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# *Executive Summary*

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**The objective of this review was to identify and characterize adverse conditions or circumstances involving potentially hazardous chemicals at DOE facilities.**

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On February 14, 1994, Secretary of Energy Hazel R. O'Leary directed the Office of Environment, Safety and Health to lead a broad-based review to identify chemical safety vulnerabilities confronting the Department of Energy (DOE). These vulnerabilities represent circumstances or conditions that could result in fires or explosions from uncontrolled chemical reactions, exposure of workers or the public to hazardous chemicals, or releases of hazardous chemicals to the environment. The Chemical Safety Vulnerability Review is an integral part of an overall strategy to increase the Department's emphasis on the safe and effective handling, use, and disposal of hazardous chemicals and to raise awareness about the importance of issues related to chemical safety. The review was conducted by the Chemical Safety Vulnerability Working Group, which was composed of environmental, safety, and health (ES&H) professionals representing DOE line and contractor organizations in partnership with the Office of Environment, Safety and Health.

The process of selecting sites examined during this review was based on sampling techniques intended to provide a representative cross section of sites and facilities. This process considered a number of factors, including the nature of the operation (e. g., production, laboratory, support, treatment, storage, or disposal); the status of the operation (e.g., ongoing, in transition, or undergoing decontamination and decommissioning); and the types and quantities of chemicals involved. Accordingly, 84 facilities at 29 sites across the DOE complex participated in a self-evaluation effort to identify chemical safety vulnerabilities having potential ES&H consequences. Thirteen of these sites were subsequently visited by independent Working Group verification teams that sought to confirm the findings of the self-evaluations, to determine whether additional chemical safety vulnerabilities existed, and to assess the seriousness of the vulnerabilities identified. As part of the effort to provide a broader perspective for this process, 64 additional facilities that were not included in the self-evaluations were examined during the field verification phase of the review. Although the 148 facilities evaluated represent only a small fraction of the thousands of DOE facilities that use or store hazardous

chemicals, it is the Working Group's judgment that this sample is representative of the range of chemical safety concerns that confront the Department.

### **Chemical Safety Vulnerabilities**

During the field verification effort, the Chemical Safety Vulnerability Review identified 35 facility- and site-specific vulnerabilities. Although these vulnerabilities are indicative of serious chemical safety issues, none represents imminent danger to the public, to worker health and safety, or to the environment. These facility- and site-specific vulnerabilities were grouped into eight generic vulnerabilities that have broad application to the DOE complex. This review did not include a comprehensive survey of chemical safety at all DOE facilities that use or contain hazardous chemicals. Nonetheless, it is the Working Group's judgment that these generic vulnerabilities are representative of vulnerabilities at other sites across the DOE complex. Specifically, the circumstances or conditions that gave rise to the generic vulnerabilities exist elsewhere; the types and quantities of chemicals used at other sites are comparable; the processes or operations performed are common to multiple sites; or the management practices used by other sites for chemical safety are comparable. The actual applicability of these generic vulnerabilities to specific sites or facilities not reviewed by the Working Group cannot be determined without

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### **Chemical Safety Vulnerabilities**

- ***Characterization of Chemicals***
- ***Unanalyzed Hazards***
- ***Past Chemical Spills***
- ***Planning for Disposition of Chemicals***
- ***Chemical Storage Practices***
- ***Condition of Facilities and Safety Systems***
- ***Abandoned and Residual Chemicals***
- ***Inventory Control and Tracking***

further evaluation. This review should be used as a guide or “roadmap” for managers in the identification, prevention, and mitigation of vulnerabilities at those sites and facilities.

- **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 they represent. This situation increases the likelihood of worker exposure to these materials resulting from lack of knowledge about where they are located, the specific hazards they pose, and the actions necessary to prevent or mitigate such hazards. The presence of these materials increases the risk of worker exposures during the conduct of routine and nonroutine operations (e.g., during decontamination and decommissioning activities at facilities containing residues, during emergency response efforts in areas containing uncharacterized hazards, or because of the increased potential for accidents resulting from the storage of incompatible chemicals).
- **Unanalyzed Hazards.** Many facilities and activities have not been thoroughly analyzed for the presence and magnitude of hazards associated with the use of chemicals. Failure to recognize and analyze such hazards increases the risk of personnel exposures and environmental releases due to accidents such as fires or explosions.
- **Past Chemical Spills.** Many facilities have experienced spills and releases of hazardous chemicals to the soil. