A Silent Saviour from Process Incident

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Abstract

Industry has regularly seen serious disasters impacting society, property and environment. Detail analysis and investigation shows systemic failures and many of them are due to inadequate inputs in the form of Process Safety Information (PSI). In the recent reviews of Process Safety Management (PSM) programs by OSHA (“the agency”), it has been confirmed that Process Safety Information (PSI) is the second most cited element. Reality check across the industry reinforces the fact that PSI is frequently overlooked and its role as saviour is normally ignored.

Inadequate PSI is due to multiple reasons like, technology suppliers not sharing complete information, uncontrolled changes in plant without modification of PSI, changes in plant ownership & loss of information during transition, poor control over PSI documents and so on. For old technology plants, issue is even more complex since regulations change over time. On the other hand, focus of the top leadership is often more on the completion of risk assessment without checking the adequacy and / or comprehensiveness of PSI.

PSI impacts all elements of process safety management system (PSM). In the absence of PSI, other elements of PSM continue to remain erroneous. In this situation, huge efforts in risk recognition, operating procedures development and training will continue to be ineffective. Such gaps in systems will cause failure of one or other component of management system and especially PSM, resulting in a process safety incident.

This paper focuses on the identification of causes for inadequacy of PSI and its impact on other PSM elements. Paper suggests various approaches to ensure PSI is adequate, maintaining PSI over the life-cycle of facility and mechanism to ensure proper understanding of PSI by leadership and its role as silent savior.

Introduction

Companies normally invest heavily to complete risk assessment studies and tend to assume that risk is under control. During the risk assessment studies viz Process Hazard Analysis, frequently we come across the issue of unavailability of updated
information such as piping & instrumentation diagram, safe operating conditions, safety valve sizing details and so on. This is one of the common issues faced by many companies across the industry. It raises the question that “In the absence of adequate process safety information (PSI), what will be the quality of risk assessment and how effective is risk management?”

In first place, why this question needs to be answered? Regularly industry has seen loss of containment of hazardous materials resulting in incidents impacting human life, property and environment. If the above questions are not answered, erroneous risk assessment studies will be the outcome leading to identification of inadequate prevention and mitigation measures i.e. ineffective process safety management system, causing disasters.

Study of disastrous incidents indicates issue of lack of understanding of process safety information. Take example of Chernobyl incident where issue of lack of understanding of process, rod insertion rate and so on resulted into operating procedure violation and critical interlock bypass which contributed substantially to disaster. Bhopal India incident indicated that hazards of material were not properly understood resulting into slack maintenance procedure causing water seepage into MIC tank and violent exothermic reaction and release of toxic MIC. Also during this incident due to lack of understanding of process design basis multiple safety mitigation systems were bypassed and not maintained. These systems could have avoided release of any toxic gas. In 2007 at Florida MCMT production facility runaway reaction resulted into explosion causing four fatalities and total destruction of facility. At this facility scale-up of

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reactor was done from 1lt to 2500 gallons and further reactor capacity was increased by 30% without any consideration for effective cooling. It clearly indicated lack of understanding of reactive chemistry under design and abnormal condition due to lack of understanding of process design basis and equipment design basis.

Recent reviews of PSM programs by OSHA ("the agency") has revealed that two of the most cited elements in agency audits are Mechanical Integrity and Process Safety Information (see chart below, from Federal OSHA's Refinery National Emphasis Program (NEP) Report, Attachment “A”, which is the result of the first year of citations)

![Figure 2: Results of OSHA studies](chart.png)

Detail study of incidents, the agency' citation records and reality check across the industry clearly indicates that lack of adequate process safety information silently keeps on weakening risk assessment process & PSM elements and thus exposing organizations to high risk.

In the next section, paper focuses on the various causes that lead to inadequate process safety information and possible ways to overcome such issues.

**Process Safety Information – Principle**

The process safety information provides a detailed description of the process or operation. It is the first element in Process Safety Management (PSM). All PSM elements hinge on accurate Process safety information for identifying and understanding
the hazards involved; Collation of relevant is one of the first steps in establishing PSM system.

