

## CHEMICAL PROCESS SAFETY MANAGEMENT WITHIN THE DEPARTMENT OF ENERGY

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## Chemical Process Safety Management within the Department of Energy

John A. Piatt

### Abstract

Although the Department of Energy (DOE) is not well known for its chemical processing activities, the DOE does have a variety of chemical processes covered under OSHA's Rule for Process Safety Management of Highly Hazardous Chemicals<sup>1</sup> (the PSM Standard). DOE, like industry, is obligated to comply with the PSM Standard. The shift in the mission of DOE away from defense programs toward environmental restoration and waste management has affected these newly forming process safety management programs within DOE. This paper describes the progress made in implementing effective process safety management programs required by the PSM Standard and discusses some of the trends that have supported efforts to reduce chemical process risks within the DOE.

### Introduction

Since 1992, the DOE has been working to implement process safety management programs for chemical processes covered by the PSM Standard. When the PSM Standard was issued, the initial perception within the DOE community was that the safety management systems originally established to address nuclear hazards were sufficient to also deal with chemical processing hazards. This was often true. However, in most cases, these systems required modification to ensure an effective and compliant program. The integration of individual safety management systems into a cohesive program is a continuing challenge, with PSM coordinators often leading integration efforts. Certain PSM provisions, such as the employee participation, have required greater efforts. A changing organization climate within the DOE, which promotes greater teamwork in solving problems, contributes to improved employee involvement in safety programs.

### Background

The Clean Air Act Amendments<sup>2</sup> of 1990 included provisions for chemical accident prevention, with OSHA having responsibility for promulgating a standard for worker protection and EPA having responsibility for developing a parallel standard for public safety.

The OSHA PSM Standard was issued February 24, 1992 with the objective of preventing catastrophic releases of highly hazardous chemicals having the potential to cause catastrophic fires, explosions, or toxic exposures with resulting worker injuries. The PSM Rule is a performance-based standard that defines the elements of an effective chemical process safety program. This encourages innovative solutions to address fundamental safety management issues. It does not prescribe how each element is to be implemented 1) due to the impossibility of addressing the diversity of chemical processes that exist, and 2) the performance-based approach developed by the chemical industry had been shown to be effective.

The draft parallel EPA Risk Management Program<sup>3</sup> (RMP) has been issued but not finalized. However, the EPA list of toxic and flammable substances<sup>4</sup> for the RMP Standard was finalized January 31, 1994.

Under the Atomic Energy Act<sup>5</sup> of 1954 and subsequent legislation, DOE is responsible for providing occupational safety and health protection for DOE contractor employees in GOCO facilities that is equivalent to that provided by private industry. DOE Orders 5483.1A, "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities,"<sup>6</sup> and DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards"<sup>7</sup> adopted OSHA standards for DOE operations. Thus, the PSM standard is a mandatory DOE standard.

#### Covered Chemical Processes

In June of 1994, a survey of chemicals exceeding OSHA PSM or EPA RMP threshold quantities (TQs) at DOE sites found that there were 22 processes that utilized toxic or reactive chemicals over TQs; there were 13 processes involving flammable gases and liquids over TQs; and explosives manufacturing occurred at 4 sites. Examination of the survey results showed that 12 of the 22 processes involving toxic chemicals involved the use of chlorine for water treatment systems. The processes involving flammable gases and liquids were located at the Strategic Petroleum Reserve and Naval Petroleum Reserve sites.

#### Strategies Used Within DOE

DOE Sites have used several basic risk reduction approaches to address chemical process hazards. These include reducing chemical inventories, changing chemical technologies, implementing OSHA PSM programs, or combinations of these approaches. Sites with clear parallels in industry, such as those under the Naval Petroleum Reserve, have implemented PSM programs. Other sites have sought to eliminate or reduce the hazard. For example, gaseous chlorination systems at the Savannah River Site were replaced with aqueous sodium hypochlorite systems to eliminate the use of one ton cylinders of chlorine.

PSM and process hazards analysis (PrHA) training has been made available to DOE contractors since the inception of the PSM standard. Guidance was issued regarding the PSM Standard and PrHA methods. Because of the high incidence of chlorination systems, an example PrHA (Hazards and Operability Study) was performed at a water treatment plant at Hanford and the PrHA report made available to DOE contractors.

#### Trends Affecting PSM Implementation

One peace dividend from the end of the cold war has been chemical risk reduction in some areas of DOE. This has resulted from the closure of many DOE chemical processing facilities with consequent elimination of process chemicals. For example, nitric acid left over when a process facility at Hanford closed was later sold to a private firm and removed. For operating facilities, production levels and associated chemical inventories have often been reduced.

The shift from a defense mission to an environmental cleanup mission at many sites has emphasized waste minimization and pollution prevention. This has resulted in chemical processes with improved technology, lower chemical inventories, and the use of less toxic materials. Improvements in plating technology at the Lawrence Livermore Laboratory have reduced their acid inventories through recycling, and eliminated the use of cyanides in most plating processes.

The accumulation of mixed wastes in the DOE presents new chemical processing hazards which could benefit from the application of PSM principles, even though processing of these wastes may not fall within the purview of the PSM standard.

