January 2019

Lessons Learnt - Overflow of LNG from the LNG Cargo Tank Mast

Analysis of an LNG carrier release in 2015

GIIGNL Technical Study Group report

Summary

This note describes the causes of an LNG release during the unloading of an LNG carrier in 2015, and makes recommendations based on these for implementation or consideration by onshore LNG terminal operators. The recommendations are grouped into those for immediate action and those which may require research or technical development.

Introduction

This technical note has been prepared following the LNG overflow and spillage during unloading from a LNG carrier (LNGC) berthed in 2015. It provides recommendations on measures that LNG terminals should consider to minimise the risk of a recurrence of a similar incident.

Description of Incident

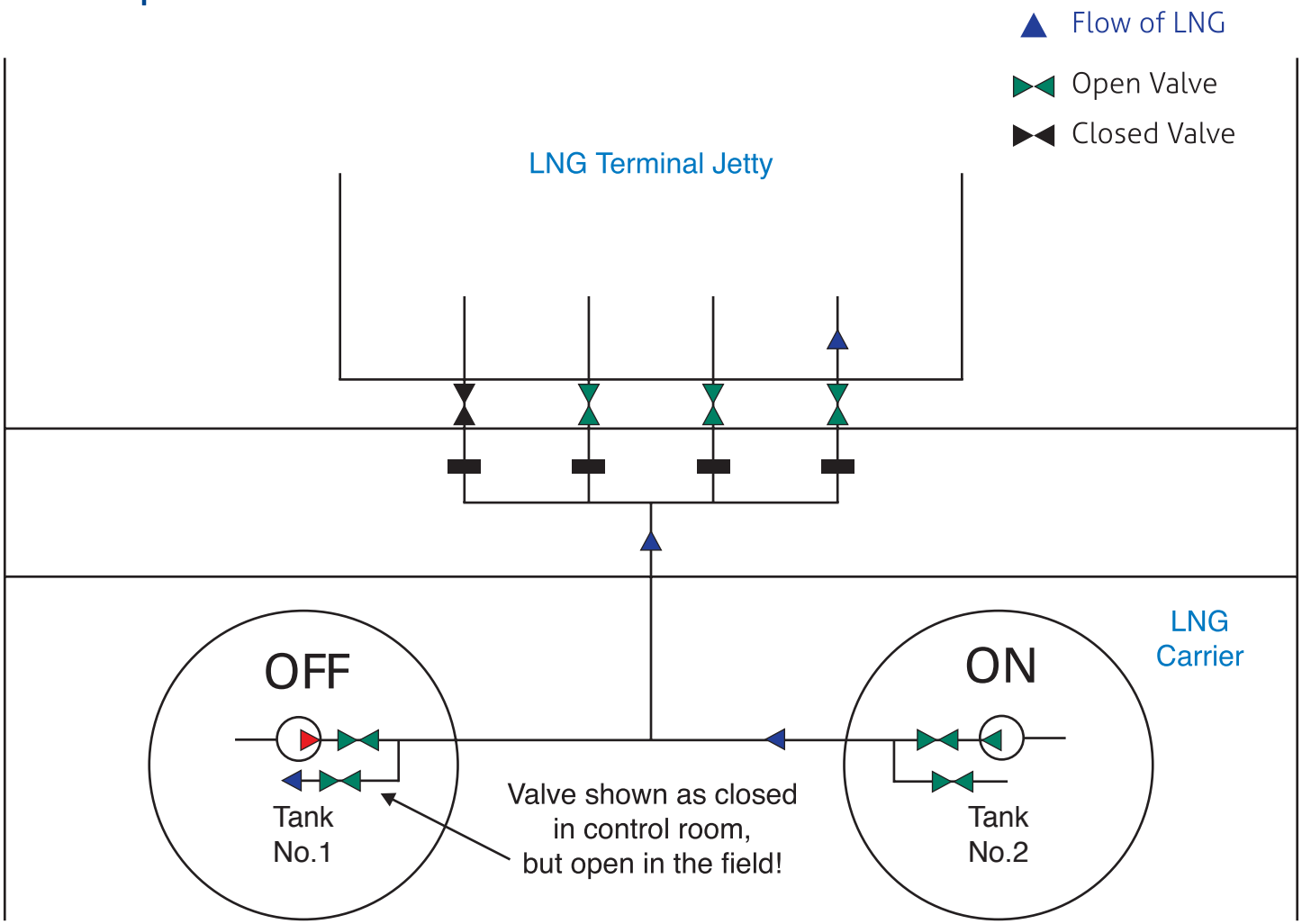

Figure 1 - Illustration of Line out Configuration

The incident occurred on 19th June 2015 during the unloading of an LNGC. An inadvertent overfill of a cargo tank led to the release of a significant quantity of LNG. The release did not ignite and there were no casualties.

The LNGC arrived at the terminal with a cargo of 138,000 m^3 of LNG for full discharge. As the unloading rate was ramping up there was an overflow of LNG from No.1 cargo tank vent mast and LNG spilled out on to the deck of the LNGC, resulting in significant damage to the LNGC's deck caused by cold embrittlement. A vapour cloud over 200 metres long formed and dispersed in the harbour basin. As normal practice during the sea transit, the LNGC's Tank Protection System (TPS) and ESD had been inhibited. However, upon arrival at the port these safety systems had not been returned into normal service. Specifically, the Independent High Level Alarm System, which is intended to initiate ESD in the event that the level in any cargo tank exceeds 99.2%, was not enabled. In spite of this, the safety check-list was completed and approved, allowing the unloading operation to commence.

