Hazard Identification and Risk Assessment in LPG Bottling Plant

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Abstract

Aim in this project is to analyze the risk associated in different sections which are being carried out in LPG bottling plant, during handling, bottling and distribution/or transportation, and to minimize the hazard in order to make the working environment and usage of LPG, safe.

Keywords: Risk Assessment, Risk Rating, Job Safety Analysis

I. INTRODUCTION

LPG bottling plant is the place where LPG is stored in a large quantity and distributes in small quantity to the, another places. In LPG bottling plant, there is the high probability of accidents during handling & storage, various hazards are faced during storage and transportation. As we know LPG is a highly flammable gas, so there are many possibilities of hazards, like explosion, fire, BLEVE (boiling liquid expanding vapour explosion), confined & unconfined vapour cloud explosions or during transportation, which may results in minor or major or fatality, due to this there is loss of man-power and money will also occur.

So a great concern is needed to minimize the occurrence of these hazards and for this purpose it is very necessary to analyze the risk associated in usage and handling of liquefied petroleum gas. In our project we are performing the hazard identification and risk assessment in order to make the work place safe, as workers and others have a right to be protected from harm caused by any kind of failure and also to take reasonable control measures which ever are necessary. For this purpose we will use various risk assessment methodologies by knowing hazards consequences and by analyzing all the processes which are being carried out during handling. Safety recommendation will be given on basis of all above analysis to reduce the hazard during the storage and handling of LPG.

II. METHODOLOGY

A. Hazard Identification:

This is the process of examining each work area and work task for the purpose of identifying all the hazards which are "inherent in the job.

Hazard Analysis A hazard analysis is used as the first step in a process used to assess risk. The result of a hazard analysis is the identification of different type of hazards. A hazard is a potential condition and exists or not (probability is 1 or 0). It may in single existence or in combination with other hazards (sometimes called events) and conditions become an actual Functional Failure or Accident (Mishap).

B. Risk Assessment:

Is defined as the process of assessing the risks associated with each of the hazards identified so the nature of the risk can be understood. This includes the nature of the harm that may result from the hazard, the severity of that harm and the likelihood of this occurring.

1) Identification of sources of hazards and their causes. It is qualitative, e.g. HAZOP. This step is known as "Hazard Identification".
2) Analysis of
- Mechanism of hazard occurrence and
- Terminal consequences of hazards.

This is quantitative e.g. HAZAN. Consequence analysis quantifies concentration, deaths injuries and damage. This step is known as "Hazard Analysis".

Risk R= probability x Severity

C. Job Safety Analysis:

Job safety analysis is an accident prevention technique that is used to identify the potential hazard associated to the job and give the control measure to minimize the hazards.
An analysis includes five steps:

1) Select a job.
2) Break the job down into steps.
3) Identify the potential hazards.
4) Apply the controls to the hazards.
5) Evaluate the controls.

Table – 1
Job Safety Analysis Worksheet Selected Failure Cases in LPG Bottling Plant

Sr.no.	*Failure case*	*Failure mode*	*Consequence*
1	*Horton sphere shell failure*	*Random failure*	*BLEVE Unconfined vapour cloud explosion*
2	*Full bore failure of LPG outlet line of Horton sphere*	*Random Failure*	*Dispersion ,unconfined Vapour cloud explosion, Blast effect, pool fire.*
3	*LPG pump discharge line full bore failure*	*Random Failure*	
4	*Road tanker failure Rail tanker failure*	*Random failure*	*BLEVE*
5	*LPG pump mechanical seal failure*	*Mech. Seal failure*	*Dispersion , UVCE*
6	*Gasket failure*	*Gasket Failure*	
7	*Filled cylinder failure*	*Random failure*	*BLEVE*

Table – 2
Major Hazard Present in LPG Bottling Plant

Sr. No.	*Hazards*	*Factors responsible for the occurrence*	*Controls*
1	*Explosion*	*Rapid oxidation or rapid burning.*	
2	*Fire*	*by any external source.*	*Automated hydrant system ,extinguisher*
3	*BLEVE (boiling liquid expanding vapour explosion)*	*occurs when LPG containers are accidentally surrounded by fire.*	*BLEVE can only be control by controlling the fire (initial start up of fire),sprinkler system, automated hydrant system .*
4	*Confined and unconfined vapour cloud explosion*	*Confined explosions are those, which occur within some sort of containment such as vessel or pipe-work. Explosions that occur in the open air are referred to as unconfined explosions.*	*For controlling unconfined vapour cloud explosion use proper ventilation ,GMS for vapour and gas detection ,*
5	*Gas leakage*	*Bursting of storage tank, or leakage of liquid LPG from bottom line ,or rupture of any cylinder.*	*Gas monitoring system, frisking gate, proper handling of cylinders during filling and transportation.*
6	*Carousel*	*Carousel failure during filling of cylinders.*	*Proper usage of carousel and continuous maintenance.*

Matrix method in risk assessment is a semi-quantified way of evaluation. Risk value is determined by estimating of the potential severity of hazardous event and the likelihood that it will occur. Risk value is formulated as:

$$R = P \times S$$

Where:
P = Likelihood of occurrence
S = Potential severity of harm

D. Categories for Likelihood of Harm:

Table – 3
Categories for Severity of Harm

Very likely	*4*
Likely	*3*
Unlikely	*2*
Very unlikely	*1*

Table - 4

Extremely harmful	*4*
Harmful	*3*
Slightly harmful	*2*
Very slightly harmful	*1*

Now
For Fire and Explosion

$R = 4 \times 3$

$= 12$

I.e. the risk level is unacceptable.

Table – 5
Risk Rating Criteria

Category of risk	*Evaluation of tolerability*
Very low (Level 1, 2, 3, 4)	*Acceptable (or Negligible)*
Low (Level 5, 6)	*Risks that should be reduced so that they are tolerable or acceptable (Unwanted)*
Medium (Level 8, 9)	*Risks that should be reduced so that they are tolerable or acceptable (Unwanted)*
High (Level 10, 12)	*Risks that should be reduced so that they are tolerable or acceptable (Unwanted)*
Very high (Level 15, 16,)	*Unacceptable*

Work: Filling of cylinders in carousel

$R = P \times S$

$= 4 \times 2$

$=8$

Similarly
For BLEVE and Leakage
Work: pipeline failure or vessel failure or rupture of any bullet

$R = 1 \times 4$

$= 4$

I.e. the risk level is acceptable.

III. CONCLUSION

Hazard Identification and Risk Assessment is a method, by which, we try to identify the main hazardous substance, and then try to reduce the effect of hazard. As we spotted the main risk during filling and transportation of LPG, so with the help of Risk Assessment, reduce the main hazards.. For this purpose we will use various risk assessment methodologies by knowing hazards consequences and by analyzing all the processes which are being carried out during handling. Safety recommendation has been, given on basis of all above analysis to reduce the hazard during the storage and handling of LPG. LPG Bottling facilities mainly pose fire and explosion hazards due to unwanted and accidental releases of hydrocarbons. This section deals with listing of various failure cases leading to various hazard scenarios, analysis of failure modes and consequence analysis. Consequence analysis is basically a quantitative study of the hazard due to various failure scenarios to determine the possible magnitude of damage effects and to determine the distances up to which the damage may be affected. The reason and purpose of consequence analysis are manifolds like:

1) For computation of risk.
2) For evaluating damage and protection of other plants.

3) To ascertain damage potential to public and evolve protection measures.
4) For preparation of effective emergency planning both ON-SITE and OFF-SITE.
5) For formulating safe design criteria of equipment and protection systems.

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