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Practical Process Safety Management (miniPSM℠)

A Scalable Process Safety Blueprint for Facilities That Are Not Subject to Federal PSM/RMP Requirements

An ioMosaic White Paper

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Abstract

A chemical incident doesn't care whether a facility triggers OSHA Process Safety Management (PSM) thresholds. For small-to-mid-sized operations or distilleries, handling hazardous materials—even in small quantities—carries a disproportionate risk. While they may technically escape the heavy administrative burden of OSHA 29 CFR 1910.119 or the EPA's RMP, a single process failure can still result in catastrophic injury, devastating property loss, and business-ending liabilities. Furthermore, "exempt" does not mean "unregulated." Smaller facilities are still strictly bound by other OSHA standards, laboratory safety codes, and aggressive state and local fire regulations.

Building a robust process safety program with limited resources can feel daunting, but it is entirely achievable. This white paper introduces a scalable, practical process safety framework designed specifically for facilities not subject to federal PSM/RMP mandates. The ioMosaic miniPSM℠ approach demonstrates how process safety can be implemented by smaller companies over time. This framework provides a universal roadmap to proactively mitigate risk, protect the workforce, and safeguard company's bottom line.

Introduction – The Threshold Fallacy

A dangerous myth quietly circulates among small and mid-sized operations: "If we don't meet the OSHA PSM threshold, we don't have a process safety problem." Many facility managers operate under the false assumption that because they don't handle massive, railcar-level quantities of highly hazardous chemicals, their processes are inherently safe.

History tells a radically different—and devastating—story.

Chemistry does not respect regulatory boundaries. A runaway reaction, a vapor cloud ignition, or a pressurized system failure is just as lethal at a local small-batch facility as it is at a massive petrochemical plant. In fact, smaller facilities are often more vulnerable because they lack the deeply integrated safety layers mandated by federal law. To understand how easily a standard workday can turn into a catastrophic headline, one only needs to look at four tragic incidents where facilities operating completely outside the mandate of OSHA PSM suffered devastating consequences:

- **Hardin, KY (2017) – Silver Trail Distillery:** A craft distillery explosion that tragically killed a distiller and severely burned another. The explosion was caused by release of alcohol due to a still overpressure. The relief valve on the still was set and sized incorrectly to prevent this catastrophic incident. This incident shook an entire industry, demonstrating that even traditional, seemingly straightforward processes like alcohol distillation involve high-energy, volatile vapors that require rigorous process safety barriers.[4]
- **Leominster, MA (2005) – Specialty Chemicals Explosion:** A stark reminder that even everyday chemical manufacturing, when plagued by a runaway reaction, can easily breach containment, resulting in a massive explosion that injures workers and severely damages the surrounding community.[2]
- **Jacksonville, FL (2007) – T2 Laboratories:** A chemical reactor at a mid-sized facility suffered a cooling failure. The resulting runaway reaction and subsequent blast killed four people, injured 13 others, and destroyed the facility—proving that handling smaller quantities of hazardous materials does not equal low risk[3]
- **Belle, WV (2020) – Optima Chemical:** A lethal explosion and fire occurred during a contract chemical manufacturing process involving a compound not even listed on OSHA's PSM chemical appendix. The blast sent debris flying onto a nearby interstate and killed a worker, underscoring that unlisted chemicals can carry catastrophic hazards.[5]

These facilities did not violate federal threshold laws; they simply fell through the regulatory cracks. For these companies, the absence of an OSHA mandate didn't prevent a disaster, it merely meant they lacked the framework to see it coming.

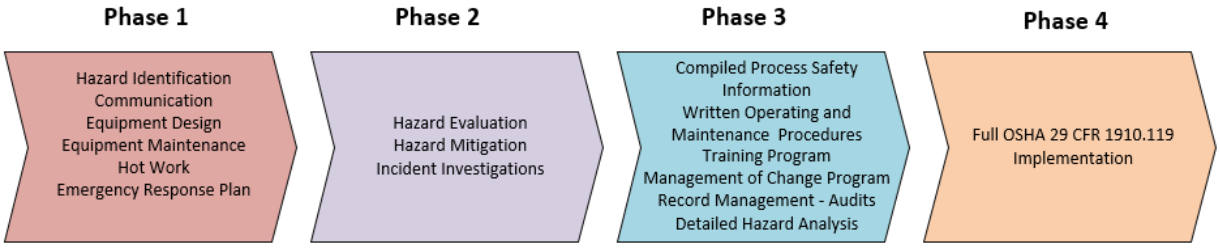
The Commonwealth of Massachusetts 527 CMR 1.00 Chapter 60[1] is one example of how a process safety program can be implemented in a smaller facility to ensure local fire departments and facilities understand site-specific hazards before a crisis occurs. This regulation specifically targets facilities that slip under federal PSM thresholds but still handle dangerous materials that threaten employees, first responders, and the public.

