OSHA’s process safety management Standard
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Among other items, the Clean Air Act Amendment of 1990 (CAA) called for a new standard to govern chemical process safety at the workplace. As a result, the Occupational Safety and Health Administration (OSHA) developed its standard for the Process Safety Management of Highly Hazardous Chemicals. Unlike many other OSHA regulations that tend to focus on individual elements of "job" or "worker" safety, this standard looks more to the facility's operations and management processes. OSHA's purpose, under this standard, is to prevent the catastrophic release of hazardous substances in the workplace.

Introduction
OSHA's standard appears in two sections of the Code of Federal Regulations. Processes with flammable and/or toxic chemicals are governed by the regulation entitled "Process Safety Management of Highly Hazardous Chemicals" that is found at Title 29 of the Code of Federal Regulations, 29 C.F.R. 1910.119. Explosive and pyrotechnic manufacturing processes are subject to the requirements of process safety management by a reference made at 29 C.F.R. 1910.109(k).

Discussion
Those elements typically found in a general safety program are discussed below.

The Process Safety Management (PSM) Regulations cover "processes" rather than any specific industry segment or facility industrial class. A "process" is any use, storage, manufacturing, handling or on-site movement of a highly hazardous chemical. According to a letter of interpretation issued by OSHA on June 7, 2007, interconnected vessels and separate vessels in close proximity to one another are considered a covered process under the regulations.

The four covered processes include:

1. Any process that involves a chemical at or above the threshold quantity listed for the chemical in Appendix A, a listing of toxic and reactive highly hazardous chemicals. [1910.119(a)].

2. Any process, with two exceptions, that involves 10,000 pounds or more of a flammable liquid or gas onsite in one location. The two exceptions are for (1) hydrocarbon fuels that are consumed on-site and used solely for workplace comfort heating or vehicle refueling and (2) flammable liquids that are stored in atmospheric tanks or transferred and kept below their normal boiling point without the benefit of refrigeration. [1910.119(a) and (b)]. Note: According to OSHA an "atmospheric tank" means a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g. (pounds per square inch gauge, 3.45 Kpa).

3. The manufacture of explosives. Explosives are defined to include the manufacture of any chemical compound, mixture, or device that is meant to function by explosion. This will include all materials classified by the U.S. Department of Transportation as either a Class A, Class B, or Class C explosive. [1910.119(k) (2)].

4. The manufacture of pyrotechnics or fireworks. [1910.109(k) (3)].
Ever since the PSM Standard went into effect, the scope and applicability have caused a great deal of confusion. For example, if an employer has two refrigeration systems containing 5,000 pounds of anhydrous ammonia, but the systems are not connected in any way, would the employer be subject to the requirements of PSM? In this example, the PSM Standard would apply. If the process vessels are stored near one another and if in the aggregate they will meet or exceed the 10,000 pounds threshold, they will be considered to be a “process” under the regulations.

A flammable gas is gas that, at ambient temperature and pressure, either forms a flammable mixture with air at a concentration of 13 percent by volume or which forms a range of flammable mixtures with air wider than 12 percent by volume regardless of the lower limit. A flammable liquid is any liquid with a flashpoint below 100°F. (37.8°C).

The elements of the Process Safety Management Standard—Fourteen elements comprise OSHA’s Process Safety Management Standard under the regulation. The 14 elements of the Process Safety Management Standard are:

1. Employee Participation
2. Process Safety Information
3. Process Hazard Analysis
4. Operating Procedures
5. Training
6. Contractors
7. Pre-Startup Safety Review
8. Mechanical Integrity
9. Hot Work Permits
10. Management of Change
11. Incident Investigation
12. Emergency Planning and Response
13. Compliance Audits
14. Trade Secrets

Employee Participation [1910.119(c)]- Employers must develop a written action plan to implement the required levels of employee participation in PSM. Employee participation is regarded as a key element of the standard. Management must consult employees and their representatives on the conduct and development of the process hazard analysis and other elements of the Standard. Employees and their representatives must also have access to the process hazard analyses and "all other" information that is required to be developed under the Standard.

