum:

The port authority should establish the zones and areas required for reloading operation

The port authority should enforce the passing distances for other ships