Limited Process Safety Framework

Based on ioMosaic's decades of experience in PSM compliance and implementation, the guidance in the Massachusetts regulation, OSHA 3908-03 2017 Process Safety Management for Small Business [6], FMDSO774 – Distilleries "FM Property Loss Prevention Data Sheets – Distilleries"[7] , and chemical industry RAGAGEP (Recognized and Generally Accepted Good Engineering Practices) ioMosaic developed a miniPSM^{SM} process safety program that can be phased in over time to improve the risk at the facility. See Figure 1 below for a breakdown of the different phases. Small companies handling lower quantities of hazardous materials can start with

Phase 1 implementation steps and then continue to move through the additional implementation phases as the amount of highly hazardous materials increases and they have resources to continue the implementation. All facilities, independent of how much material they handle, must comply with applicable federal, state, and local regulations such as OSHA 1910.1200 Hazard Communication, OSHA 1910.252 Welding, Cutting and Brazing, OSHA 1910.147 The Control of Hazardous Energy (lockout/tagout).

Figure 1: Process Safety Program Implementation Phases



Source: ioMosaic

Across all 50 states, OSHA and the EPA utilize "General Duty Clauses" to fine un-regulated companies after an incident occurs. Adopting this framework proactively demonstrates that a company is fulfilling its legal obligation to identify and mitigate known hazards—shielding the business from devastating legal, financial, and reputational ruin.

Phase 1 – The Basics

Any facility handling hazardous chemicals, whether a laboratory or a production facility, needs to understand the hazards of the materials being handled and ensure that the equipment used is designed per industry standards and properly maintained.

Hazard Identification and Communication

"You cannot manage a hazard if you cannot identify the hazard"

Reactive incident data for 167 incidents analyzed by U.S Chemical Safety and Hazard Investigation Board (CSB) [8] determined that over 50% of the incidents in the US from the years 1980-2001 were involving chemicals that were not covered by OSHA or EPA process safety regulations. These incidents still resulted in fatalities, major injuries and damage.

The first step is to ensure that all the hazards of the materials used are identified and understood:

- Is the material flammable?
- Can it be ignited by static?
- Is it toxic?
- Is it corrosive?
- Can it react in an unexpected way with other materials being handled?
- Can the chemical reaction generate unexpected pressures and/or temperatures?
- Is it a combustible dust?
- Can there be unexpected/side reactions that will generate hazardous conditions?

A lot of this information can be found on Safety Data Sheets (SDS) but not necessarily all. In general, safety data sheets are not sufficient as they do not always contain accurate physical properties and/or thermal stability and reactivity data about either pure chemicals, mixtures of chemicals, or combustible dusts. Safety data sheets are a good starting point but should not be the sole source of information for hazard identification and/or decision making.

A reactivity matrix should be created for all the chemicals handled to determine any reactivity or compatibility issues. Some of the available resources are:

- Process Safety Office® SuperChems®
- Cameo Reactive Chemicals Software
- Bretherics's Handbook of Reactive Chemical Hazards

If existing information is inadequate additional hazard/reactivity tests should be conducted to determine specific hazard of the process. ISO certified ioKinetic Laboratory can conduct hazardous property, combustible dust, and reactivity testing to properly identify reactivity issues.

This information should be shared with all personnel involved in handling these materials and used for proper equipment design.

Equipment Design and Maintenance

Equipment handling hazardous materials should be designed according to industry standards and include proper materials of construction, overpressure and vacuum protection, proper electrical area classification, electrical equipment design, and fire protections as required by local fire codes.

Overpressure and vacuum protection devices need to be sized properly for hazardous conditions and possible reactions. Process Safety Office® SuperChems® software can be used to ensure that properly sized overpressure/vacuum protection equipment is installed.