Process Safety Information Requirements [1910.119(d)]- Employers must complete and compile written process safety information before conducting any process hazard analysis required by the Standard. This material must include information about:

- Highly hazardous chemicals in the process
- Technology of the process
- Equipment in the process

The information about the highly Hazardous Chemicals must at least include: toxicity information, permissible exposure limits, physical data, reactivity data, corrosivity data, thermal and chemical stability data, and information about the hazardous effects of the inadvertent mixing of differing materials that could foreseeably occur. Material Safety Data Sheets (MSDS) may satisfy this information requirement if they contain these items.

The information about the Technology of the Process must at least include a block flow or simplified process flow diagram; information about the process chemistry; the maximum intended inventory; the safe upper and lower limits for items such as temperature, pressures, flow, or compositions; an evaluation of the consequences that any deviations would have on the safety and health of the employees. If the original information no longer exists, it may be developed in conjunction with the hazard analysis.

The information about the Equipment in the Process must include information about the materials of construction; piping and instrument diagrams (P&ID’s); the electrical classification; relief system design and the design basis; the ventilation system design; the design codes and standards that were employed; information about the safety systems, such as interlocks, detection or suppression
systems; "accepted good engineering practices" documentation; material and energy balances for processes built after May 26, 1992. For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer shall determine and document that the equipment is designed, maintained, inspected, tested and operating in a safe manner.

Process Hazard Analysis [1910.119(e)] - An initial process hazard analysis that is appropriate to the complexity of the process must be conducted for each covered process.

Management is responsible for documenting and determining the order for conducting the hazard analyses at its plant or facility, taking into consideration such factors as the number of potentially affected employees, the age of the process, and the operating history of the process. The initial hazard analysis must identify, evaluate, and control the hazards of the process. It is critical that once hazards are identified, management develop recommendations to control the hazards, and implement the controls. The employer, again depending upon the complexity of the process, may use one or more of the following methodologies: What-If, Checklist, What-If/Checklist, Hazard and Operability Study (HAZOP), Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis, or an appropriate equivalent methodology.

The hazard analysis must at least consider and address seven elements:

1. Hazards of the process
2. Identification of any previous incident that had a likely potential for catastrophic consequences
3. Engineering and administrative controls that are applicable to the hazard
4. The consequence of the failure of the engineering and administrative controls
5. Facility siting, (any location or neighborhood factors that might contribute to or hinder response to a catastrophic incident)
6. Human factors (a consideration of the possibility of human error and the resources' capabilities of the company. OSHA recognizes that the smaller company may have to go outside for the necessary expertise)
7. Qualitative evaluation of the range of possible health and safety effects to the employees resulting from a failure of the controls

OSHA's standard favors a team approach. For the hazard analysis, at least one member of the team must be an employee who has knowledge and experience that is specific to the process. One team member must be familiar with the methodology used for the hazard analysis. OSHA recognizes that employees and other experts may be brought into the team on a temporary basis to contribute their own specialized knowledge to the process. The idea is to assemble the right team for the task.

Under the standard, management must establish a system to promptly address the team's findings and recommendations which are to be "resolved" in a timely fashion. This means that management must either implement the recommendations or, if they are not feasible, analyze and document the reasons why the team's recommendations have been modified or rejected. OSHA believes that the team must be free to make broad recommendations but recognizes that not all of the team's decisions will be correct. The "key" here is for management to provide the documentation. The employer's documentation should clearly outline the content, timing, and progress of the implemented recommendations.

OSHA’s PSM standard also addresses management and procedural issues. For example, the regulation provides that the initial hazard analyses should be reviewed and revalidated at five-year intervals. From a record-keeping standpoint, OSHA requires management to retain the process hazard analyses and revalidations for the life of the process. These requirements are designed to foster a climate for management's continued review of processes and safety issues.

