



PSM Part 2: Building Your PSM Facility

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OSHA holds industries accountable for managing highly hazardous chemicals in their facilities to include toxic chemicals, reactive chemicals, and flammable liquids and gases. They know that chemicals, when not managed safely could cause “disastrous incidents with extremely dangerous and sometimes fatal consequences.”¹

For this reason, OSHA has developed Process Safety Management (PSM) standards to drive down risk in production operations and for auditing purposes. As a

result, companies may hire PSM experts to help them implement and maintain a centralized Process Safety Management (PSM) system.

There are four steps that PSM consultants follow when bringing a non-PSM compliant facility into OSHA compliance:

- Identify safety gaps.
- Advise the client on OSHA regulations.
- Define a PSM plan.
- Execute the PSM plan.

PSM Steps to OSHA Compliance

1

IDENTIFY

Meet with new clients to determine the extent of their PSM knowledge and potential gaps in their current safety program

2

ADVISE

Discuss OSHA'S PSM protocols and processes with the client

3

DEFINE

Build a tailored PSM plan that addresses relevant PSM elements and client requirements

4

EXECUTE

Execute the PSM plan to bring client's facility into OSHA compliance

Step 1: Identify

Initial discussions with the client focus on the extent of their PSM knowledge and potential gaps in their current safety program. The list of questions PSM consultants might ask new clients include the following:

- Is your facility OSHA regulated?
- Does your company have a database of Process Safety Information (PSI)?
- Are there electronic copies of your P&ID's?
- Does your team update the PSV files, if a change was made to the process?
- Do you have any investigation logs for past safety incidents?
- Do you have a compliance auditor?
- Do you have a Process Narrative, which will help me understand the process?
- Has your site had any incidents in the past 5 years?
- How much does one day of downtime cost you?
- How much does employee lost work time cost you?
- How long does it take to train an employee?
- How long does it take to fix broken equipment (pump, compressors etc.)?
- Does the site stock any spares?
- What process deviations has your site normalized?
- Who meets to discuss safety incidents or near-misses at the facility?
- Is facility safety information accessible for all employees?
- If an accident occurs on-site, are employees trained to address it?
- How long would it take for external emergency responders to arrive and address a safety incident at your facility?
- Can we audit your facility for free? (Auditing Slide)

Step 2: Advise

After uncovering safety gaps in operations, consultants discuss OSHA's PSM protocols and processes and review a PSM Key Provisions checklist with the client, along with brief descriptions of each of the elements to determine the most relevant PSM elements that apply to their needs and requirements based on the following:

- What can go wrong and why?
- What has gone wrong and why?
- What controls are in place to prevent an event from occurring?
- Are these controls operating as intended with predictable results?
- Does the client focus more on active risk monitoring or reacting to situations with failure data?
- Is the client aware of local area regulations and codes?
- What is the condition of the existing PSI documentation?
- Is there PSM documentation (e.g., P&ID's or datasheets)?
- What are the client's leading/lagging indicators and KPIs?
- Does the client have an MOC process?
- When was the last HAZOP or PHA conducted?
- Who is their current PHA facilitation company?
- How are they conducting employee training?

Step 3: Define

In the "Define" phase, the PSM consulting team conducts the following analyses and studies:

- Layers of Protection Analysis (LOPA) and engineering analysis based on OSHA's PSM Key Provisions elements to determine if there are gaps in layers of protection to protect the company from a possible event and identify action items.
- Safety studies (e.g., HAZID, HAZOP, risk analysis).
- Multiple PHA's to identify all risk and safety issues and to determine the problem, root causes, and consequences. This includes gathering PSIs to identify process nodes and recent facility changes to determine if the changes followed proper Management of Change (MOC) procedures. PHA's or Process Hazards studies are conducted to assess risk. The type of PHA's include:
 - "What If" studies for simple results.

- HazOp for more qualitative results.
- LOPA analysis for more quantitative results.

After gathering the information, the PSM team appoints a subject matter expert to review the documentation and analyze the results of the PHA studies. A risk waterfall matrix is then developed to determine the severity and likelihood of each risk.

A good matrix defines each level as an order of magnitude different than the previous level. For example, a recordable injury is 10 times worse than a first aid incident.

In addition, HAZOP and LOPA likelihood results are different in that HAZOP uses subjective terms (i.e., remote) while LOPA results are more quantitative (i.e., once every 1,000 to 10,000 years).

