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Lessons Learned from 40 Process Safety Management Audits

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Background Information

Following tragic events such as the 1984 Bhopal, India incident as well as several high-profile industrial accidents around the United States in the late 1980's and early 1990's, amendments to the Clean Air Act (CAA) were enacted into law on November 15, 1990. Section 304 of the CAA required the Secretary of Labor, in coordination with the Administrator of the Environmental Protection Agency (EPA), to 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.

On May 26, 1992, 29 CFR Part 1910.119 – Process Safety Management (PSM) of Highly Hazardous Chemicals, became effective. The purpose of this Occupational Safety and Health Administration (OSHA) standard is to establish requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable or explosive chemicals. To protect the public and environment beyond the regulated facilities' property lines, the EPA promulgated the Risk Management Rule (49 CFR Part 68) in 1996. The EPA and OSHA standards are performance based and are very similar in nature but have some differences. In simple terms, the OSHA PSM Standard is intended to protect employees. The EPA Risk Management Program (RMP) regulation is intended to protect the public and the environment. Both standards require a compliance audit at least once every three (3) years.

Since the inception of the OSHA standard, the author has facilitated or participated in over 40 compliance audits or GAP analyses in the United States, Canada, the United Kingdom and Germany. The purpose of this document is to review common compliance deficiencies found during the course of these audits and GAP analyses.

The OSHA PSM Standard contains the following elements:

- 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 Investigations
- Emergency Planning and Response
- Compliance Audits
- Trade Secrets

What follows is a listing of the most frequently observed PSM program deficiencies.

Process Safety Information (PSI): 29 CFR 1910.119(d)

1. The PSI did not address the hazardous effects of inadvertent mixing of different materials that could forseeably occur.

2. The PSI did not include:

   - Maximum intended inventories including quantities stored in railcars and other transportation containers
   - Safe upper and lower operating limits and never-exceed limits (based on equipment design specifications)
   - Evaluations of the consequences of deviations

3. The PSI also did not include:

   - The area electrical hazard classification
   - The relief system design and design basis
   - The vent system design basis (for occupied buildings in the process areas)
   - The equipment and process design codes and standards employed

4. The piping and instrumentation diagrams (P&ID's) did not show expansion joints or hoses and reference the specifications for each.

Process Hazard Analysis (PHA): 29 CFR 1910.119(e)

1. The PHA methodology was not appropriate to the complexity of the process. As a result numerous hazards were overlooked or not identified.

2. The PHA did not take into consideration previous incidents that had a likely potential for catastrophic consequences.

3. The PHA was performed by a team but lacked expertise in one or more of the following areas:

- Engineering and Process operations
- A person knowledgeable of the specific process
- A person knowledgeable in the PHA methodology

4. There is no system for tracking the status of control actions resulting from PHA's.

5. There was no documentation of temporary controls put in place to address a specific hazard while permanent controls are being developed. For example, what actions are being taken to protect building occupants from over pressure due to an explosion while a new building or control room is built?

6. There is no system to communicate the PHA results and the status of action items to affected operations and maintenance personnel.

7. The company's maximum "acceptable level of risk" has not been defined. As a result, there is no system to quantify the potential level of risk associated with a hazard and what level is unacceptable to the company. **Note:** This is a good management practice (GMP).

8. Credit factors for mitigating risk have not been established. (GMP) What is the value of an engineering control as opposed to an administrative control? How many controls are required to reduce the level of risk to that which is acceptable to the company?

9. Credit factors for mitigating risk are not documented in the "recommendations " section of the PHA worksheets. (GMP) If the recommendation is implemented, what will be the resulting risk level? Management needs this information to make intelligent decisions.

10. The team failed to evaluate the potential for operator overload from alarms and tasks in an emergency.

11. Failure to evaluate the need for automatic and remote operated isolation valves for critical equipment.

12. Failure to evaluate possible building over-pressure in event of an explosion (temporary and permanent buildings).

13. Failure to evaluate the quality and reliability of critical instruments and controls.

14. Failure to evaluate the risk of heat exchanger failure and the need for early detection and warning.

15. Failure to evaluate the hazards presented by blow down drums and flares.

16. Failure to verify the accuracy of the process safety information, including but not limited to, standard operating procedures and the piping and instrumentation diagrams.