Guidance

Written Standard Operating Procedures [1910.119(f)] - The regulations require management to develop and implement written operating procedures for each covered process. At a minimum, these operating procedures must cover the "steps" for each operating phase of the process, i.e., initial startup, normal operations and shutdown, emergency operations and shutdown; the operating limits of the process (an analysis of the consequences of any deviation with the process and the steps necessary to avoid the deviation); safety and health considerations, like chemical properties and hazards, control measures, and the effects of physical or airborne contacts; the safety systems and their functions. The employer is also charged with the responsibility for developing and implementing safe work practices for the control of hazards during the process. This would include among other items, lockout/tagout, confined space entry, hot work, and procedures regarding the opening of process equipment or piping.

Management must review and update the operating procedures as necessary to reflect its current practices and processes. OSHA's Standard does require the employer to annually certify that operating procedures are current, but does not elaborate on the
certification requirements. A document review page contained in the administrative control documents is an easy way to track and maintain annual certification of SOPs. The employees are to be given reasonable access to the operating procedures.

**Process Safety Training [1910.119(g)]** - The three components of Process Safety Training include an initial training requirement, refresher training, and training documentation. Employees involved in a process as of May 26, 1992, must receive training on an overview of the process and operating procedures, the specific health and safety hazards of the process, emergency operations, and safe working practices. In lieu of this training, an employer may certify in writing that the employee has the required knowledge, skills, and abilities to carry out the duties outlined in its operating procedures. Employees newly assigned to a process must receive the initial training.

Regulations provide that refresher training shall be provided to each employee involved in the process at least every three years. Management must consult with the employees involved in the process to determine the appropriate level of refresher training. Training documentation is the responsibility of management, who must be prepared to demonstrate for each employee, the date of training, the substance of the training, and the means used to verify that the employee understood the training. Including a test as part of the training process is an easy way to document the employee's understanding of the training content.

**Contractor Notification and Training [1910.119(h)]** - The Standard's contractor notice and training provisions apply to contractors who are performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. Specific employer and contractor employer obligations exist. The facility employer must obtain and evaluate the contract employer's safety program before selecting the contractor. After the selection, the facility employer must inform the contract employer about the known potential hazards of the process; explain an emergency action plan to the contract employer; develop and implement the safe work practices for the contract employer and the contract employees; periodically evaluate the contract employer's safety performance; maintain a log of contract employee's illness and injuries.

The contract employer is generally charged with the responsibility of relating the information provided by the facility's employer to the contract employees. The contract employer, like the site employer, is responsible for the training of the contract employee. This is a shared obligation in that the site employer must train the contract employer, and then the contract employer must train his or her employees. Although the contract employer alone is responsible for the training documentation for its employees, the facility employer would be well advised to monitor and insist upon proof of training documentation.

**Pre-Startup Safety Review [1910.119(i)]** - A pre-startup safety review is required for all new or modified facilities. This review involves a process hazard analysis prior to the introduction of hazardous substances into the process. The review itself is intended to confirm that the equipment and construction has been installed according to specifications and that safety, operating, and emergency procedures are in place and adequate.

**Mechanical Integrity Requirements [1910.119(jj)]** - The Standard calls for a series of measures to ensure the mechanical integrity of the process equipment, i.e., pressure vessels and storage tanks, piping, venting, valves and controls, and emergency shutdown systems. The essence of a good mechanical integrity program is "replacement in kind". Management must establish and implement written procedures to maintain the integrity of the system. The procedures should address maintenance, training for process activities, and inspection and testing procedures. Regulations require management to develop quality assurance and inspection programs including documentation (frequency of inspection, inspector, equipment identification number, description of test, and results). The employer must develop "pass/fail" criteria. Any situation that does not conform to the limits defined by the hazard analysis must be corrected.