Typical 6x6 Risk Matrix

| Impact/Probability | Rare | Unlikely | Possible | Likely | Almost Certain |
|--------------------|----------|----------|----------|-----------|----------------|
| Insignificant | Low | Low | Low | Moderate | High |
| Minor | Low | Low | Moderate | Moderate | High |
| Moderate | Low | Moderate | Moderate | High | High |
| Major | Moderate | Moderate | High | High | Very High |
| Catastrophic | High | High | High | Very High | Very High |

PSM Key Provisions Checklist

- | | |
|------------------------------------|---|
| ✓ Process Safety Information (PSI) | ✓ Pre-Startup Safety Review |
| ✓ Employee Participation | ✓ Mechanical Integrity |
| ✓ Process Hazard Analysis (PHA) | ✓ Nonroutine Work Authorization |
| ✓ Operating Procedures | ✓ Management of Change (MOC) |
| ✓ Employee Training | ✓ Incident Investigation Emergency Planning |
| ✓ Contractor | |

| Level | Severity | HAZOP Likelihood | LOPA Likelihood | Revenue Loss |
|-------|---|------------------|-----------------------|------------------|
| 1 | 50+ Fatalities | Rare | Once per 10k Years | >\$100MM |
| 2 | 3-50 employee fatality or 1-10 public fatality | Remote | Once per 1k-10k years | \$10MM - \$100MM |
| 3 | 1-3 employee fatalities or 1 permanent disabling or 1 public fatality | Unlikely | Once per 100-1k years | \$1MM - \$10MM |
| 4 | Permanent disability | Seldom | Once per 10-100 years | \$100k - \$1 MM |
| 5 | Recordable injury | Occasional | Once per 1-10 years | \$10k-\$100k |
| 6 | Slight - First Aid Required | Likely | Once per year | Loss of <\$10k |

The PSM team determines the LOPA rankings based on the following activities:

- Identify and discuss the purpose of a node.
- Identify the node's design limitations.
- Look at variable changes (e.g., No Flow, Low Temp).
- Brainstorm ideas for operational changes (e.g., inadvertent valve closure, Level Instrument Failure) that would result in the variable change (i.e., No Flow).
- Identify the worst thing that can happen assuming no safeguards are in place (e.g., no PSV's, no operator response, or nothing).
- Identify the severity of the incident using a safety matrix.
- Identify the likelihood of the initiating event and not the consequence. This is the primary difference between a LOPA and a HAZOP likelihood ranking.

After developing the risk matrix, the PSM team ranks each risk. If the risk ranking is not acceptable, the team lists all the safeguards and identifies an Independent Protection Layer (IPL) that must be put in place (e.g., automatic system shutdown, alarms) to mitigate the risk. The team then recalculates the risk ranking with the reduced likelihood numbers. If the new risk ranking is still not acceptable, the PSM team will recommend adding more Independent Layers of Protection.

After finalizing the customized PSM plan, the PSM consulting team presents the document to the client for review and approval before moving into the "Execute" phase.

Step 4: Execute

In the "Execute" phase, the PSM team provides guidance on the PSM process to bring the client's facility into OSHA compliance.

The PSM plan includes the following:

- Collecting the safety data, consolidating, organizing, and prioritizing the data, and continually updating the safety documents and file structure in the PSM system architecture.
- Specifying the Safety Instrumented Functions (SIFs) and preparing the Safety Requirements (SRS).
- Developing the Safety Integrity Level (SIL) verification worksheet and report.
- Identifying leading and lagging indicators and

applying KPI and SPI calculations to continually monitor and measure the effectiveness and quality of the PSM system.

- Partnering with the client to build a consolidated and centralized PSM SharePoint site where all users can easily access and download safety critical information or refer to hard copy backups if needed.
- Developing and conducting customized employee training on how to use the system for plant safety and security and reliable operations.
- Following up as needed through system maintenance, ad hoc audits, or annual safety refresher courses.

Summary

PSM is about prevention and rapid recovery should an incident occur. The ultimate measure of success is when nothing happens because a facility has taken the proper steps to stay ahead of any risk that could threaten plant operations, human safety, or the environment and surrounding communities. No matter the size or type of facility or number of assets, the cost of the problem far exceeds the cost of the solution. A proactive solution demonstrates long-term cost savings in terms of reduced number of incidents and increased quality, productivity, and reputation.

No matter the political or economic environment, a well-structured PSM system stands the test of time and is well-worth the investment. Regardless of the costs associated with implementing a PSM system, saving the environment and human lives is priceless. Nothing is more important. With safeguards in place, such as safety protocols, meticulous documentation, risk mitigation methodologies, lessons learned, and best practices, the system can, in turn, provide predictive analytic models to drive down risk across all operations.

Most importantly, as the first line of defense against catastrophic events, accidents, or life-threatening situations, it serves to protect a company's greatest asset—its people.

REFERENCES

1 "Process Safety Management," [Process Safety Management](#) | Occupational Safety and Health Administration (osha.gov), April 2024.