17. Failure to walk through the facility prior to conducting the PHA to identify any major deficiencies and the potential for critical piping to be struck by vehicular traffic.

18. PHA documentation is kept only on computer using a commercially available software, but there is no one available who can access and print the data when needed. In some cases the information was lost when computers crashed, and there was no back up of the data. In other cases the individual who led the PHA was the only one trained to use the PHA software and no longer works for the company.

19. Failure to record and retain the actual documents or reference material used in the PHA (P&ID's, SOP's including document name and / or number, issue and revision dates).

Operating Procedures: 29 CFR 1910.119(f)

1. Operating procedures do not include:
    - Emergency shutdown including the conditions under which emergency shutdown is required and the identity by job title of those responsible for authorizing shutdown.
    - Critical operating limits, never-exceed limits, including the consequences of deviation and the steps required to correct or avoid deviation.
    - Quality control for raw materials and control of hazardous chemical inventory levels.
    - Operating procedures do not include or reference all of the safety systems and their intended functions. Safety systems include but are not limited to:
        - Pressure control systems and alarms
        - Temperature control systems and alarms
        - Level control systems and alarms
        - Flow control systems and alarms
        - Pressure relief systems, including pressure safety valves, rupture disks and disposal of the relieved material
        - Process interlocks and emergency shutdown systems
        - Flammable and toxic gas detection systems
        - Fire protection systems

2. Operating procedures are not reviewed at least annually and certified as current and accurate.

3. Pre-startup and shutdown checklists mandated in the operating procedures are not used or completed.

4. Operating logs sheets are not completed and audited.

5. Work Permit Procedures such as Lockout / Tagout, Line Entry and Confined Space Entry are not audited.

6. Gas testing equipment used to issue work permits is not properly calibrated and bump-checked. **Note:** This is also a Mechanical Integrity issue.

Training Programs: 29 CFR 1910.119(g)

1. Operator refresher training has not been performed at least every three (3) years.

2. Operator training documentation does not include one or more of the following:

- The identity of the employee
- The date of the training
- The means to verify the employee understood the training.

3. Operations personnel cannot locate operating procedures and MSDS's in the computer.

4. Operators cannot explain or describe conditions requiring emergency shutdown.

5. There was no documentation to indicate how site personnel were consulted on the frequency of refresher training.

Contractors: 29 CFR 1910.119(h)

1. There is no procedure for evaluation of prospective contractors' safety performance and procedures.

2. There is no documentation that the facility obtained and evaluated contractors' safety performance prior to issuing a contract to work on or near a covered process.

3. There is no documentation of contractor orientation concerning potential fire, explosion or toxic release hazards related to the process.

4. There is no documentation of the facility's safe work practices relative to Lockout / Tagout, Confined Space Entry, Line Entry and entry into covered processes by contractors.

5. There is no documentation the facility is auditing contractor compliance with safe work practices, such as but not limited to Lockout / Tagout, Confined Space Entry, Line opening, MOC requirements, PPE requirements and Emergency Reporting and Response Procedures.

Pre-Start Up Safety Reviews (PSSR): 29 CFR 1910.119(i)

1. PSSR's are not always performed and documented prior to start-up of new processes or after major process modifications that require a change in Process Safety Information.

2. PSSR's do not always address:

    - Verification that construction and equipment meet the design specifications.
    - Safety, operating, maintenance and emergency procedures are in place and are adequate.
    - PHA action items have been resolved / implemented before start-up.
    - Operators and maintenance personnel have been appropriately trained.

Mechanical Integrity Program: 29 CFR 1910.119(j)

1. The facility does not have a list of the following types of PSM critical equipment:

- Pressure vessels and storage tanks
- Piping systems
- Pressure relief devices
- Instruments
- Pumps

Note: To ensure that all PSM-critical equipment has been covered in the MI Program, check the PHA. If the PHA team listed an instrument or piece of equipment as a safeguard, it should be identified on the PSM-critical equipment list.