**Cause for inadequate Process Safety information**

Reasons of inadequacy of process safety information can be captured under three broad categories as also shown in Figure 3. Categories are as follows

1. New technology
2. Legacy
3. Administrative

During establishing **new technology** it is important that custodians should be competent to understand and demand the complete PSI from technology suppliers or developers of technology. Sometime technology suppliers are reluctant to share details and front end alignment for PSI sharing can avoid such issues. Occasionally, intellectual property control restricts supplier to share the information and during such cases minimum required PSI should be identified and obtained for management of PSM. Another cause is the test runs or experiments which are carried out in well-established plant. This particular phase of operation may expose plant to high risk due to inadequate understanding of process design basis and required controls. So it is important to develop adequate PSI before carrying out such test runs in plant and development of adequate process controls.
The second category is “legacy” which is about the incomplete PSI due to multiple issues and changes happening over the life cycle of plant. Frequently, it is common that aged plants lack comprehensive PSI. In past adequate PSI was neither developed by technology supplier nor demanded & maintained by plant owners. Due to obsolesce of technology, suppliers are not in position to help client to upgrade PSI. In-house technology approach frequently limits development of PSI to minimum requirements essential to design and build plant. Changes in technology or business ownership also impacts support for upgradation of PSI.

Third category named as “administrative” since it tries to address issues related to PSI information management process. Loss of document given by technology or equipment supplier is one of the major reasons for inadequacy of PSI. Very few companies manage documents in structured way.

Management of PSI need adequate competency at multiple levels of organization and adequate resources in terms of money and time. Management understanding and commitment determine status of PSI over the life cycle of plant. Changes in plant ownership frequently results in loss of knowledge in various ways impacting PSI adversely.

Regulations related to PSI and PSM changed drastically during last couple of decades. Lack of sufficient efforts to upgraded PSI resulted into incomplete PSI as per requirements.

**Proposed Approach to overcome PSI Issues**

Process safety information consists of three parts as follows:

1. Hazards of material,
2. Process design basis
3. Equipment design basis.

All the three parts of PSI need specific approach and efforts. First part hazards of chemical focuses on chemical hazards identification, Chemical to chemical interaction matrix and chemical to metal interaction matrix development.

Process design basis focuses on chemistry of the process, process sizing and application of understanding to control process in safe limits.

Equipment design basis focuses on designin of facility and technology, specifications and standards to be used and equipments required for mitigation measures.
Team with adequate competency to drill down the details of each part of PSI is crucial to develop comprehensive PSI. Organization need to develop strategy to identify and equip team to develop PSI. Help of technology provider is essential. Frequently help from external experts like consultants, universities, industry associations is taken. Information from public domain, independent agencies and government supported nodal agencies is also good source.

![Figure 4: Way to develop risk assessment in the absence of adequate PSI](image)

Frequently we come across situation where comprehensive PSI is not available and management want to carry out risk assessment. Complete PSI development can be time consuming process and resource intensive. It also depends upon process complexity and support from technology developers. During such situation short term and long term plans need to be developed by focusing on hazards of substances handled.

Risk assessment in the absence of PSI may leave organization in vulnerable condition. So in order to bridge over the time till full PSI gets developed for comprehensive risk assessments following two steps are suggested.

First step involves chemical hazard table development. Identification of hazardous chemicals their maximum quantities and typical operating conditions. This information is used to carry out consequence analysis to understand the severity of hazard and
develop strategy to manage hazards and mitigation. Subsequently process hazard review methodology like “What – If” analysis can be used for risk assessment.

Second step involve collation and development of essential PSI to facilitate comprehensive HAZOP along with Consequence analysis. Team should identify which information is required for the preparation of HAZOP studies, which information is required during study and which information needed only as reference. This approach will help organization to develop risk assessment to control hazards. While conducting risk identification and assessment critical PSI can be identified and can be prioritized for development.

Management role to manage PSI

Management support for resource is crucial for development and maintenance of PSI. PSI requirements need to be built in design and procurement stage. Facilities need to be provided to manage documentation. PSI needs to be maintained during every stage of life cycle of plant. Management participation in governing processes can ensure Updating, auditing of PSI as per need. This will enable reduction of risk in the plant.

Conclusion

This paper demonstrates the importance of PSI and lack of it can increase risk significantly and can lead to an incident. Understanding of reasons for inadequate PSI will help organization to develop systems to develop and maintain across the life cycle of the facility. Management oversight, involvement and understanding of the importance of comprehensive PSI at various stage of life cycle of plant will help develop a strong PSM system. We also proposed how an organization can approach the development of PSI in a systematic manner when it is lacking. Inadequate PSI silently affects the risk while updated PSI acts as a savior and enables an organization to understand, manage risks and avoid process incidents.