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The Evolution and Need for Process Safety Management Regulations

By Craig "Jim" Browning

First a word of introduction. I am a 40+ year veteran of the refining industry. I began as a 19 year old working as a laborer in a large refinery. I had a number of positions over the course of my career at that facility including Quality Control Lab Technician, Process Unit Operator, Operations Shift Supervisor, Operations Supervisor, and a position that meshed operations activities with Process Safety Management (PSM) requirements. Since "retiring" 10 years ago, I have worked as a consultant in the refining industry in a variety of PSM compliance-related efforts for various clients.

OSHA Process Safety Management regulations for the handling of a defined list of "Highly Hazardous Chemicals" became law in the United States in 1992. These regulations were prompted by several major releases at facilities around the world that resulted in multiple fatalities both inside the respective plant and in their surrounding communities. Since that time, the PSM regulations have been modified and adjusted periodically to best serve the interests of the refining and chemical industry and the general public. Process Safety Management regulations consist of 14 Elements covering all aspects of Highly Hazardous Chemical management. Some elements are intended to be preventive in nature, while others are mitigative and/or in response to a PSM incident. In general, a PSM incident is considered a "loss of primary containment" – something with the potential to be hazardous if it got out of the pipes or other pressure containing equipment. An understanding of the difference between personal safety and process safety can be explained in this way: A personal safety event affects an individual, or possibly a small number of co-workers. A process safety event can affect a large number of employees and possibly the community outside the facility.

The 14 Elements of Process Safety Management are:

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

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Work Highlights

Operations

- *Provided first line operations and fired equipment health audit consulting onsite at various domestic and foreign locations.*

Process Development

- *Provided guidance on corrosion potential, metal dusting, alloy selection, plus process consultation for technology development work.*

Project Management

- *Full time procurement consulting support provided for a major chemicals plant located in the Far East. Our procurement advisor was an integral member of the Owner's Project Management team and was resident in the contractor's office for over 18 months.*
- *Provided full time engineering manager for major expansion project for a US Gulf Coast refinery.*

All sites that are PSM-covered facilities, based on the types of chemicals they handle or the volume of flammable/toxic materials onsite, are required under the law to conduct a rigorous **Compliance Audit** every three years.

The **Trade Secrets** element of PSM protects the business interest of companies while at the same time allowing for open auditing of a site's management systems and practices.

But, when I began my career, there were no PSM requirements and things were very different than they are today. I want to emphasize that none of the activities I will discuss were ever malicious or intended to be reckless, we simply didn't recognize and understand the risk.

1. In my early roles as a laborer and then a Lab Technician, I frequently worked with chemicals and materials that I didn't know much about. We would clean sludge from tank floors with what would today be completely unacceptable Personal Protective Equipment. In the laboratory, I (we) used Benzene to remove grease and oils from the work areas, with no gloves. Today **Process Safety Information** requirements make it possible for employees to know and understand the hazards associated with the work they are undertaking.
2. Also, the laboratory personnel were responsible for firefighting and emergency response, we referred to ourselves as the "Involuntary Fire Department." We were trained and my company had good equipment; however, I doubt you would have wanted us to show up if there was an emergency at your house. Today's PSM requirements for **Emergency Response and Planning** provide a well-planned, proceduralized, and structured response to emergencies.
3. When I started as an operator in a process unit, all of the training was hands on with an experienced operator, even if that individual just finished his/her training the week before. There was no training material or qualification criteria. A person trained for a pre-determined amount of time and then went to work. Today, with PSM requirements for **Training**, there are well developed training materials and clear guidelines for operator qualifications before conducting work in process units containing Highly Hazardous Chemicals.
4. In the same way, there was no established training and operator qualification process, there were also no standardized operating guidelines. Each person, or shift, performed operational activities such as startup, shutdown, and emergency response the way they had learned and thought best for the situation at the moment. Today, **Operating Procedures**, which have been reviewed and approved for use by a team of individuals, are used for all phases of unit operation.
5. Without standardized Training, Operating Procedures, and accurate Process Safety Information, there were broad varieties of opinions as to how a process unit could be operated. In the effort to maximize production, it was possible to inadvertently exceed equipment design conditions as well as fail to perform critical aspects of the operation. Some form of operating limits would typically be established only after an event occurred. Today a **Process Hazard Analysis** is required for each PSM-covered process every five years. These detailed hazard analysis reviews utilize a multi-disciplined team of individuals with expertise in the specific unit under review to identify potential hazards and establish sufficient safeguards with the intent of preventing a PSM-related incident. When potential hazards are identified, corrective actions must be developed and implemented to strengthen the existing safeguards to reasonably prevent the event.
6. On a night shift on a cold night, we were starting up a Propylene Unit. In the transient operation to bring the unit up, a control valve on the feed line from the charge pump to the reactor would vibrate and chatter while at minimum flow. This night, the vibration caused the bleeder valve piping to crack and the valve broke off. There was a large release but with the cold weather the vapor cloud did not ignite. The production impact of shutting this unit down was significant and would result in both FCC and Crude Unit rate cuts or even shutdown. To prevent this refinery-wide rate reduction, three of us decided that since we fortunately had an operator in another unit who could weld, we would just weld the bleeder valve back on. We pulled a portable welder into the unit, started a Nitrogen sweep into the new valve, and the operator welded the valve in place. We had the unit back online in less than an hour and the refinery cutback was avoided. Today's **Mechanical Integrity** guidelines would have required both a thorough inspection of the failed piping and a mechanic/welder who is certified to weld on Class 1 piping to make that type of repair. Also, today, an **Incident Investigation** would be conducted and the equipment would not be restarted until the investigation concluded that startup was safe. Back then, we were recognized for our efforts. Today we would most likely be fired.



7. In order to keep units running, it would be necessary at times to make temporary repairs. This may involve replacing anything from pressure gauges to small piping or instrumentation components. Without accurate Process Safety Information, that included design conditions and materials of construction, we used what was available. A number of tragic, and nearly tragic, incidents occurred across the industry due to materials being installed that were not adequate for the service where installed. Today the **Management of Change (MOC)** process is utilized to control changes to PSM-covered equipment. If a change is required, the MOC process is used to methodically evaluate and document the alteration to the process equipment to eliminate the potential for a release.
8. In my early days as an operator when maintenance work was completed on individual equipment, the hand off between maintenance and operations was informal at best. Job completion was in the eye of the mechanic, who was also most likely working with no written procedures or checklist. When “they” said it was ready “we” put the equipment back in service. All too frequently, we would find out after the fact that something wasn’t quite right. Anything from small gasket leaks to major unit fires occurred during startups, often resulting in units having to be shut back down for even more extensive repairs than the original maintenance activity. Today, there are requirements for **Pre-Startup Safety Reviews** that are intended to ensure that all aspects of unit maintenance are completed prior to returning equipment to service. These reviews include not just maintenance activities; they also include operational checks, MOC completion, confirmation that normal and emergency procedures are in place, there are adequate emergency response provisions, activated alarms, and training has been completed, etc.
9. In the facility where I worked, a contractor workforce was typically only used during major turnarounds. This infrequent use of contractors meant that the individuals would be from out of town and would only be there for the duration of the work. For the most part, these were highly skilled craftsmen who did a great job. However, it was “assumed” they knew all of the safety rules and understood the hazards of the chemicals they could be exposed to. All too often, neither assumption was accurate. Today, **Contractors** are required to be trained and educated on all PSM requirements relative to the process equipment they will be working on.
10. Lastly, two separate events that I was not personally involved in but have stayed fresh in my mind for a long time, were fatalities at our facility. One occurred during a fired heater startup when the ignition torch was introduced into a heater firebox that had not been adequately purged to remove uncombusted gas. The heater exploded killing the operator who was inserting the torch into the firebox. The second involved a contractor who left his toolbox key at home. He lit a cutting torch to cut the lock off of his toolbox in order to be on the job site on time. Tragically, his tool box was sitting near an oily water sewer and the torch flame ignited gasses in the sewer. The resulting explosion blew the manway cover into the man’s head killing him. Both of these horrible incidents could have been prevented with today’s PSM requirements for **Hot Work**. Had Hot Work gas testing and permitting processes been followed, these two men would have gone home to their families at the end of those terrible days.

These days, much of my work involves facilitating Process Hazard Analysis (PHA) reviews and PSM Auditing. As I talk with a much younger generation of refinery and chemical plant workers, I sometimes will ask them to tell me about their “Bad Day.” It has become increasingly encouraging to me to hear about the worst thing a 5-10-year operator ever having experienced being what I would have at one time considered a minor event. Part of the passion for what I do now is driven by a desire to help make sure that we don’t go back to “the good old days” of process operations.

In a business environment driven by regulation, there are ample opportunities to provide services to clients. Unfortunately, regulatory work also provides opportunities for providers who are just in the business for the money to deliver a product that may meet the minimum regulatory requirement but add no value to the client’s workplace. Our challenge is to always provide excellent service in the areas of our expertise with the focus and intent to improve the overall safety of the refining and chemical industry.

Please contact Jerry Lacatena, Process Department Manager (jlacatena@carmagen.com) if you’d like more information on Carmagen’s expertise in this area. Carmagen Engineering, Inc. is an engineering consulting company with experienced staff that can support clients’ efforts associated with utilities and offsites requirements.