2. There is no documentation that maintenance or contractor employees who perform maintenance and service work have been trained in an overview of the process and its hazards.

3. There are no (or insufficient) written procedures for maintenance and inspection of process equipment.

4. Inspections and tests are not being performed on process equipment in accordance with the facility's schedule, which should be based on generally accepted good engineering practices.

5. There are no procedures to assure that maintenance materials and spare parts are suitable for the process application for which they are used.

6. There is no Positive Materials Identification (PMI) of metallic parts or equipment components. This is critical when exotic metals are used. There is equipment on the market today to identify metallurgy very quickly.

7. Checks of critical instrumentation and safety devices may include a loop check (that a signal was sent and received) but often fail to include an actual operational check to assure that the controller functioned as intended (i.e., valve opened or closed as intended or the equipment shut down).

8. Facilities have indicated that they have adopted certain industry standards (such as API, ANSI, etc.) for the inspection and testing of tanks, pressure vessels and piping but have not fully implemented the requirements of the adopted standards nor have inspection personnel been trained and certified to perform such inspections.

9. On stream leak repairs and kits are not evaluated as part of the MOC process.

10. There is no documentation that personnel who made welds or repairs on ASME code vessels were actually qualified to do so.

11. There is no (or incomplete) documentation as to what repairs or adjustments were made by service / maintenance personnel.

12. There was no documentation to indicate that maintenance and service personnel were trained and certified to perform tasks such as but not limited to:

- Welding
- Non-destructive testing
- Pressure relief valve testing and repair

13. There was no procedure indicating what measures must be taken if inspection or test results are outside the minimum acceptable criteria.

14. There was no documentation as to what was actually done when inspection / test results on PSM-critical equipment were outside the minimum acceptable limits.

15. Piping inspections do not include pipe supports and hangers.

Hot Work: 29 CFR 1910.119(k)

1. The facility does not have a Hot Work Permit system that documents the fire prevention and protection requirements for welding and cutting as outlined in 29 CFR 1910.252(a)(2)(iv).

2. The Hot Work Permits are not correctly completed in that one or more of the following is missing:

    - Date
    - Identify of object being welded

3. Critical equipment such as cable trays, sumps and sewers are not adequately protected from slag and sparks generated by hot work.

4. Fire Watch personnel cannot accurately describe their duties and responsibilities.

Management of Change (MOC): 29 CFR 1910.119(l)

1. There is no written procedure to manage change to a covered process with respect to changes in process chemicals, technology, equipment and procedures or stationary sources.

2. MOC procedures do not address one or more of the following items:

    - Technical basis for the proposed change
    - Impact on safety and health (and the methods for doing so)
    - Modifications to operating procedures
    - Time period for the change
    - Authorization / approval requirements

3. Employees affected by the proposed changes are not informed / trained on the changes prior to implementation.

4. PSI is not updated when a change is made.

5. Operating, maintenance, safety or emergency response procedures are not updated when a change is made.

6. Temporary changes are allowed to become permanent without the required review and approval.

7. Emergency changes do not go through a formal review process.

8. The MOC process is so cumbersome that personnel look for ways to circumvent the system.

9. The design basis for flares, vents and blowdown systems are not reviewed when changes are made to equipment upstream.

Incident Investigation: 29 CFR 1910.119(m)

1. Incidents that did or could have resulted in a catastrophic release of regulated substances are not investigated.

2. The incident investigation was not started within 48 hours of having knowledge of the event.

3. The incident investigation was not conducted by a team comprised of at least one (1) person knowledgeable of the process and a contractor representative if a contractor was involved.

4. The incident investigation report did not contain the required information relative to the date of the incident, the date the investigation began, a description of the incident, factors contributing to the event and any recommendations.

5. The facility does not have a system to promptly address and resolve incident report findings and recommendations.

6. The final report was not reviewed with all affected parties.

7. Incident Investigation reports are done in phases and updated online, but there is no complete and final report.

Emergency Response Procedures: 29 CFR 1910.119(n)

1. The site emergency response plan does not include:

    - An organizational statement indicating the level of response site personnel are expected to provide with respect to fire fighting and spills or releases of hazardous materials
    - Procedures for informing the public and local emergency response agencies about accidental releases.
    - Procedures and measures for emergency response after an accidental release of a regulated substance.
    - Training for all employees in relevant procedures.

