

Hazard Identification of Chemical Process Industry through HAZOP Study

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Abstract: Hazard and Operability (HAZOP) techniques the best step for identification and analyzing the hazard and operational issues of the system. It is very organized, methodical and structured process to identify hazards of any system or process from the initiating stage till decommissioning of the project. Technology and system possess exposure to undesired events because system can fail or improper work resulting in injury, damage and deaths. Our lives are dealing with a web of different systems, each of which can affect our safety. Each of these systems contains inherent hazard that present unique risk. The major concerned is about eliminating and reducing risk which leads to undesired events. The overall methodology like Failure Mode Effective Analysis, Fault Tree Analysis, Event Tree Analysis, HAZOP, Checklist, inspection, Audit, and What if Analysis presented in this dissertation allows systematic identification of hazards as well as quantification of the risks associated with the operation of chemical process plants. This aids the selection and prioritization of necessary strategies for accident prevention, reduction and limiting their consequences. This dissertation can be used for improving plant safety performance as well as to reduce human and property losses. The result of Hazard identification helps to suggest the control measures in order to prevent deviation and to avoid the consequences. HAZOP technique provides clear and detailed analysis of hazard associated with the process and results are easy to understand.

Keywords: Hazard identification, Fault Tree Analysis, Event Tree Analysis, Checklist

I. INTRODUCTION

HAZOP technique plays a dominant role in chemical process industry in order to carry out hazard analysis. It is one of the tools generally using for hazard identification for any process. Chemical Industry consists of such scenarios that would lead to the release of flammable or hazardous material into the atmosphere, thus exposing workers to injury or severe effects. In order to make this determination team needs to investigate all such scenarios whose consequences result in such hazardous condition. So basically HAZOP results with two main outcomes as First, determines the conceivable ways in which design intent gets deviated and Second, by considering each deviation what all possible consequences can occur and how much severe they can be.

1.1 Basic Concept of Hazard Operability Study

“An ounce of prevention is worth a pound of cure.” As this old saying goes, safety should be an important element in every industry. Safety covers hazard identification, risk assessment and accident prevention. Safety should always come first and remain so despite of costs. Good design and forethought can often bring increased safety at less cost.

Operators of volatile plants must implement measures to ensure that their plants are operated and maintained in a safe manner. In the chemical process industry there are chances of a number of potential hazards. A hazard has the potential of causing an injury or damage to the plant as well as the working members. Raw material and intermediate toxicity and reactivity, energy release from chemical reactions, high temperatures, high pressures, quantity of material used etc. are some of the hazards that can cause damage in a chemical industry pla.

1.2 Objective

- To identify all deviations from the way the design intended to work, their causes and all the hazards and operability problems associated with these deviations.
- To decide whether action is required to control the hazard or the operability problem, and if so, to identify the

ways in which the problems can be solved

- To identify cases where a decision cannot be taken immediately and to decide on what information or action is required.
- To recommend ways to mitigate the identified problems or to identify areas that need to be further investigated.
- The technique aims to stimulate the imagination of designers, engineers and operators in a systematic way so that can identify the potential hazards in a new design or modification works.

1.3 Scope

The purpose of this dissertation is to provide a structure and direction that will be applied for conducting HAZOP study. HAZOP study shall be review of design to determine the consequences of deviation from design intent. This process covers formal, systematic, critical examination of the process operability and engineering intention of facility.

1.4 Outcome

- To educate the people or employee or occupants about the importance of process safety how it can contribute to enhance the productivity.
- Will be able to know how process are safe and estimation of existing risk and process risk to assess the existing control system.
- Will be able to know the possible emergency arising from the process operation.
- Will be able to know the chemicals (Liquid/Gas/Solid) which are potential to cause human injury, property loss or other environmental issues.
- To know about the process safety deviation how it is dangerous to manufacturing plant since there are numerous flammable liquids and combustibles dusts are handled.
- To provide other preventive measure to bring down the risk into the acceptable level.
- Review the existing control measure to prevent catastrophic event.

II. ELEMENTS OF CHEMICAL PLANT

Following below elements of chemical plant which works together to make the desired product.

1. Material- Chemical, MSDS, Label
2. Machine-Reactor, Centrifugal, Storage Tanks
3. System-OHSMS, SOP
4. Personnel- PPE, Training

III. METHODOLOGY ADOPTED

A HAZOP Hazard and operability study is a structured and systematic examination of a planned or existing process or operation in order to identify and evaluate problems that may represent risks to personnel or equipment or prevent efficient operation. Before starting of any HAZOP following below requirement should be fulfilled on or prescribed timeline.



Figure 3.1 HAZOP Planning and Execution

3.1 HAZOP Team

1. HAZOP Leader (Respective area Manager or Manager of user department)
2. Engineering team (Mechanical Engineer, Electrical Engineer, Civil Engineer, Instrument Engineer, Project Engineer, Designer, Process development representative)
3. Facility team (Operating Persons, Area officer or executive, Area in-charge or Sr. Executive, Safety coordinator etc.
4. A EHS representative will be added to the team as and when needed to be determined by the leader of the HAZOP study.

