UK Petroleum Industry Association Ltd.

Report

Implementation of the PSLG LOPA Guidance

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Foreword

This report has been prepared following a meeting held by UKPIA member LOPA specialists on the 22nd February 2010, to ensure alignment in the interpretation of the guidance provided in appendix 2 of the final Process Safety Leadership Group (PSLG) report.

It is not the intention of this document to specify how LOPA should be completed, nor replace any existing corporate guidance. The intent of this document is to provide an overview of the outcomes from the UKPIA LOPA specialist meeting, providing information that may be of use to other members of the PSLG.

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1. It is understood that this report represents UKPIA's view of the application and interpretation of appendix 2 of the final PSLG report.
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1. Introduction

The Buncefield Major Incident Investigation Board (MIIB) recommendation 1 requires that the Competent Authority (CA) and operators of Buncefield-type sites should develop and agree a common methodology to determine safety integrity level (SIL) requirements for overfill prevention systems in line with the principles set out in Part 3 of BS EN 61511.

To address this recommendation, the PSLG commissioned a working group to develop guidance on the application of layer of protection analysis to the overflow of an atmospheric storage tank. This guidance can be found in appendix 2 of the final PSLG report

To ensure consistent interpretation of the LOPA guidance, UKPIA LOPA specialists met to discuss how the guidance should be interpreted and applied. The following sections provide an overview of the output of this meeting, though it should be noted that this is provided as supplementary clarification only, and does not replace the guidance contained in the final PSLG report.

Note: where paragraph numbers are provided in this report, these refer to the PSLG Final Report, Appendix 2.

2. Interpretation of LOPA Guidance

The base case for assessment should be based on the following:

- Night time situation, between the hours of 1600 and 0800 (Paragraph 131)
- Stable weather conditions (stability class E or F) (Paragraph 131)
- Low wind speed, less than 2 m/s (Paragraph 129)

Typically, these conditions may occur 5-15% of the time, but this should be confirmed using local weather data.

- Occupancy appropriate to this time window should be used (Paragraph 145)
- Occupancy outside night hours should be considered as a separate sensitivity. For example, a higher occupancy for 1 or 2 hours of the day, but separate to the base case if the consequence category is different (eg 11-50 fatalities compared to 2-10 fatalities), with a lower weather probability (Paragraph 145)

2.1 Consequence Assessment

Consequence assessment should be performed on the basis of the primary event (i.e. over-topping of a gasoline storage tank, leading to the formation of a flammable vapour cloud which is ignited and leads to an explosion).

- Zone A - The probability of fatality within this zone should be taken as ‘1’

- Zone B – Outside of the 250m zone there is very rapid decay in overpressure. Impacts within Zone B should be considered on a case by case basis, although people in open air are likely to survive. Occupied buildings within this zone should be reviewed in comparison to the potential overpressures (5-25 kPa)

- Explosion impact beyond 400m can be discounted (although sensitive populations should be considered).

2.2 Risk Tolerance Criteria

The emphasis for the LOPA should be on scenario based risk assessments (Paragraph 40)

- Table 8, 'Risk matrix for scenario based safety assessments' should be used as the standard

- The LOPA guidance provided is on the basis of a single scenario, i.e. over-topping of an in-scope gasoline tank

- Users should aim for the 'broadly acceptable' region, but should remember also that if a risk falls short of the 'broadly acceptable' region, it may still be tolerable if the risk is deemed to be ALARP with a supporting cost befit analysis

2.3 Initiating Events

Refer to paragraphs 61-68

- For a Basic Process Control System, this may be broken down into constituent parts, so long as the overall failure rates are consistent with the limits defined within BS EN 61511

- Human error and equipment failure should be clearly differentiated – i.e. differentiate between operator error and BPCS equipment failure as an initiating event

- Note that 'Time at Risk' is an enabling event, and is independent of equipment failure rates (Paragraph 57)

- When using analysis techniques such as HEART, challenge results that are unexpected – always perform a review to ensure that they have been completed correctly and pragmatically.

2.4 Protection Layers

Layers of protection should be effective, sufficiently independent and auditable, refer to paragraphs 79-80.

A definition of sufficient independence can be found in paragraph 90

2.5 Conditional Modifiers

CM1 – Probability of calm and stable weather (Paragraphs 128-131)

- Determines the base case for the LOPA, see section 2 above

CM2 – Probability of ignition of a large flammable cloud (Paragraphs 132-138)

- This is the probability of *delayed* ignition of a flammable cloud, allowing time for the vapour cloud to spread
- This should not be assumed to be ‘1’, it is also influenced by CM1 and CM2, refer to the simple event tree in Appendix 1.
- Typically, CM2 may be in the range of 0.3 to 0.8, however if there are no obvious ignition sources, it may be less than 0.3. Conversely, if there is a continuous ignition source (such as a fired heater), CM2 may be ‘1’
- It should be recognised that if a continuous ignition source is present within the 250m Zone A, for example at 150m, Zone A now has a radius of 150m (refer to section 2.1)

CM3 – Probability of explosion after ignition (Paragraphs 139-141)

- The probability of explosion is assumed to be ‘1’ given the precautionary principle, but consider the effects of CM1 and CM2, refer to the simple event tree in Appendix 1

CM4 – Probability that a person is present within the hazard zone (Paragraphs 142-145)

- The consequence assessment (refer to section 2.1) determined who could be affected if the explosion occurred, CM4 should be based on what the probability is of all of these people being present at the time of explosion.

CM5 – Probability of fatality (Paragraphs 146-147)

- Within Zone A, the probability of fatality is ‘1’, however, be aware of the affects of CM2 when determining the radius of Zone A.
- Within Zone B, the probability of fatality is likely to be ‘0’ for people in the open air, but could be anything up to 1 for people in buildings. Take care not to add this factor twice – either take this into account with the consequence assessment (refer to section 2.1), and do not use CM5, OR assess the vulnerability of people within occupied buildings by using CM5

CM6 – Probability of environmental consequence (Paragraph 148)

This is included to account for any further environmental factors. These however are generally addressed as part of secondary and tertiary containment measures and emergency preparedness.

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

Abbreviations

Abbreviation	Description
ALARP	As Low As Reasonably Practicable
BPCS	Basic Process Control System
CA	Competent Authority
HEART	Human Error Assessment and Reduction Technique
LOPA	Layer of Protection Analysis
MIIB	Major Incident Investigation Board
PSLG	Process Safety Leadership Group
UKPIA	United Kingdom Petroleum Industry Association

Revision History

Rev.	Section	Description	Date	Changed By
0	All	First Issue	25-Mar-2010	PSD
0.1	All	UKPIA Comments incorporated	26-Mar-2010	PSD

Appendix 1 – Simple Tank Overflow Event Tree