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HAZOP for Propylene Recovery Plant at HOC Ambalamugal

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ABSTRACT

Primarily, safety in the design of chemical plants relies on the application of various codes of practice or design codes which are based on the wide experience and knowledge of professional experts and specialists in the industry. Such application is backed up by the experience of local plant managers and engineers who have been involved in similar plants and who have had direct experience in their operation. All new projects embody some element of change but in the chemical industry the degree of change from one plant to the next is often considerable. It-is important to recognize that the body of established experience expressed in codes, etc is limited by the extent of existing knowledge and can only be relevant to the extent to which it is possible to apply it to new products, new plants and new methods of operation involved in the new design. It has become increasingly clear in recent years that although codes of practice are extremely valuable, it is particularly important to supplement them with an imaginative anticipation of hazards when new projects involve new technology.

This study is intended to carry out HAZOP study of Propylene Recovery Unit in accordance with BS: 61882 & EPSC-HAZOP. The purpose of this report is to identify deviations from the design intent, identify potential hazards and operability problems associated with the deviations; and to recommend ways to mitigate the identified problems or to identify areas that need to be further investigated.

1. Introduction

The technique originated in the Heavy Organic Chemicals Division of ICI, which was then a major British and international chemical company. The history has been described by Trevor Kletz who was the company's safety advisor from 1968 to 1982, from which the following is abstracted.

In 1963 a team of 3 people met for 3 days a week for 4 months to study the design of a new phenol plant. They started with a technique called *critical examination* which asked for alternatives, but changed this to look for deviations. The method was further refined within the company, under the name *operability studies*, and became the third stage of its hazard analysis procedure (the first two being done at the conceptual and specification stages) when the first detailed design was produced.

In 1974 a one-week safety course including this procedure was offered by the Institution of Chemical Engineers (IChemE) at Teesside Polytechnic. Coming shortly after the Flixborough disaster, the course was fully booked, as were ones in the next few years. In the same year the first

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paper in the open literature was also published. In 1977 the Chemical Industries Association published a guide. Up to this time the term HAZOP had not been used in formal publications. The first to do this was Kletz in 1983, with what were essentially the course notes (revised and updated) from the IChemE courses. By this time, hazard and operability studies had become an expected part of chemical engineering degree courses in the UK.

Hazard and Operability Analysis (HAZOP) is a structured and systematic technique for system examination and risk management. In particular, HAZOP is often used as a technique for identifying potential hazards in a system and identifying operability problems likely to lead to nonconforming products. HAZOP is based on a theory that assumes risk events are caused by deviations from design or operating intentions. Identification of such deviations is facilitated by using sets of "guide words" as a systematic list of deviation perspectives. This approach is a unique feature of the HAZOP methodology that helps stimulate the imagination of team members when exploring potential deviations.

As a risk assessment tool, HAZOP is often described as:

- A brainstorming technique
- A qualitative risk assessment tool
- An inductive risk assessment tool, meaning that it is a "bottom-up" risk identification approach, where success relies on the ability of subject matter experts (SMEs) to predict deviations based on past experiences and general subject matter expertise.

The ICHQ9 Guideline, *Quality Risk Management* endorses the use of HAZOP (amongst other allowable tools) for pharmaceutical quality risk management. In addition to its utility in Quality Risk Management, HAZOP is also commonly used in risk assessments for industrial and environmental health and safety applications. Additional details on the HAZOP methodology may be found within IEC International Standard 61882, *Hazard and Operability Studies (HAZOP) Application Guide*.

This document presents some guiding principles in the execution of HAZOP analyses. Successful application of any risk management model requires that tools are used in concert with the overall quality risk management process. This guide will present the principles of HAZOP in the context of the accepted Quality Risk Management process consisting of Risk Assessment, Risk Control, Risk Review and Communication and is intended to compliment (not replace or repeat) the guidance available within IEC International Standard 61882.

2. Materials and Methods

Hindustan Organic Chemicals Limited (HOCL) was set up by the Government of India in 1960 with the objective of attaining self –reliance in basic organic chemicals needs. In fact this was the first endeavour to dependence on import of vital organic chemicals. HOC, started as small chemical unit, has today acquires the status of a multiunit company with two fast growing units and one subsidiary unit. HOCL, Kochi Unit situated at Ambalamugal, 15kms away from Ernakulam city was commissioned in the year 1987 to manufacture Phenol and Acetone. The installed capacity is 40,000 TPA of Phenol and 24640 TPA of Acetone. A new project was commissioned in the year 1997 to manufacture Hydrogen Peroxide with an installed capacity of 5225 TPA.

Myself, Ragesh.A.R with the help of employees of various departments of HOC has been engaged by HOC for carryout HAZOP of propylene recovery unit .the present HAZOP study report is based on the design information and suitable conservative assumptions.

Propylene recovery Plant is designed to produce Lean Propylene of 75%purity suitable for the production of Cumene Lean Propylene: 21840 TPA (100% Basis). The Propylene recovery plant is designed to recover Propylene from the cracked LPG received from BPCL. The cracked LPG is a mixture of Propane, Propylene, Butane, Isobutene and Butylenes. The plant is designed to produce to Propylene by fractionation (lean propylene of 75% purity minimum). The process scheme consists of a fractionating column with the auxiliaries and equipment.

This study is conducted through a node-by-node review, i.e. the system was divided into discrete nodes and each node was numbered accordingly. The method involved several repetitive steps:

i. Identify a node of the process on the P&IDs.
ii. Define the design intent and normal operating conditions of the node.
iii. Identify a deviation from the intent or operating condition by applying guidewords based on the BS-IES 61882 list of guide-words.
iv. Identify possible causes and consequences of the deviation. A deviation can be considered meaningful if it has a credible cause and can result in harmful consequences.
v. Identify safeguards, if any

Identify recommendations and action parties if no safeguard is provided or safeguard are insufficient..

The HAZOP analysis process is executed in four phases as illustrated below:, see Fig. 1.

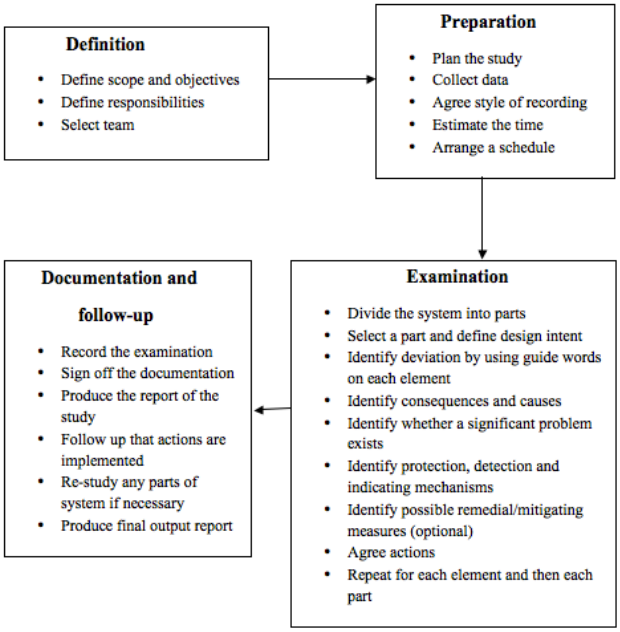

Fig. 1 – The HAZOP analysis process.

Guide Words used in the Study:

a. More
b. Less
c. Less
d. Reverse
e. Other than
f. High
g. Low
h. Composition
i. Leakage
j. Corrosion

3. Results and Discussions

The Hazard and Operability study is carried out to identify the hazards and operability problems. In addition, recommendations in the process facilities to reduce the probability and consequences of an incident are provided.

Table 1 - Recommendations.

S.No.	Ref. No.	Recommendation	Action By
1	N1.02.2.1.1.1	Consider Low Pressure alarm on receipt pipeline	HOCL
2	N1.03.1.1.1.1 N2.05.3.1.1.1 N3.05.1.1.1.1	DMP needs to be updated, approved and implemented	HOCL
3	N1.09.2.1.1.1	Cathodic protection on receipt pipeline	HOCL
4	N2.02.2.1.1.1	Consider flow gauge in propylene transfer line.	HOCL
5	N2.09.1.1.1.1	Consider high level alarm on propylene storage bullet	HOCL

Table 2 - Model HAZOP Sheet.

Project: HOCL propylene recovery unit					**Session date: 24 February 2013**			
Section description: LPG storage facility& receipt pipeline to splitter.					**Node no:1**			
Design intension: to receive LPG from storage sphere to splitter					**Revision no: 0**			
Drawing no: 1					**Revision date:**			
Ref no.	**Parameter**	**Guide word**	**Deviation**	**Cause**	**Consequence**	**Safeguards**	**Recommendation**	**Action by**
N1.01	Flow	More		NFH				
N1.02		Less/no	No flow in the line	1.pump101 trip	1.1 process delay	1.1.1 flow gauge 1.1.2 manned operation		
				2.leakage	2.1 loss of containment	2.1.1 flow gauge 2.1.2 manned operation	2.1.1.1 consider low pressure alarm on receipt pipeline	HOCL
N1.03	Pressure	High	Increased pressure in the pipeline	1.external fire	1.1 possible damage to equipment/piping	1.1.1 fire suppression system 1.1.2 ESD 1.1.3 manned operation	1.1.1.1 DMP needs to be updated, approved and implemented	HOCL
N1.04		Low	Decreased pressure in the pipeline.	Refer less/no flow cause 1&2.				
N1.05	Temperature	High	High temperature in the pipeline.	Refer to high-pressure cause1.				
N1.06		Low		NFH				

4. Conclusion

HAZOP is a very useful term in any industry, which helps in finding out deviation from the intent and consequences. HAZOP is based on design information and assumptions. HOCL works on the model of HAZOP. HOCL was setup by government whose intention is to maintain the functioning of plant and avoid probability of accidents. HOCL works step by step and take proper action according to guideword provided by BS-IES 62882. Every chemical industry must follow these guidelines for safe working condition and process facilities and prepare HAZOP model for safeguards. ICHQ9 guidelines provide quality risk management for HAZOP in industry. This help in regulating the risk assessment, risk control, risk review and communication, which comes under the IEC international standard 61882.

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