3.2 HAZOP Documents

1. List of all chemicals and their MSDS- MSDS of all chemical must be produced at the time of HAZOP session. If any intermediate and API which has no sufficient data for MSDS. The safety information can be obtained from the supplier or PD lab or R&D.
2. List of all process equipment and its P&ID- All equipment which shall be a part of HAZOP process or shall be used for processing, its updated or latest P&ID shall be produced during HAZOP session for better clarity and proper discussion on each section nodes.
3. Process Flow Diagram- Process flow diagram can be obtained from BMR Batch Manufacturing Record or Manufacturing process record or Production Record. Process flow diagram shall contains all the process information includes Chemical name, Process Parameter, Process sequence or unit of operation sequence etc.
4. Critical process parameter list- All the critical process parameter list shall be produced and relevant information must be available at the time of HAZOP
5. Process Safety Related Data- Process safety related data plays significant roles while performing the HAZOP study. It improves the quality of HAZOP. When adequate process safety related information like ARC data, Thermal screening data, Powder processing data (Flammability or explosion data) are available during HAZOP, then appropriate decision shall be taken while discussion.

3.3 HAZOP Discussion

Following below typical HAZOP process is generally utilized for performing of HAZOP in chemical industry. This typical HAZOP process is actual methodology as per BS IEC-61882 for performing of HAZOP.

1. Typical HAZOP Process Methodology
2. List of Process Parameter
3. List of Guide Word
4. Combination of Parameter
5. HAZOP Worksheet

IV. ANALYSIS

4.1 Hazard Operability Study

A Hazard Operability study has been under taken for Mumbai Plant of Droft Ketol. HAZOP study has been performed for manufacturing of specialty chemical MTP (4- methyl-2-(2,2,2-trifluoro-1,1,1-dimethyl-ethyl)-pyridine) which is used to make Active Pharmaceutical Ingredient. Based on the above methodology HAZOP study report is as follows:

4.2 HAZOP Team & Document

Step-01- HAZOP Team:

Following below team members were present to perform HAZOP study on MTP batch.

- 4.2.1 Deputy General Manager Production - HAZOP Leader
- 4.2.2 Sr. Manger R&D - HAZOP Secretary
- 4.2.3 Manager- Mechanical & Civil
- 4.2.4 Manager- Instrumentation
- 4.2.5 Manager- Process Engineering

- 4.2.6 Manger- Technology Transfer Department
- 4.2.7 Assistant Manager- Production
- 4.2.8 Executive –Production
- 4.2.9 Manger- Safety Department
- 4.2.10 Executive Production- Safety Coordinator

Step-02- HAZOP Document:

List of all chemicals and their MSDS- Chemicals which shall be used for manufacturing of MTP Product are as follows along with their hazardous properties. Only three types of chemicals are used for manufacturing of MTP product. MSDS is easily accessible in public domain here only hazardous properties, list of PPE and its antidote are shown to perform HAZOP.

List of Chemicals

Sr. No.	MaterialName	MSDS	Hazard Identification /Pictogram
01	Methanol	Available	   Flammable, CMR, Irritant
02	AnhydrousHydrogen Fluoride(AHF)	Available	  Toxic, Corrosive
03	MTP-Stage-01	Available	 Irritant

List of Chemicals & its PPE

Sr. No.	Chemical Name	Hand Protection	Respiratory protection	Safety Shoes	Body Protection
01	Methanol	Nitrile handgloves	Full faceRespirator	SafetyShoes	Apron
02	AnhydrousHydrogen Fluoride(AHF)	Neoprene/ Natural Rubber hand-gloves elbowend with inner surgical gloves.		Gumboot	Full Air Pressure Suit
03	MTP-Stage-01	Nitrile handgloves	Full faceRespirator	SafetyShoes	Apron

V. CONCLUSION

This dissertation presents useful information about performing of Hazard Operability Study for Chemical Industry. This dissertation is guidance document and gives direction how to perform HAZOP in a systematic manner how team is formed for HAZOP, which type of documents are essential or mandatory to perform HAZOP study, templates of HAZOP study etc. HAZOP study plays a vital roles in chemical or pharmaceutical company. It is one kind of accident preventive and accident investigation technique. This is the only single technique where group of people gather at one place and perform brain storming on a single process or nodes, allow them to thing beyond the circumstances or positive notes , emphasis to focuses how process can go wrong If one parameter deviates from their usual path. This dissertation systematically examined and quantitatively assessed HAZOP study for various process operation. In this dissertation is has been assessed that how process hazard analysis assessment is very necessary before starting of any new product or modification of process or plant. . This report will help to the organization and similar Chemical industry and API pharma organization to assess process safety hazard and preventive measure

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