UK Petroleum Industry Association Ltd.

Report

Automatic Shutdown of Ship Transfers

Doc. Type Report Title Automatic Shutdown of Ship Transfers		Committee Terminals Working Group Issue Date: 23rd July 2010			
UKpia		Document identity UKPIA Report – Automatic Shutdown of Ship Transfers	Lang. en	Rev. ind. 0.2	Sheet 1 No. of sh. 12

Foreword

This report has been prepared by UKPIA's Terminals Working Group to aid in the interpretation of the guidance provided in appendix 4 of the final Process Safety Leadership Group (PSLG) report when applied to the automatic shutdown of ship transfers.

It is not the intention of this document to specify explicitly how automatic shutdown should be implemented, nor replace any existing corporate guidance or methodologies. The intent of this document is to provide an overview of the issues surrounding the automatic shutdown of ship transfers, and provide possible solutions to these issues.

There are no limitations on further distribution of this document to other organisations outside of UKPIA, provided that:

1. It is understood that this report represents UKPIA's view of the application and interpretation of appendix 4 of the final PSLG report when applied to ship fed transfers.
2. UKPIA accepts no responsibility in terms of the use or misuse of this document.
3. The report is distributed in a read only format, such that the name and content is not changed and that it is consistently referred to as "UKPIA Report – Automatic Shutdown of Ship Transfers".
4. It is understood that no warranty is given in relation to the accuracy or completeness of information contained in the report except that it is believed to be substantially correct at the time of publication.

Contents

1. Introduction

The Buncefield Major Incident Investigation Board (MIIB) recommendation 3 requires that operators of Buncefield-type sites should protect against loss of containment of petrol and other highly flammable liquids by fitting a high integrity, automatic operating overfill prevention system.

To address this recommendation, the PSLG commissioned a working group to develop guidance on automatic overfill protection systems for bulk gasoline storage tanks, this includes transfers from ship. This guidance can be found in appendix 4 of the final PSLG report.

When closing import lines from ships, due to the activation of the overfill protection system, care must be taken to ensure against damage to pipelines and flexible hoses (and other related equipment) due to pressure surges or over-pressure. The purpose of this report is to discuss the implications of this requirement, highlighting the potential issues, and suggest possible solutions. This document does not however provide detailed technical solutions, which should be developed by operators dependant on their individual process plant and operating procedures.

2. Shutting against Ship

The typical issues relating to the automatic shutdown of a transfer from a ship relate specifically to the surge pressure that may occur if the import line to the bulk storage tank is closed, but the export pumps on the ship remain running. This may result in loss of process containment if the rise in pressure exceeds the design pressure of either:

- The fixed on-shore import lines
- The loading arms, including hoses, from the ship to the on-shore import lines
- Pumping systems and related pipework on the ship

In addition to the risk of exceeding design pressures, a surge may also lead to oscillations in the pressure of the loading system, potentially resulting in vibration, and ultimately damage and/or displacement of import equipment and pipework.

Closure of the valves in the import line to a bulk storage tank may occur either by design, where, for example, an automatic overfill protection system is fitted, or inadvertently, through a spurious trip. It should be noted that manual shutdown systems, requiring an operator to close import line valves, also rely on manual communication with the ship to stop discharge pumps.

The final PSLG report, appendix 4, requires that automatic overfill protection be fitted to finished gasoline tanks which are within scope (paragraph 24 of the report), including those tanks that can be fed from a ship. The requirement for these protection systems should be determined through an appropriate risk assessment technique (such as LOPA), but they should, as a minimum, be designed and maintained to Safety Integrity Level 1 (SIL1), as defined by BS EN 61511.

2.1 Possible Solutions

Where equipment and pipework associated with the ship transfer have been designed with a pressure rating greater than that of the surge pressure created (based on the flowrate, pipeline diameter and distance from the ship) on closure of the import line valves, then theoretically automatic closure of these valves as part of an overfill protection system should cause no inadvertent damage or loss of containment. However, consideration should be given to the following:

- Can the integrity (and pressure rating) of the flexible hoses connecting to the on-shore import pipeline be guaranteed?

- Can the integrity (and pressure rating) of the pumping equipment and local pipework on the ship be guaranteed? This equipment may vary from ship to ship, and often its maintenance and certification is outside of the control of the receiving terminal

- Imports may occur at different flow rates, for example due to differences in ship pumping systems, can the pressure rating of equipment be guaranteed across the range of flowrates?

- By reducing the flowrate from the ship, some of the potential issues may be addressed, though this may need to be determined on a ship by ship basis. In addition the flowrate will need to be regularly monitored to ensure that it remains within the limit defined.

Appendix 1 provides a simple flowchart to assist operators in the selection of appropriate measures to combat the issues relating to import from ship. A more detailed description of these solutions, their benefits and potential shortfalls, is given in the following sections.

2.1.1 Diversion to another Tank

Solution

When a High High level is detected on the bulk storage tank, the flow is diverted to another tank (for example a surge tank), allowing on-shore personnel time to contact the ship to manually shut down the export pumps, thus preventing dead-heading the pumps and causing a pressure surge.

