Process Safety Management

An Online Continuing Education Course for Engineers

Course Number: H-3002

Credit: 3 Hours / 3 PDH / 3 CPD

Process Safety Management

Introduction

Process Safety Management (PSM) is an analytical tool focused on preventing releases of any substance defined as a "highly hazardous chemicals" by the U.S. Environmental Protection Agency (EPA) or the Occupational Safety and Health Administration (OSHA). This course summarizes the requirements of OSHA's *Process Safety Management of Highly Hazardous Chemicals Standard*, *Title 29, Code of Federal Regulations* (*CFR*) Part 1910.119.

The standard mainly applies to manufacturing industries—particularly, those pertaining to chemicals, transportation equipment, and fabricated metal products. Other affected sectors include natural gas liquids; farm product warehousing; electric, gas, and sanitary services; and wholesale trade. It also applies to pyrotechnics and explosives manufacturers covered under other OSHA rules and has special provisions for contractors working in covered facilities.

The Problem

Unexpected releases of toxic, reactive, or flammable liquids and gases in processes involving highly hazardous chemicals have been reported for many years. Incidents continue to occur in various industries that use highly hazardous chemicals which may be toxic, reactive, flammable, or explosive, or may exhibit a combination of these properties. Regardless of the industry that uses these highly hazardous chemicals, there is a potential for an accidental release any time they are not properly controlled. This, in turn, creates the possibility of disaster.

Some fairly recent major disasters include the 1984 Bhopal, India, incident resulting in 3,800 deaths; the October 1989 Phillips Petroleum Company, Pasadena, TX, incident resulting in 23 deaths and 132 injuries; the July 1990 BASF, Cincinnati, OH, incident resulting in 2 deaths, and the May 1991 IMC, Sterlington, LA, incident resulting in 8 deaths and 128 injuries.

Although these major disasters involving highly hazardous chemicals drew national attention to the potential for major catastrophes, the public record is replete with information concerning many other less notable releases of highly hazardous chemicals. Hazardous chemical releases continue to pose a significant threat to employees and provide impetus, internationally and nationally, for authorities to develop or consider developing legislation and regulations to eliminate or minimize the potential for such events.

On July 17, 1990, OSHA published in the *Federal Register* (55 FR 29150) a proposed standard—"Process Safety Management of Highly Hazardous Chemicals"—containing requirements for the management of hazards associated with processes using highly hazardous chemicals to help assure safe and healthful workplaces.

OSHA's proposed standard emphasized the management of hazards associated with highly hazardous chemicals and established a comprehensive management program that integrated technologies, procedures, and management practices.

The notice of proposed rulemaking invited comments on any aspect of the proposed standard for process safety management of highly hazardous chemicals and announced the scheduling of a hearing to begin on November 27, 1990, in Washington, DC.

On November 1, 1990, OSHA published a *Federal Register* notice (55 FR 46074) scheduling a second hearing to begin on February 26, 1991, in Houston, TX, enumerating additional issues, and extending the written comment period until January 22, 1991.

The hearings on the proposed standard were held in Washington, DC, from November 27, 1990, through December 4, 1990, and in Houston, TX, from February 26, 1991, through March 7, 1991. The Administrative Law Judge presiding at the hearings allowed participants to submit post-hearing comments until May 6, 1991, and file post-hearing briefs until June 5, 1991. OSHA received more than 175 comments in response to the notice of proposed rulemaking. In addition to these comments, the hearings resulted in almost 4,000 pages of testimony and almost 60 post-hearing comments and briefs. For convenience, the full text of the final OSHA standard issued in the *Federal Register* on February 24, 1992, is included as an attachment to this course.

States may administer their own occupational health and safety programs through plans approved under section 18(b) of the Occupational Safety and Health Act of 1970. Such plans must adopt standards and enforce requirements which are at least as effective as Federal requirements.

Approximately four months after the publication of OSHA's proposed standard for process safety management of highly hazardous chemicals, the Clean Air Act Amendments (CAAA) were enacted into law (November 15, 1990). Section 304 of the CAAA requires that the Secretary of Labor, in coordination with the Administrator of the Environmental Protection Agency (EPA), promulgate, pursuant to the Occupational Safety and Health Act of 1970, a chemical process safety standard to prevent accidental releases of chemicals that could pose a threat to employees.

The CAAA requires that the standard include a list of highly hazardous chemicals which includes toxic, flammable, highly reactive, and explosive substances. The CAAA also specified minimum elements that the OSHA standard must require employers to do, as follows:

(1) Develop and maintain written safety information identifying workplace chemical and process hazards, equipment used in the processes, and technology used in the processes;

(2) Perform a workplace hazard assessment, including, as appropriate, identification of potential sources of accidental releases, identification of any previous release within the facility that had a potential for catastrophic consequences in the workplace, estimation of workplace effects of a range of releases, and estimation of the health and safety effects of such a range on employees;

(3) Consult with employees and their representatives on the development and conduct of hazard assessments and the development of chemical accident prevention plans and provide access to these and other records required under the standard;

(4) Establish a system to respond to the workplace hazard assessment findings, which shall address prevention, mitigation, and emergency responses;