2. The site emergency response plan has not been coordinated with the community emergency response plan.

3. There is an insufficient number of properly trained HAZMAT and / or Fire Brigade personnel to respond to emergencies on the night, evening and weekend shifts.

Compliance Audits: 29 CFR 1910.119(o)

1. Audits were not done once every three (3) years.

2. Audits did not address all PSM-covered areas.

3. "Draft" reports were never finalized.

4. There was no documentation to indicate the status of audit action items.

5. Audit findings were overly broad or too vague to establish correction action plans.

6. The audit protocol was not documented.

Suggestions for Improving Your PSM/RMP Compliance Audits

1. Consider using a team consisting of one (1) or more third party auditors and facility personnel. Don't overlook the value of using operations and maintenance personnel from the hourly ranks. Having these individuals on the team illustrates that the company is truly involving employees in the PSM program. It also demonstrates to the workforce the sheer magnitude of the PSM regulations and why compliance is critical. If and when a regulator shows up to conduct an inspection, these individuals can support the company by explaining to the regulator exactly how things are done at the site. If you involve site personnel on your audit team, take the time to provide them with an overview of the OSHA and EPA standards, the audit protocol and auditing techniques.

2. Consider using an independent third party as your audit team leader or facilitator. This will add credibility to the audit. While there is great value in using site personnel to serve on the audit team, an experienced outside auditor may bring up issues that have not been previously identified. Keep in mind we don't know what we don't know. When selecting an outside auditor, a person who has actual plant experience as well as auditor training and experience will give you the most bang for your buck.

3. Develop, publish and maintain a Critical Documents Locator. Such a document should indicate where PSM / RMP-related documents are located and who is responsible for keeping them current and accessible.

4. Have the audit team conduct short daily briefings with the site management team (no more than 30 minutes) to discuss any areas of concern and / or resolve any questions relative to the elements being audited.

5. Mandate that the audit team provide you with a draft report for review to assure that the audit is accurate and that findings are not overly broad or too vague. Remember, any audit deficiencies will need to be addressed. You want the auditors' findings to be very specific.

6. Don't shoot the messenger but do not hesitate to ask the auditor(s) to clarify his or her findings. Everybody concerned wants an accurate assessment of the company's PSM program. Keep in mind that some auditors are advocates for what they believe is correct or have seen in the past and may not be auditing to the applicable standards. Don't hesitate to ask for additional information to support the auditor's findings.

7. Once the audit is complete and the report has been accepted, assemble a team to address each and every audit finding. Audit findings should be put into some sort of action tracking database and managed aggressively. If an audit deficiency will require engineering or capital, make sure you document what control measures will be taken in the interim. Document closure to each and every action item. If a finding was found to be in error, be sure to document the inaccuracy and any information supporting your opinion.

8. Communicate the results of the audit findings and action items with all affected personnel.

Conclusion

The author sincerely believes that compliance with the OSHA PSM and EPA RMP regulations is just good business. Keep in mind that both sets of regulations are performance based and give each facility latitude in implementing their program. However, these regulations have been in effect for over 15 years. What was considered to be an acceptable standard of care in 1992 may not be acceptable by today's standards.

Since the inception of the regulations, many additional resources have been developed by such groups as the American Institute of Chemical Engineers, the American Petroleum Institute and the American Chemistry Council. Plant personnel and regulators have a greater knowledge of process safety management techniques and industry best practices. Regulatory agency inspections are much more in-depth than they were even five (5) years ago. Companies are being issued citations for failure to meet "Recognized and Generally Accepted Good Engineering Practices" (RAGAGEP). One only has to look at the results of some of the refinery special emphasis inspections that were done over the past two (2) years. Compliance audits should help us continuously improve employee and public safety, while protecting the environment and the viability of the industry. How good is your audit process?