All equipment must be properly inspected and maintained according to the manufacturer's recommendations and applicable industry standards.

Hot Work

OSHA 1910.252 Welding, Cutting and Brazing regulation applies to anyone doing maintenance or construction work that can generate sparks. Proper precautions need to be taken to eliminate flammable and combustible materials before starting work, providing fire watch and fire extinguishers, area inspection before authorizing work and fire watch for a period of time after completion of work.

Emergency Action Plan

The emergency action plan should specify how any emergency is handled and may include a facility floor plan or plot plan that shows where the hazardous materials are stored and processed, and where emergency equipment is located. The plan should establish on-site emergency coordinator(s) who are knowledgeable of hazardous materials processing and any information that is necessary for the shutdown of the process or facility and include their contact information. Additional information can be included that is helpful for the facility to initially respond to and report an emergency. The OSHA standard 1910.38, Emergency Action Plans, can be useful guidance when developing a facility's emergency plan.

Phase 2

Phase 2 of the implementation for larger facilities should include completing a hazard evaluation, identifying hazard mitigation, and developing a system for proper incident investigations.

Hazard Evaluation & Mitigation

A hazard evaluation is an assessment to identify process hazards during normal and abnormal operating conditions and determine control measures. High level methods such as HAZID (Hazard Identification) or What IF? methodologies can be used. Guidance for hazard evaluations is available in RAGAGEP publications such as the Center for Chemical Process Safety guidelines. Action items that come out of a hazard evaluation would include the implementation of determined mitigation systems to prevent or mitigate the hazards. A hazard evaluation should also be carried out prior to the startup of any new processes and any significant process modifications.

Incident Investigations

Any incident that occurs on site should be internally reported and investigated to determine the cause of the incident and all contributing factors. The investigation report should include recommendations to prevent a future recurrence. Lessons learned should be communicated to employees and local emergency responders.

Phase 3

Phase 3 is when detailed and controlled documentation is developed for the process in order to ensure consistent implementation

Compiled Process Safety Information

All information pertaining to hazards and technology of the process should be compiled. This should include information on all chemicals, processes, controls, equipment drawings, and other design documents. With well-documented process information, process hazard analyses (PHA) can be developed.

Written Operating and Maintenance Procedures

The next step is to fully capture written operating and maintenance procedures, which includes all the safety and health considerations. Operating procedures should include (normal, abnormal, and emergency conditions any safety interlocks and required response). Maintenance and safety procedures should be documented. The documentation of these procedures provides the material for the training element.

Process Hazard Analysis

Based on detailed process information available in this phase and written operating procedures, a detailed process hazard analysis should be conducted. This should include structured qualitative and semi-quantitative methods such as HAZOP (Hazard and Operability Study) and LOPA (Layer of Protection Analysis). ioMosaic's Process Safety Office® PSMPro® provides structured guidance to complete process hazard analysis using different RAGAGEP methods available.

Training Program

A written training program documents the frequency of training and criteria of understanding for operators, maintenance workers, and contractors. This program should include training on process hazards as well as all applicable procedures.

Management of Change Program

A written record management program ensures that changes to the process are properly evaluated for any additional hazard introduced by the change in equipment, materials, or procedures. It includes a date and authorization by managers responsible for the change.

Record Management

Proper record management includes internal review/audits of the documentation and state of implementation of the process safety program elements.

Phase 4

Phase 4 requires full implementation of the fourteen elements of OSHA 29 CFR 1910.119 or the twenty elements of the CCPS RBPS framework. These include:

- Employee participation
- Process safety information
- Process hazard analysis
- Operating procedures
- Training
- Contractors
- Pre-startup safety review
- Mechanical integrity
- Hot work permit
- Management of change
- Incident investigation
- Compliance audits
- Trade secrets

Moving from Strategy to Action

Implementing a phased process safety framework requires consistency, organization, and a shared safety culture—assets that can strain smaller teams if managed on spreadsheets and paper logs. To make this framework truly achievable for small-to-mid-sized operations, ioMosaic utilizes a streamlined technology ecosystem with visual workflows designed to do heavy lifting:

- Process Safety Enterprise® (PSE): While a full 14-element OSHA PSM program can be overwhelming, PSE simplifies the process by providing structured visual workflows for each PSM element. It scales down to match your specific implementation phase, allowing you to easily track, document, and manage your critical process safety elements in one centralized, audit-ready space without the administrative bloat. Additional resources, see page 14, will provide hyperlinks to white papers that provide detailed description of these workflows.
- Process Safety Learning® (PSL): A safety culture is only as strong as the team's understanding. PSL serves as your on-demand, self-paced training hub, ensuring the workforce understands process hazards without disrupting daily production. It provides company with a dedicated, secure, and private e-learning space to deliver targeted safety education exactly when and where the team needs it.

To shift Process Safety Management (PSM) from a daunting administrative burden to a seamless, everyday routine, ioMosaic offers the 'miniPSM℠' framework. In this framework, the ioMosaic team works with small and medium enterprises to design a right-sized PSM program paired with digital tools that together seamlessly embed incident-mitigation strategies into daily operations, making proactive safety both achievable and highly rewarding.

See the "Additional Resources" section for links to more information on Process Safety Enterprise® (PSE), the software that helps clients ensure compliance with all 14 elements of OSHA's Process Safety Management (PSM) standard and the CCPS 20 Elements of Risk Based Process Safety (RBPS).

Conclusion

Process safety is not a regulatory burden to be avoided; it is a fundamental operational shield. While the scale of federal compliance can feel insurmountable to a growing business, the phased framework outlined in this paper proves that resource constraints are no longer an excuse for inaction. By breaking down process safety into manageable, quantity-based milestones, facility can systematically integrate critical safeguards into daily operations without overwhelming their team. Over time, this practical approach does more than just prevent disasters—it builds an organic, deeply ingrained safety culture that protects people, defends the brand, and secures the bottom line. Companies don't need a federal mandate to protect their business. They just need the foresight to start.

Authors

1. Katherine Anderson; anderson.k.nh@iomosaic.com
2. Anna Shinkawa; shinkawa.a.tx@iomosaic.com
3. Lisa Ruth; ruth.l.tx@iomosaic.com

Research Support

1. Shannon Etheredge; etheredge.s.tx@iomosaic.com

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3. "Investigation Report: T2 Laboratories, Inc. Runaway Reaction." U.S. Chemical Safety and Hazard Investigation Board, September 2009
4. "Fire Marshal's Report: Silver Trail Explosion Caused by Excessive Pressure Build-Up." Marshall County Daily, 25 July 2015
5. "Fatal Chemical Decomposition Reaction and Explosion at Optima Belle LLC". U.S. Chemical Safety and Hazard Investigation Board, July 2023
6. OSHA 3908-03 2017 “Process Safety Management for Small Business”
7. FMDSO774 – Distilleries “FM Property Loss Prevention Data Sheets – Distilleries” – January2010
8. U.S. Chemical Safety and Hazard Investigation Board “Incident Data – Reactive Hazard Investigation”, September 2003

Additional Resources

1. “Simplified Process Safety Management for Smaller Companies” Melody E. Sodeberg
2. Process Safety Management (PSM) White Papers
    1. Effectively Manage Changes Using Process Safety Enterprise®
    2. Effectively Manage Operating Procedures Using Process Safety Enterprise®
    3. Effectively Manage Safe Work Practices Using Process Safety Enterprise®
    4. Effectively Manage Key Performance Indicators Using Process Safety Enterprise®
    5. Effectively Manage Compliance Audits Using Process Safety Enterprise®
    6. Effectively Manage Employee Participation Using Process Safety Enterprise®
    7. Effectively Manage PSM Training Using Process Safety Enterprise®
    8. Effectively Manage Contractor Safety Using Process Safety Enterprise®
    9. Effectively Manage Trade Secrets Using Process Safety Enterprise®
    10. Effectively Manage Process Safety Information Using Process Safety Enterprise®
    11. Effectively Manage Emergency Planning Response Using Process Safety Enterprise®
    12. Effectively Manage Pre-Startup Safety Reviews Using Process Safety Enterprise®
    13. Effectively Manage Process Hazard Analyses Using Process Safety Enterprise®
    14. Effectively Manage Incident Investigations Using Process Safety Enterprise®
    15. Effectively Manage Mechanical Integrity using Process Safety Enterprise®