Health and Safety Programs

Process Safety Management

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What is process safety?

The overall goal of a process safety management system is to protect workers, the surrounding community, and the environment while also protecting the business and its assets. Although process safety slightly differs from other occupational health and safety programs, they complement each other and are equally important for protecting workers.

Process safety focuses on the control of hazards and risks associated with highly hazardous processes. These processes involve chemicals, where process incidents or failures may result in fatalities, injuries, exposures, fires, explosions, chemical releases, spills, structural collapses, equipment malfunctions, and other consequences. Process safety management involves the use of systems and principles to continuously identify hazards, assess risks, and control hazards associated with high-risk processes. Process safety management is also important for responding to and recovering from process-related incidents.

When new processes are being introduced or when there are changes to a process, hazards, risks, and control measures need to be revalidated. Process safety management is important for many types of industries, and examples include oil and gas, energy generation, manufacturing, mining, food and beverage, pharmaceutical, chemical, pulp and paper, construction, and others.

How is a process safety management system developed?

Developing a comprehensive process safety management system (or process safety plan) for your organization requires forming a cross-functional team of managers, supervisors, and workers who are knowledgeable about the operating systems and work activities. External expertise from engineers and professionals may also be required to ensure compliance with health and safety legislation, environmental legislation, and applicable codes. Collaborating and seeking input from other organizations with similar processes is also recommended to make sure all the hazards and risks have been identified and adequate controls are in place.

How is process safety analyzed?

The complexity of a process safety analysis will depend on the type of process. The analysis includes identifying potential hazards and assessing the risks.

Multiple methods, frameworks and terminology are used for analyzing and strengthening process safety. Examples include:

- Process Hazard Analysis (PHA)
- Failure Mode and Effects Analysis (FMEA)
- Hazard and Operability Study (HAZAOP)
- Fault Tree Analysis (FTA)
- Customized Checklists
- CSA Standard Z767:17 Process Safety Management

When there are changes made to a process, or there are other changes that can impact a process (e.g., climate change), the hazards and risks need to be identified and assessed again, and the control measures revalidated, with the required modifications to the controls being made if needed.

Identifying potential hazards

It is important to identify the potential sources of harm or failure associated with a process throughout its lifecycle. These include chemical, fire and explosion hazards and natural or climate-related hazards, such as wildfires, flooding, severe winds, high temperatures, and storms. It is also important to consider worst-case situations and scenarios (e.g., extreme weather events) to identify all potential hazards.

Assessing the risk of the hazards

Risk assessments for each of the hazards identified must be done to help determine the appropriate control measures and to prioritize the order in which the hazards need to be addressed.

Risk assessment takes into account the severity of the consequences (e.g., the potential impact on people, environment, and property) and the probability or likelihood of the consequences occurring.

Process safety often requires the use of modelling tools or other techniques for assessing the severity and probability.

How can a workplace control the hazards?

After the hazards have been identified and the risks assessed, appropriate control measures can be implemented, or existing controls can be modified if needed. It is important to have redundancies in place if a control measure fails or is breached. This higher level of protection can be accomplished by adopting a layer of controls. The hierarchy of controls, which is a step-by-step approach to eliminate or reduce the risk of workplace hazards, should be considered. The hierarchy of controls prioritizes controls from the most effective level of protection to the least effective level of protection.

Elimination is the most effective method of control because it involves removing the source of the hazard. This control typically involves the removal of a hazardous substance or process. For example, removing a step in a process that is not needed.

Substitution is also very effective and involves using an alternative chemical or process that is less hazardous. For example, replacing a highly toxic and flammable chemical used in a process with a safer alternative.

Engineering Controls are very important for process safety and involve steps or methods that are built into the design of the plant, equipment, or process to minimize the hazard. They are a reliable way to remove or control workplace hazards as long as the controls are designed, used, and maintained properly. Examples of engineering controls include:

- Appropriate ventilation
- Pressure or explosion relief venting
- Automated process controls for maintaining safe operating parameters (e.g., temperature, pressure, flow, safe shutdowns)
- Backup power supply in the event of a power failure
- Protective barriers, enclosures, and isolation
- Use of electrical equipment that is designed for hazardous locations (as required by the applicable electrical code).
- Appropriate use of interlocks
- Appropriate fire detection and suppression systems (as specified in the applicable fire code).

- Adequate secondary containment for hazardous chemicals
- Proper design of building structures, such as walls and equipment to prevent the spread of a fire and to withstand damage from a fire or explosion. Requirements are often outlined in building codes and fire codes.
- Making sure equipment and process components are designed, constructed, installed, and maintained in accordance with the manufacturer's requirements and in accordance with the applicable legislation (e.g., health and safety legislation, building codes, electrical codes, fire codes, pressure vessel codes, etc.)

Administrative controls include training and educating workers and developing or improving work policies, practices, and procedures.

Examples of work practices and procedures include:

- Maintenance planning and work
- Developing clear instructions for workers on how to monitor and operate the process safely under all potential conditions
- Developing emergency response procedures
- Developing business continuity plans

Examples of training include:

- Making sure workers understand how to safely monitor and operate the process controls – computerized process controls may add complexity to the operations, and workers need to be familiar with all alarms and how to monitor and control the operating parameters.
- Training and drills on emergency response procedures

Personal Protective Equipment (PPE) is the last line of defence against a hazard and should only be used in addition to other control measures. This control provides protection for the worker. Using this control includes making sure workers responsible for operating and maintaining a process and those who respond to emergencies have access to the required PPE to perform their duties safely. There are many types of PPE, which include respiratory protection, head protection, skin protection, eye and face protection, gloves, protective footwear, etc. The appropriate PPE must be selected based on the hazards and risks. Workers must also be instructed and trained on the proper use and care of any PPE they use, as well as any limitations.

How do workplaces verify the effectiveness of controls?

Process safety also requires a system in place to continuously monitor the safety of a process and the effectiveness of the controls. This system ensures any deviations from the normal operating parameters and other potential risks are identified and addressed before an incident or failure occurs. It is important that process control deficiencies and unacceptable levels of risk are dealt with immediately.

Should workers be involved in process safety?

From a high level, this framework is similar to identifying, assessing, and controlling other workplace health and safety hazards. Regarding process safety, it is important to include and consult individuals with relevant engineering and technical expertise. This consultation is required to help make sure all risks and hazards associated with a process have been considered.

It is also crucial to consult with workers and consider the risks from their perspective. It is important not only to identify hazards for the process but also for workers who operate and maintain the process and other workers who could be impacted. For example, consider the hazards associated with the operation, cleaning, maintenance, deconstruction, and other activities where a worker could suffer an injury or exposure. Appropriate controls must be in place and continuously monitored based on the hazards and risks to protect workers.

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