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HAZOP Study of Horton Sphere of LPG

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***Abstract*: Hazard and Operability Analysis (HAZOP) is a technique for risk management. There are many methods which can be used for identifying the risk in the plant and process. But this method is widely used in industry before installation of plant and machinery so that at the primary stage risk can be identified and subsequently issue can be resolved. The hazard and operability study (HAZOP) is a technique for identifying hazards and operating problems in a process plant.**

***Keywords*: hazard and operability analysis, refinery, hazard identification and risk analysis, code of practice.**

1. Introduction

In refinery as well as in petrochemical industry safety of the plants primarily relies on the application of various codes of practice or design, which are based upon the wide experience and knowledge of professional experts and specialists in the industry. This will be also supported by the experience of local plant managers, engineers and operators who have direct experience in the relevant plant operation. In all new projects, and in some cases modifications to existing plants, embody some element of change and the degree of change is often considerable.

In recent years it is evident that it is important to supplement these codes with an imaginative anticipation of the hazards that could arise. HAZOP is the technique developed to study the possibility and consequences of hazardous situations arising in the plant and process. Hazard and Operability Study (HAZOP) defined as: "The application of a formal systematic critical examination to the process and engineering intentions of new or modified facilities to assess the hazard potential or mal-operation or mal-function of individual items of equipment and the consequential effects on the facility as a whole". The technique helps to inspire the imagination of designers, engineers and operators in a systematic way so that they can identify the potential hazards in a new design or modification works.

For HAZOP studies multi-disciplinary team using a structured approach systematically examines all relevant parts of a design. During this examination procedure a full description of the process, systematically questions every part of it to discover how deviations from the design intent can occur and decides whether these deviations can give rise to hazards or operational/maintenance problems.

There are number of questions formulated around a number of guidewords/deviations. The guidewords/deviations are used to ensure that the questions will discover ways in which the process could deviate from the design intent. During this study some of the causes of a deviation may be unrealistic and derived consequences irrelevant, and would therefore not be considered further. However, there may be a deviation with both possible causes and potentially hazardous consequences. This HAZOP study identifies problem areas and does not seek engineering solutions.

2. Methodology

This study was conducted through a node by node review, i.e. the system was divided into discrete nodes and each node was numbered accordingly.

Table 1
Guide Word/Deviation used for HAZOP

Guide Word Code	No.
More Flow	01
Less / No Flow	02
Reverse Flow	03
Other Than Flow	04
High Pressure	05
Low Pressure	06
High Temperature	07
Low Temperature	08
High Level	09
Low Level	10
Composition	11
Startup / Shut down	12
Maintenance	13
Leakage/Rupture	14
Sampling	15
Corrosion / Erosion	16
Drawing Error	17

3. HAZOP Worksheet

By following the above-mentioned methodology, HAZOP worksheets have been developed for important nodes during HAZOP sessions. The HAZOP worksheets are given in below table.

Node 3: LPG Sphere
Intention: Storage of LPG in Sphere — *Parameter : Level*

Sl.No	Guideword	Deviation	Possible Cause	Consequence	Action Required
1	Low	Low Level	Leakage from bottom line. Leakage from valve. Leakage from drain line. Less LPG in the Sphere.	Release of LPG Fire and explosion hazards. Operation delay.	Level Indicator provided For corrosion protection. Sphere is painted regularly. Regular inspection and maintenance to maintain integrity of bullets and piping.
2	High	High Level	Initial quantities in Sphere not ascertained faulty Level Indicator. Human Error in Reading of Level Indicator.	Over filling of LPG in Sphere. LPG Release. Possibility fire and explosion.	High Level Alarm (HLA) provided Level indicator provided. Ensure proper operating procedures. Calibration and maintenance of level indicator.

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Node 3: LPG Sphere					
Intention: Storage of LPG in Sphere					*Parameter : Pressure*
Sl.No	**Guideword**	**Deviation**	**Possible Cause**	**Consequence**	**Action Required**
1	Low	Low Pressure	Low Ambient Temperature.		
2	High	High Pressure	Due to heat isolation by sun Fire near Sphere.	Possibility of release of LPG. Possibility fire and explosion.	Pressure indicator provided. Temperature indicator provided. Two Safety Release Valves (SRV) provided at the Sphere.

Node 3: LPG Sphere					
Intention: Storage of LPG in Sphere					*Parameter : Temperature*
Sl.No	**Guideword**	**Deviation**	**Possible Cause**	**Consequence**	**Action Required**
1	Low	Low Temperature	Low Ambient Temperature		
2	High	High Temperature	Due to heat isolation by sun. Fire near Sphere.	Possibility of release of LPG Possibility fire and explosion	Pressure Indicator provided. Temperature Indicator provided. Two Safety Release Valves (SRV) provided at the bullet. Sprinkler System Provided. Fire Fighting Facilities are available as per OISD.

Node 3: LPG Sphere					
Intention: Storage of LPG in Sphere					*Parameter : Water Draining*
Sl.No	**Guideword**	**Deviation**	**Possible Cause**	**Consequence**	**Action Required**
	Other Than	Other Than Water	Operational Error	Possibility of release of LPG Possibility fire and explosion.	Water draining to be done under strict supervision. Written instruction on water draining mechanism to be displayed near drain point.

4. General Recommendations and Conclusion

- Need to conduct scheduled inspection and testing of Pressure Gauge, Safety Relief Valve (SRV) of compressor, Horton Sphere to be carried out.
- Need to conduct inspection and maintenance schedule for EFCVs and ROVs which is to be strictly followed.
- Need periodic maintenance of Roto gauge to be carried out.

References

[1] Hazard Identification and Risk Analysis-Code of Practice: IS 15656:2006.
[2] HAZOP Guide to Best Practice by EPSC.
[3] P&IDs of Horton sphere of LPG.