Benefits

Reduces the risk of relying on the integrity (pressure rating) of the ship's pumping system and ancillary equipment, as pressure surges are avoided by not closing the import line valves automatically.

Potential Issues

Diverting the flow to another tank relies on another tank being available; the diversion tank may also have the potential to overfill.

If the valve serving the primary tank fails to close, it still has the potential to overfill. There is still a reliance on a manual shutdown of the ship's discharge pumps via communication from the on-shore operator.

If the diversion to a secondary tank relies on the operator, the operator now forms part of the safety function. Where this function has been determined to be SIL1, reference should be made to the UKPIA document 'Gap Analysis and Self Assessment – Operators and SIL1 Safety Systems for Overfill Protection Systems'. Where the safety function is determined to be greater than SIL1, it is unlikely that the target SIL will be achieved with an operator.

Following the shutdown, the material in the diversion tank will need to be dealt with.

2.1.2 Automatic Closure of Tank Side Valves

Solution

When a High High level is detected in the bulk storage tank, the tank side valve is automatically closed, the closure time of the valve is calculated based on worse case pipeline surge calculations.

Benefits

Automatic overfill protection is achieved for the bulk storage tanks, the slow closing valve prevents surge pressure in the pipeline.

Potential Issues

Discharge facilities may be different from ship to ship, with differing discharge flowrates and configurations, can the closure time of the tank side valve be assured to prevent overpressure in all such instances?

Appropriate processes would be required to ensure that new ships into the terminal, or existing ships whose discharge facilities have been upgraded, are assessed to ensure correct closure times have been set for the tank side valve.

Ship discharge facilities are often outside the control of the terminal, can the ship's pumping system and ancillary equipment be assured to cope with the pressure surges created as part of the design of the slow closing valve on the tank.

2.1.3 Delayed Closure of Tank Side Valves

Solution

When a High High level is detected in the bulk storage tank, the tank side valve is delayed in closing allowing the on-shore operator to contact the ship to manually stop the export pumps. Following the delay, the tank side valve is automatically closed.

Benefits

Reduces the risk of relying on the integrity (pressure rating) of the ship's pumping system and ancillary equipment. Pressure surges are avoided by not closing the import line valves immediately, allowing the ship's discharge pumps to be shutdown.

Potential Issues

If there is a problem with communications to the ship, the discharge pumps may still not be shutdown before the tank inlet valve is closed, resulting in a potential pressure surge (refer also to the potential issues associated with automatic closure of tank side valves).

Safe shutdown is reliant on the on-shore operator requesting the ship to stop the discharge pumps, the operator may now form part of the safety function. Where this function has been determined to be SIL1, reference should be made to the UKPIA document 'Gap Analysis and Self Assessment – Operators and SIL1 Safety Systems for Overfill Protection Systems'. Where the safety function is determined to be greater than SIL1, it is unlikely that the target SIL will be achieved with an operator.

2.1.4 Automatic Closure of Tank Side Valves and Trip of Ship's Discharge Pumps

Solution

When a High High level is detected in the bulk storage tank, the tank side valve is automatically closed, and the ship's discharge pumps are automatically shutdown.

Benefits

Automatic overfill protection is achieved for the bulk storage tanks, the automatic trip of the discharge pumps on the ship prevents surge pressure in the pipeline.

Potential Issues

Interface with the ship's discharge systems is required, requiring the installation of suitable plug/socket and umbilical cable to allow for the remote trip of the ship's discharge pumps.

Whilst a radio based system could be employed to avoid the use of hard wiring via an umbilical cable, would this arrangement meet the requirements of BS EN 61511 for the target SIL?

All ships that visit a terminal would be required to have exactly the same configuration for discharge pump trip system. A vetting process for ships would be required to be introduced to ensure that they can accept a remote shutdown of discharge pumps.

As the discharge pumps now form part of the safety instrumented system, these would need to be maintained and proof tested in accordance with BS EN 61511, though this equipment is typically outside the control of the terminal.

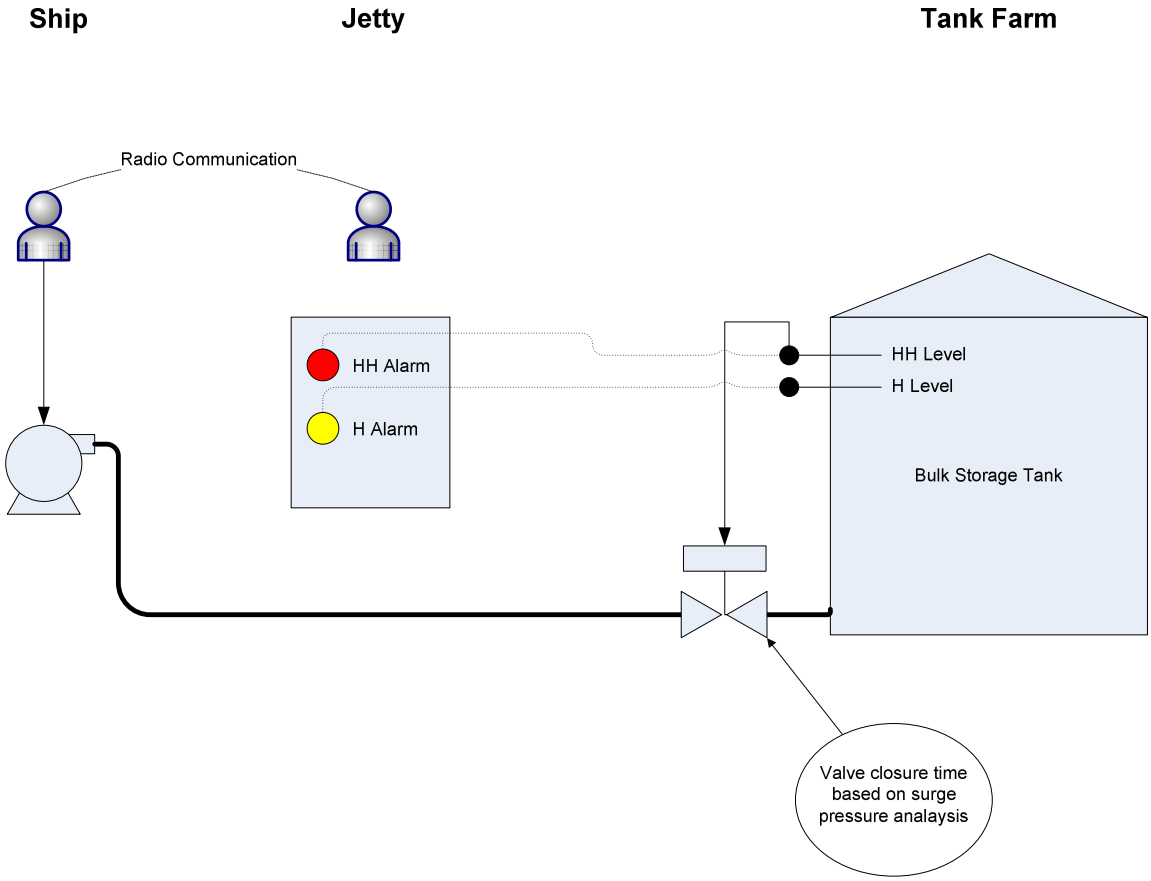
The cost of the installation, maintenance and compliance with BS EN61511 of the ship side discharge pump trip interface would need to be considered.

3. Conclusions

In conclusion, option 2.1.2 may be the most viable when designing an overfill protection system for a bulk storage tank fed from a ship.

This solution applies only to those tanks within the scope of the final PSLG report (as defined by paragraph 24).

The following diagram provides an overview of the architecture of the system.



Functionality

- High and High High Alarms repeated at the Jetty
- Tank side valve closure time calculated from worse-case surge pressure analysis

- Reference should be made to the final PSLG report, paragraphs 79 to 103 and to appendix 3, for guidance on defining tank capacity; this should take account of the time it takes for the tank side valve to close

- The guidance provided in Appendix 2 of the final PSLG report may be adopted when determining the risk of overflow from the atmospheric storage tank. Should an additional layer of protection be required, the Safety Instrumented Function (SIF) extends to the High High Level indicator and tank side valve only.

- On high level, jetty operator will request ship to stop transfer pumps, and manually initiate closure of the tank side valve

- On high high level, automatic shutdown of the tank side valve will be initiated. Jetty operator will request ship to stop transfer pumps

Further consideration

- There is no guarantee of the safety and integrity of onboard equipment such as pumps, piping and loading manifolds from the surge created by the shore line valve closure. This means ship owners will have to carry out separate specific surge analysis for various terminals and its receiving parameters based on onshore surge analysis and quoted inlet valve closing time. Consideration should be given to revising ship transfer procedures to inform the ship operator of the overfill protection measures in place, and a revision to charter terms to ensure that this assessment is done.

- Additional, alternative, communication mechanisms between the jetty and the ship should be considered in case of failure of radio communication system.

Note that whilst this option may be the most viable for some operators, it does not discount the other options available. Operators should assess their individual requirements, and employ the most effective and efficient solution.

References

The following table provides references to documentation used to develop this report.

Description	Reference
Safety and environmental standards for fuel storage sites – Process Safety Leadership Group final report	ISBN 978-0-7176-6386-6
Functional Safety – Safety Instrumented Systems for the Process Industry Sector	BS EN 61511

Abbreviations

Abbreviation	Description
LOPA	Layer of Protection Analysis
MIIB	Major Incident Investigation Board
PSLG	Process Safety Leadership Group
SIL	Safety Integrity Level
UKPIA	United Kingdom Petroleum Industry Association

Revision History

Rev.	Section	Description	Date	Changed By
0	All	First Issue	12-Apr-2010	PSD
0.1	All	Terminal Working Group Comments Incorporated	14-Apr-2010	PSD
0.2	2.1.4, 3	Updated with conclusions from Terminals Working Group	23-Jul-2010	PSD

Appendix 1 – Simple Selection Flowchart – Overfill Protection for Ship Fed Transfers