(5) Review periodically the workplace hazard assessment and response system;

(6) Develop and implement written operating procedures for the chemical processes, including procedures for each operating phase, operating limitations, and safety and health considerations;

(7) Provide written safety and operating information for employees and employee training in operating procedures, by emphasizing hazards and safe practices that must be developed and made available;

(8) Ensure contractors and contract employees are provided with appropriate information and training;

(9) Train and educate employees and contractors in emergency response procedures in a manner as comprehensive and effective as that required by the regulation promulgated pursuant to section 126(d) of the Superfund Amendments and Reauthorization Act;

(10) Establish a quality assurance program to ensure that initial process-related equipment, maintenance materials, and spare parts are fabricated and installed consistent with design specifications;

(11) Establish maintenance systems for critical process-related equipment, including written procedures, employee training, appropriate inspections, and testing of such equipment to ensure ongoing mechanical integrity;

(12) Conduct pre-startup safety reviews of all newly installed or modified equipment;

(13) Establish and implement written procedures managing change to process chemicals, technology, equipment and facilities; and

(14) Investigate every incident that results in or could have resulted in a major accident in the workplace, with any findings to be reviewed by operating personnel and modifications made, if appropriate.

Also the CAAA identifies specific duties for EPA relative to the prevention of accidental releases (see section 301 (r)). Generally, EPA must develop a list of chemicals and a Risk Management Plan.

How the Standard Works

Subject to the rules and procedures set forth in OSHA's Hazard Communication Standard (29 *Code of Federal Regulations* (*CFR*) 1910.1200(i)(1) through 1910.1200(i)(12)), employees and their designated representatives must be given access to trade secret information contained within the process hazard analysis and other documents required to be developed by the PSM standard.

The key provision of PSM is process hazard analysis (PHA)—a careful review of what could go wrong and what safeguards must be implemented to prevent releases of hazardous chemicals. Covered employers must identify those processes that pose the greatest risks and begin evaluating those first. PSM clarifies the responsibilities of employers and contractors involved in work that affects or takes place near covered processes to ensure that the safety of both plant and contractor employees is considered. The standard also mandates written operating procedures; employee training; pre-startup safety reviews; evaluation of mechanical integrity of critical equipment; and written procedures for managing change. PSM specifies a permit system for hot work; investigation of incidents involving releases or near misses of covered chemicals; emergency, action plans; compliance audits at least every three years; and trade secret protection.

To understand PSM and its requirements, employers and employees need to understand how OSHA uses the term "process" in PSM. Process means any activity involving a highly hazardous chemical including using, storing, manufacturing, handling, or moving such chemicals at the site, or any combination of these activities. For purposes of this definition, any group of vessels that are interconnected, and separate vessels located in a way that could involve a highly hazardous chemical in a potential release, are considered a single process.

Process Safety Information

Employers must complete a compilation of written process safety information before conducting any process hazard analysis required by the standard. The compilation of written process safety information, completed under the same schedule required for process hazard analyses, will help the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals. Process safety information must include information on the hazards of the highly hazardous chemicals used or produced by the process, information on the technology of the process, and information on the equipment in the process.

Information on the hazards of the highly hazardous chemicals in the process shall consist of at least the following:[1]

- Toxicity,
- Permissible exposure limits,
- Physical data,
- Reactivity data,
- Corrosivity data, and
- Thermal and chemical stability data, and hazardous effects of inadvertent mixing of different materials.

Information on the technology of the process must include at least the following:

- A block flow diagram or simplified process flow diagram,
- Process chemistry,
- Maximum intended inventory,
- Safe upper and lower limits for such items as temperatures, pressures, flows or compositions, and
- An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

Information on the equipment in the process must include the following:

- Materials of construction,
- Piping and instrument diagrams (P&IDs),
- Electrical classification,
- Relief system design and design basis,
- Ventilation system design,

[1] Note: Material Safety Data Sheets (MSDS's) meeting the requirements of the Hazard Communication Standard (20 CFR 1910.1200) may be used to comply with this requirement to the extent they contain the required information.

- Design codes and standards employed,
- Material and energy balances for processes built after May 26, 1992, and
- Safety systems (e.g., interlocks, detection, or suppression systems).

The employer shall document that equipment complies with recognized and generally accepted good engineering practices. 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 operated in a safe manner.

The compilation of the above described process s… …s for identifying and understanding the hazards of a… …hazard analysis and may be nec… …ent of change and incid…

Proc…

The pr… …, evaluating, and contro… …er must perform an initi… …s standard. The process… …the process and must ide…

First, en… …rocess hazard analyses … …s hazards, the number … …istory of the process. A… …zard analyses must be u…

The emplo… …ermine and evaluate th…

- Wh…
- Che…
- Wh…
- Haz…
- Failu…
- Faul…
- An a…

A discussion … …analysis is contained in OSHA 3133, *Process Safety Management–… …Compliance*. Whichever method(s) are used, the process hazard analysis must address the following:

- The hazards of the process;
- The identification of any previous incident that had a potential for catastrophic consequences in the workplace;
- Engineering and administrative controls applicable to the hazards and their interrelationships, such as appropriate application of detection methodologies to provide early warning of releases. Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors;