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Risk Management Techniques HAZOP & HAZID Study

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ABSTRACT

Risk assessment and management techniques are used in industrial activities to reduce accidents by applying preventive and protective methods. In this article a preventive approach called Hazard and Operability Study (HAZOP) and Hazard Identification (HAZID) was used. The application of HAZOP, a process hazard identification and control method, has been demonstrated in the Effluent Treatment Plant (ETP).

The aim of the HAZID is to provide input to the subsequent risk analysis to be conducted as part of the Environment, Health & Safety at Effluent Treatment Plant (ETP). The HAZID session is a small contribution to the overall aim of the project, through being the initial step in the safety analysis. The value added of the HAZID work (Step 1) is that it facilitates a more focused risk analysis (Step 2) through providing an understanding of the existing hazards. The HAZID report also provides a valuable input to the risk-based design process to be conducted in Effluent Treatment Plant (ETP). Recommendations are made on the basis of the findings to improve the installation and make it better and more safe place to work. Attempt has been made to carry out HAZID and HAZOP study thoroughly through the Effluent Treatment Plant (ETP) and recommendations were given to make the plant more safe place to work.

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1. Introduction

Risk is basically defined as the combination of the probability of an event and its consequences. The management of risk recognizes and deals with the threats to an organization or person, the vulnerability being carried and the likelihood that the threat will meet the vulnerability, causing damage. These words effectively illustrate the nature of risk.

Risk is an integral aspect of everyday life and a natural ingredient to any activity. Different people, different organizations, different cultures have dramatically varying views on the level of risk which they can tolerate. Basically, there are two kinds of people with regard to risk tolerance, one that are risk takers and others are risk averse.

Risk Takers are those who love to take risk; they enjoy taking risk, as they consider risk as challenge for them. Risk averse are those people who avoid risk, they are reluctant to take any type of risk. They strongly oppose and dislike risk. Those people, who fit into the wide gap between the two extremes, bring their own personalities into businesses and organizations.

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Hazard Identification Study (HAZID)

The Hazard Identification Study (HAZID) is a process that breaks a project down into component parts for detailed analysis. This analysis helps identify hazards that could cause injury to personnel, asset damage or loss, environmental damage, loss of production, or liability/litigation.

The HAZID process can be based on the client's hazard control hierarchy or based on one provided by consultancy firms. Hazards require some form of control in order to mitigate risks. Using this tool during early phases of the project may provide key information that determines whether the project is feasible.

Hazard and Operability Study (HAZOP)

Hazard and Operability Study (HAZOP) helps identify and evaluate problems that may represent risks to personnel, equipment or project efficiency. Multi-disciplinary teams focus on specific elements (or nodes) of the project design during a series of workshops.

For each node, the team examines process parameters and guide words to methodically ensure that the process is explored in every possible way. The best time to conduct a HAZOP is when the design is fairly firm. That's when it is defined well enough to allow meaningful answers to questions raised in the process, but can still be changed without major cost.

2. Materials and Methods

Methods of HAZID

Multi disciplinary team performs the HAZID: personnel from owner, staff from the installation and the study chairman and scribe from consulting team to ensure that the HAZID review was comprehensive. The agreed action items were recorded on the HAZID worksheets.

The various drawings and support documents were referred to as appropriate. The study progressed through the following steps:

- The design intent and normal operating conditions of the area;
- Identify possible causes and consequences of the hazard. A hazard can be considered "meaningful" if it has a credible cause and can result in harmful consequences;
- Identify any existing safeguards, mitigations and control measures included in the design;
- Carry out a ranking of the hazards based on its safety or environmental impacts; and
- Identify recommendations and action parties if further mitigation is required.

In keeping with the purpose of the study and referring to the HAZID procedure, Chilworth Technology Pvt Ltd. (CTPL) developed a number of guidewords that were used in the HAZID workshop to initiate discussion within the HAZID team. The guidewords used in this study are summarised in Table 1.

Table 1 - Guidewords used for the HAZID Study.

S.No	Hazard Guideword
1	Un-ignited HC Release
2	Ignition of uncontrolled HC Release – Fire
3	Ignited HC Release – Explosion
4	Toxic exposure
5	High Pressure
6	High / Low temperature
7	Dropped Object
8	Maintenance
9	Confined Space (entry into tanks / vessels for inspection & maintenance)
10	Hazards due to improper Access / Egress / Escape / Evacuation.
11	Extreme weather
12	Radioactivity
13	Explosives
14	Sabotage / Piracy / Acts or Terrorism / Theft.
15	Electrical Hazards / HAC
16	Effluent disposal
17	Others

HAZOP 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.

The method involved several repetitive steps:

1. Identify a node of the process on the Piping & Instrumentation Diagrams.
2. Define the design intent and normal operating conditions of the node.
3. Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 list of

guidewords.

4. 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.
5. Identify safeguards, if any.
6. Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

In practice the guidewords/deviations are set down in a standard list of questions relevant to the systems under review.

The following guidewords/deviations were used in this study:

Table 1 - Guidewords / Deviations used for HAZOP Study.

S.No	Guide-word Code
1	More Flow
2	Less / No Flow
3	Reverse Flow
4	Other Than Flow
5	High Pressure
6	Low Pressure
7	High Temperature
8	Low Temperature
9	High Level
10	Low Level
11	Composition
12	Start-up / Shut-down
13	Maintenance
14	Corrosion / Erosion
15	Drawing Issues

Other relevant deviations were discussed and used wherever applicable. If a condition is found whereby a specific deviation or event could occur and give rise to a significant consequence, it was noted on the HAZOP study worksheets. Guide-words covering every parameter relevant to the system under review:

Physical properties

- Temperature
- Flow rate
- Pressure
- Reaction rate
- Viscosity
- Quality

The HAZOP facilitator duties: Review of design drawings prior to attending the HAZOP; Lead and documented the HAZOP sessions.

3. Result & Discussion

Many risks probabilities occur in any project. Risk analysis assessment plays a vital role to reduce the hazard, accidents, or incidents in any project. Risk analysis may be used right from construction, operation, generation, and disposal to scrapping obsolete plant and vacating a site. Risk analysis includes hazard identification, risk assessment, risk management and risk communication. Hazard identification is the first step in risk analysis. Risks analysis involves:

- The identification of risks, however they may arise, and whoever they may affect;
- The assessment of the risks, as to their probabilities of occurring, and the impact they would have if they did occur;
- The investigation for the scope of reducing the risk.
- The examine of mitigation of the risk whether it is possible.
- To allocate such the risks between the main project parties.

The approach to dealing with risk depends on the nature of the risk. One would expect high probability, low impact risks to be managed actively on a day-to-day basis. On the other hand, low probability, high impact risks are usually insured. Any risk which has both a high probability and a high impact must be reduced. Refer table below:

Table 3 - Probability.

	PROBABILITY		
IMPACT	Low	Medium	High
Low	Ignore	Accept	Manage
Medium	Accept	Share	Transfer
High	Insure	Transfer	Reduce & Mitigate

Each accident event has been assessed to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as 'low', 'medium' or 'high'.

A total of twenty (20) hazards were identified in the HAZID session of Effluent treatment Plant. Out of the twenty (20) hazards, seventeen (17) was classified as low risk hazard, three (3) as medium risk hazard. None of the hazards were classified as High-risk hazard in the HAZID session of Effluent treatment Plant.

A total of six (6) hazards were identified in the HAZID session of Pipelines connecting to Effluent treatment Plant. All these six (6) hazards were classified as low risk hazard. None of the hazards were classified as

High & Medium risk hazard in the HAZID session of Pipelines connecting to Effluent treatment Plant

Hence, in the whole HAZID session of this project, a total of twenty six (26) hazards were identified. Out of twenty six (26) hazards, twenty three (23) were identified as low risk hazard, three (3) as medium risk hazard. None of the hazards were classified as High-risk hazard in the HAZID session.

A total of ten (10) independent recommendations were proposed during the HAZOP sessions and they were recorded on the HAZOP worksheets. These recommendations fall under the scope of action team. The facility under consideration was divided in the following nodes, which is logical system, based on the process and the operating conditions.

4. Conclusion

It has been a common practice nowadays, that plants have started adopting stringent safety measures owing to the pressurizing norms by the Government. Though these have led to downward pressure on the margins, Companies have started taking it seriously considering the socio-economic factors on the production and employer-employee relationship issue.

The objectives of the HAZID procedure are to identify main hazards, to review the effectiveness of selected safety measures and, where required, to expand the safety measures in order to achieve a tolerable residual risk. In compliance with the Seveso II Directive, besides facility safety concepts for new installations, also safety concepts for existing operational facilities have to be reviewed. The analysis serves the operator as proof that installations are operated such that hazards for employees, third parties, the environment and the surroundings can largely be excluded. The operator's management gets an up-to-date picture of the present hazards and their possible effects. By means of the HAZID analysis the primary process, but also non-process, hazards as well as their possible escalations can be identified due to the structured manner of the procedure. Employees can be advised of the relevant hazards concerning their working area. At the same time the outcomes can be taken as a support in compiling the required neighbour hood information. The facility designer considers the analysis results to improve safety concepts for new-built installations.

A unique benchmarking system was devised to measure & compare its safety standards & measures with standards prescribed. HAZOP system helps the companies to identify deviations from the design intent, to 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. The process of using HAZOP is contributing significantly to the betterment of the company working processes and better sustainable environment recommendations.

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