Current downsizing and process reengineering efforts within the DOE have helped to focus attention on the elements of safety programs that effectively reduce risk. The integrated model provided in the PSM standard is receiving increasing attention as having the necessary and sufficient elements of a good safety program. The historical emphasis on radiological safety within DOE often relegated chemical safety to being considered a routine industrial hazard. The changing environment with potential elimination of DOE or possible OSHA oversight has prompted contractors to reevaluate safety priorities.

#### The Chemical Safety Vulnerability Study

In February 1994, the Secretary of Energy initiated a detailed review of chemical vulnerabilities within the DOE. This review identified eight generic vulnerabilities and four management weaknesses which were summarized in DOE's *Management Response Plan for the Chemical Safety Vulnerability Working Group Report*<sup>8</sup>. While this review was not directed specifically at processes covered by the OSHA PSM standard, the findings were widespread and are considered relevant. The eight generic vulnerabilities were:

- Characterization of Chemicals - "Many hazardous materials found at DOE facilities have not been adequately characterized to determine the types or quantities of the chemicals they contain or the potential risks." This is principally a concern for waste materials.
- Unanalyzed Hazards - "Many facilities and activities have not been thoroughly analyzed for the presence and magnitude of hazards associated with the use of chemicals."
- Past Chemical Spills - "Many facilities have experienced spills or releases of hazardous chemicals to the soil." Not all have been identified and of those identified, not all have been characterized.
- Planning for Disposition of Chemicals - "DOE has significant quantities of hazardous and specialty chemicals that are no longer required to support ongoing activities."
- Chemical Storage Practices - "Improper chemical storage practices are in use at many DOE facilities." Problems were identified regarding containment integrity, fire protection, compatibility, and ventilation.
- Conditions of Facilities and Safety Systems - "The structural deterioration of many DOE facilities in which chemicals are stored, handled, or processed increases the potential for worker exposures and environmental releases involving hazardous chemicals." Inadequate maintenance of safety and essential support systems was also noted.

- Abandoned and Residual Chemicals - “Chemicals and chemical residuals have been abandoned in place in equipment or facilities that are no longer needed. As facility missions changed or were terminated, chemical inventories were often left in place; tanks, pipes, and other equipment were not flushed to eliminate chemical residuals.”

Based on these identified vulnerabilities, the DOE, while making progress in PSM, has not embraced an integrated chemical safety program at all chemical facilities including those with less than TQ amounts of hazardous chemicals. This is further amplified by the four management weaknesses:

- Emphasis on, Commitment to, and Implementation of Chemical Safety Programs - “Many physical deficiencies and programmatic weaknesses can be partially attributed to an overall lack of management emphasis on, commitment to, and strategic planning for chemical safety.”
- Management of Aging Facilities - “DOE has a significant number of aging operational facilities that store or process chemicals.” Physical structures and support systems are deteriorating from lack of maintenance, may not have been designed for chemical storage, and designs and practices do not comply with current safety requirements.
- Transition of Facilities from Active Status to New Missions or to Decontamination and Decommissioning - “Due to the Department’s shift in focus, many DOE facilities are either awaiting or undergoing transition to decontamination and decommissioning. Although the Department has committed to clean up and restore or dismantle these facilities, the process will require many years to complete.”
- Budget Decision Making for Chemical Safety - “DOE budget decision making does not provide for consistent and effective budgeting and allocation of resources to support chemical safety programs.”

While this review did identify “pockets of innovation and excellence” in specific chemical safety practices or management systems, there was a notable absence of integrated comprehensive chemical safety systems due to a lack of management emphasis on and direction regarding chemical safety throughout DOE.

### Conclusions

The PSM standard has had an impact on the DOE community. Greater attention is being paid to chemical process hazards. Chemical inventories are receiving greater scrutiny. The necessity and benefits of good chemical management and tracking systems are being recognized. The model for chemical process safety management is being examined for relevance in other areas of safety management.

DOE contractors have begun to recognize that existing safety management systems need to be tailored and integrated for effective PSM programs. The chemical vulnerability study, while not directed at PSM-covered processes, provides an indication of the problems that still exist in this area. DOE and its contractors face the challenge of ensuring that such chemical safety management systems function as part of a value-added, integrated program. In response to the findings of the chemical vulnerability study, DOE committed to a vision of achieving a level of safety equivalent to that of the leading chemical companies by the year 2000. To help reach this goal, the DOE has become a member of the AIChE’s Center

for Chemical Process Safety and is exploring a possible relationship with the Chemical Manufacturer's Association.

It has been said that PSM is just the application of good management practices. The necessary practices for a successful PSM program are well documented. DOE has taken the effort to examine its chemical safety management posture. Time will tell whether DOE can develop the integrated chemical safety management systems necessary to reach it's goal.

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Mr. Piatt is a senior research engineer at the Pacific Northwest Laboratory which is a national laboratory operated by Battelle Memorial Institute for DOE. He has over 20 years experience in system safety, human factors, industrial hygiene and safety management. He has served as safety engineer and safety manager with government, private and international organizations. John earned B.S. degrees in mechanical and industrial engineering from the University of Washington, and a masters degree in industrial engineering (system safety specialty) from Texas A&M University. He is a Registered Professional Engineer in Safety Engineering in the State of California, a Certified Safety Professional and a Certified Industrial Hygienist. He is a graduate of the Army Materiel Command's Safety Graduate Engineering Program through Texas A&M.