

Safety Bulletin

Process Hazard Analysis (PHA)

Methodologies



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Introduction

This Safety Snippet provides an overview of the various Process Hazard Analysis (PHA) methodologies applicable in facilities covered under the Occupational Safety and Health Administration's (OSHA) Process Safety Management (PSM) standard. Understanding and effectively implementing these methodologies is crucial for identifying, evaluating, and controlling hazards associated with processes using highly hazardous chemicals.

1. What is a Process Hazard Analysis (PHA)?

A PHA is a thorough, systematic approach for identifying, evaluating, and controlling the hazards of processes involving highly hazardous chemicals. It is a fundamental element of OSHA's PSM standard. There are various methodologies that can be used for the study and they are outlined below, including a comparison of their advantages and shortfalls for reference.

2. Importance of PHA in PSM

- Identifies potential hazard scenarios and provides a basis for improving safety.
- Ensures compliance with OSHA PSM requirements, thereby avoiding legal and financial repercussions.
- Enhances communication and safety culture within the organization.

3. Best Practices for Conducting a PHA

- Team Composition: Include personnel with expertise in engineering, operations, and safety.
- Regular Review: Conduct PHA at least every five years or when there are significant changes in the process.
- Documentation: Keep thorough records of the PHA, including findings and recommendations.
- Action Items: Develop a system to address, track, and communicate the status of PHA recommendations.

4. PHA Methodologies

The following PHA methodologies are presented in the OSHA PSM standard in 29 CFR 1910.119(e) as well as in the EPA RMP Rule in 40 CFR § 68.67. Further guidance is provided by the EPA in Appendix 7-A of their General RMP Guidance.^{1, 2}

In This Issue

This Safety Bulletin provides an overview of the various Process Hazard Analysis (PHA) methodologies that can be used to satisfy the OSHA PSM PHA requirement. A comparison of the benefits and shortfalls of each methodology is also provided for reference.

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<https://www.NebulaSafety.com>

Methodology	Description	Advantages/Uses	Shortfalls
Checklist	Involves a list of pre-developed questions based upon past experience and industry standards aimed at verifying the safety of a system. Often used in conjunction with other techniques which provide a more in depth review of the process. Can be used as a standalone for simpler processes with which there is greater experience.	- Commonly used to ensure compliance to standards - Variable levels of detail - Simple communication of information - Useful for routine processes	- Can overlook unique or unusual hazards - Limited to application with simple designs, processes, or systems
What-If Analysis	Involves brainstorming sessions where a team of experts considers potential scenarios by asking "What if...?" questions regarding the process. It explores various hypothetical situations to identify potential hazards and their consequences.	- Simple to understand - Low Effort - Suitable for simpler processes or as a preliminary analysis tool	- Less structured - Relies on experience and thoroughness with no formal assurance of adequate question coverage.³
Hazard and Operability Study (HAZOP)	Involves a systematic and structured examination of a complex system or process to identify potential deviations from the intended operating intentions that could lead to hazards. It focuses on analyzing deviations in parameters such as temperature, pressure, flow rate, etc., and assessing their potential consequences.	- Addresses Safety and operability - Thorough analysis helps ensure all hazards are identified - Structured, thorough review for complex processes	Higher time and effort requirements than simpler methods
Layer of Protection Analysis	LOPA assesses the adequacy of existing layers of protection against identified hazards. It quantifies the likelihood of a hazard and the effectiveness of existing safeguards to determine if additional risk reduction measures are necessary. Often used in conjunction with HAZOP methodology for more severe hazards.	- Provides a semi-quantitative method for evaluating the adequacy of existing or proposed layers of protection against identified hazards - Risks and protections required are often more standardized than HAZOP alone	- Not a stand-alone methodology - Resource intensive
Failure Modes and Effects Analysis (FMEA)	Systemic evaluation of each component of a system to identify potential failure modes, their causes, and their effects on the overall system. It prioritizes failure modes based on their severity, occurrence probability, and detectability. ³	- Good for equipment reliability³ - Useful in identifying single point failures that could lead to a process incident	Does not directly analyze human error³
Fault Tree Analysis (FTA)	Used to identify and analyze the potential combinations of events (failures or faults) that could lead to a specific undesired event or hazard. A deductive, top-down method to analyze the causes of a specific event (fault). It uses a diagram to represent the logical relationships between events. ³	- Often used when another technique has identified an accident that requires more detailed analysis - Helps in understanding the pathway of failure in complex systems - Can identify combinations of basic equipment and human failures that can lead to an accident⁴	Less useful for single point of failure concerns³

5. PHA Methodology Considerations

The following factors should be considered when selecting a PHA methodology:

- Applicability to the Process: Certain methods might align better with specific types of processes. For instance, FTA might be more suitable for analyzing system failures, while HAZOP would better identify deviations in chemical processes.
- Complexity: The complexity of the system or project being analyzed is often directly related to the level of complexity required for the PHA study.
- Experience of Operations/ Level of Standardization: More standardized systems, along with those that have been safely operated for longer periods without significant changes often require less in depth methodologies than those analyzing more novel systems, or those undergoing large changes.³
- Risk Tolerance and Severity: The level of risk tolerance within the organization and the severity of potential consequences influence the selection. Methods that provide a more detailed analysis might be preferred for high-risk processes.⁵
- Required Level of Detail: Consider the level of detail needed for the analysis. Some methods provide a more granular examination of hazards and risks, while others offer a broader overview.⁴
- Time and Resource Requirements: It is important to understand the amount time that personnel will be required to commit to the study for the methodology selected. If personnel cannot dedicate their time and focus as required, study quality can suffer; therefore, considerations should be made as to personnel availability and the impact of the study on their schedules.³

Conclusion

Understanding and effectively implementing PHA methodologies is essential for maintaining a safe work environment in OSHA PSM covered facilities. It is not just a regulatory requirement but a cornerstone of proactive safety management. All employees are encouraged to familiarize themselves with these methodologies and actively participate in the PHA process.

References:

- 1: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-68/subpart-D/section-68.67>
- 2: [https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-H/section-1910.119#p-1910.119\(e\)](https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-H/section-1910.119#p-1910.119(e))
- 3: <https://www.epa.gov/sites/default/files/2013-11/documents/chap-07-final.pdf>
- 4: <https://www.primatech.com/images/docs/comparison-of-pha-methods.pdf>
- 5: <https://synergenog.com/conduct-process-hazard-analysis-methods/>