Separately, the No.1 Tank filling valve had been directed to close, but had not closed fully due to a failure in the valve positioner resulting from corrosion caused by moisture. The valve status showed as 'closed' in the LNGC's control

room. The failure to isolate the No.1 Tank created a route for LNG to enter the tank when discharge from the No.2 tank commenced.

The pressure in Tank No.1 increased, and numerous high pressure alarms (over fifty) sounded in the control room but these were not acted upon by the crew. The Custody Transfer Management System (CTMS) recorded the high tank level but the ESD was not initiated as the Independent High Level Alarm System was inhibited.

As the unloading pumps continued to pump LNG from Tank No.2, No.1 Tank pressure continued to increase and the PSV opened, resulting in a release of methane vapour to atmosphere. After a few seconds, pressure decreased and the PSV re-seated. However, the crew did not activate manual ESD, although the venting from the No.1 Tank vent had been observed. After a further 10 minutes the PSV opened again, resulting in an LNG release. At this point the manual ESD was activated.

Description of Causes

A number of sources were used to identify the causes of this incident. Causes include issues with the maintenance, operation and management of the LNGC and could not be influenced by the terminal; however, some of the lessons are transferable to onshore terminal operations and where appropriate, recommendations have been made below.

The primary causes can be summarised as follows:

- Procedures were not complied with, resulting in the isolation of critical safety systems (ESD and TPS), preventing their operation when required during LNGC unloading;
- Safety systems status were not checked as part of the routine pre-unloading safety checklist, which is signed off by both parties. There is a concern that these checklists may be excessively long and time-consuming to complete, resulting in a potential conflict with commercial imperatives to start unloading operations at the earliest opportunity;
- The tank filling valve was not maintained appropriately, resulting in a failure of the valve positioners and giving an erroneous reading in the control room;
- The Chief Officer was overwhelmed by the number and frequency of alarms and lost his situational awareness;
- The crew was inadequately trained to respond to the incident;
- The crew failed to follow procedure by initiating manual ESD when the initial LNG release occurred;
- The terminal was unable to initiate LNGC's ESD independently;
- The terminal was unable to recognise that the quantity of LNG coming into the onshore storage tanks did not match that being pumped out of the LNGC's tank, with a proportion being misrouted to the No.1 Tank.

RECOMMENDATIONS

The following recommendations, arising from a review of the main causes of this incident, have been divided into short-term and longer-term recommendations. Short-term recommendations should be considered for implementation by LNG terminal operators. The longer-term recommendations may require additional studies and more wide-ranging agreements with LNGC operators to establish best practice, or development of more advanced ship-shore interface technology.

The recommendations are divided into three categories:

Prevention

Actions or measures that would reduce the probability of a similar incident occurring;

Detection

Measures which would give the terminal greater visibility of a developing incident, enabling appropriate actions to be taken to avoid further escalation;

Mitigation

Measures which would minimise the consequences once an incident has developed, either by limiting escalation or improving emergency response.

RECOMMENDATIONS - SHORT-TERM

Prevention

- The terminal operator's LNGC vetting processes should include thorough examination and documentation of the LNGC's ESD/TPS inhibiting procedure;
- Terminals should carry out periodic LNGC vetting with emphasis on management of safety systems;
- Ship-shore interface safety checklists should include visual verification of LNGC ESD inhibit status (Sea/Port);
- Procedures should be reviewed to ensure that the LNGC informs the terminal if they intend to change the condition/status of any safety system override related to LNG transfer and acknowledgement received from the terminal;
- In the event that a change to the override status of the LNGC's safety systems becomes known to the terminal and not previously agreed, the responsible person for unloading should shut down unloading immediately;
- The reliability of valve position indication in terminal systems should be reviewed, and corrective actions implemented where the acceptance criteria are not met.

Detection

- Terminals should consider if it is desirable for the terminal's responsible person for unloading (or nominated representative) to be present on board the LNGC during the ramp-up stage, this is in addition to having an operator at the jetty head at part of current good practice.

Mitigation

- Simulator training for terminal staff should include process incidents aboard the LNGC while at berth/unloading;
- Terminals should adopt best practice for alarm systems management (e.g. EEMUA 191, ISA18.2 etc.);
- Incident management training for terminal staff should be carried out in line with corporate and local/national jurisdiction requirements.

RECOMMENDATIONS - LONGER-TERM

Prevention

- Terminals should consider the length and complexity of ship-shore checklists and this should be reviewed to ensure that they are focussed and can be completed in a reasonable time upon arrival;
- LNG industry to consider the requirements of interlocks in the ship's IAS between TPS and cargo system to prevent starting of cargo pumps. Also investigate the possibility of sharing this status with the terminal.

Detection

- Terminals should consider how flow discrepancy monitoring during the ramp-up phase of unloading operation could be achieved (e.g. by rates of change of tank levels).

Mitigation

- Terminals should ensure that hazardous area classification at jetties is compliant with the current requirements of local/national jurisdiction.