**Hot Work Permits [1910.119(k)]** - Hot work permits are required for all operations conducted at or near covered processes. The permit should document that the fire prevention and protection requirements in 29 CFR 1910.252(a) have been implemented prior to beginning the hot work operations; it should indicate the date(s) authorized for hot work; and identify the object on which hot work is to be performed. The permit should be kept on file until completion of the hot work operations.

**Management of Change [1910.119(l)]**

Management must establish and implement written procedures to manage changes in or with the process technology, chemicals, and equipment. These procedures should cover all modifications to the process (or facility if it affects the process) except for changes "in kind." Considerations such as health and safety, technical basis for the change, impact of modifications to the procedure or process, training requirements, and authorization must be contemplated before the change is made. Some confusion surrounds mechanical integrity and management of change. Mechanical integrity is intended to maintain the process "as is"; whereas management of change is intended to control significant changes to the covered process.

**Incident Investigation [1910.119(m)]** - The standard also requires an "incident" investigation procedure. Each incident that has either resulted in or "could have" resulted in a release of a highly hazardous material must be investigated promptly (no later than 48 hours
after the event). The investigation team must include at least one person who is knowledgeable about the process and must include a contract employee if the incident involved work with the contractor. At a minimum, the incident investigation team’s report must include the date of the incident, the date that the investigation began, a description of the incident, a discussion of the factors that led to the incident, and the team’s recommendations. Afterwards, management must address and “resolve” the issues raised by the report and review the report with all affected process personnel, including contract employees. Incident reports must be retained for five years.

Emergency Planning and Response Plan [1910.119(n)] - The Process Safety Management Standard reaffirms OSHA’s existing requirement of emergency response planning. Management must have a plan that conforms to the requirements of OSHA’s Employee Emergency Planning provisions [29 C.F.R. 1910.038] and, where appropriate, the emergency planning provisions of the Hazardous Waste Operations and Emergency Response Regulations [29 C.F.R. 1910.120]. Every employer subject to compliance with PSM should carefully review the requirements and applicability of 29 CFR 1910.119 and 1910.120 to determine what their obligations are under these standards.

Compliance Audits [1910.119(o)] - A compliance audit must be completed at least every three years. The audit must be conducted by at least one person who knows the process. Since management must be in a position to certify its compliance with the PSM regulations, they would be well advised to also include at least one person who is well versed with the requirements of the regulation itself. The two most recent audit reports must be retained. Again, some confusion exists regarding compliance audits and PSM documentation. To summarize, the Standard requires annual certification of SOPs, a full compliance audit every three years, and a formal process hazard analysis review every five years.

Trade Secret Documentation [1910.119(p)]
Although no provisions exist for the protection of trade secrets, management bears the burden of demonstrating that their claim of a trade secret is bona fide. In the final rule comments, OSHA noted that it believes few bona fide trade secrets exist. Management should assemble the necessary documentation to substantiate any claim of trade secrets. The trade secret provisions afford a limited protection and do not restrict many of the information “accesses” supplied to the hazard analysis team members, employees, and their representatives. The Standard envisions “confidentiality agreements” as the employer’s primary means of protecting trade secrets.

In addition to the regulations found in 1910.119, OSHA also has 4 appendixes. Appendix A is the List of Highly Hazardous Chemicals, Toxics and Reactives. Appendix A is designated Mandatory. In addition to the mandatory appendix A, there are also 3 non-mandatory appendixes. Appendix B – Block flow Diagram and Simplified Process Flow Diagram; Appendix C – Compliance Guidelines and Recommendations for Process Safety Management; Appendix D – Sources of Further Information.

Conclusion
OSHA’s Process Safety Management Standard is intended to reduce the likelihood of a catastrophic event that could pose risk to employees, and the surrounding community. The regulation requires the employers to conduct an in-depth hazard analysis, and then develop robust controls. As noted above, OSHA’s PSM standard references other OSHA regulations such as emergency planning, control of hazardous energy, hazard communication, and hot work. Also as noted above, OSHA does have a guidance document (Appendix C) that provides assistance and guidance for employers who are subject to the PSM standard.

References
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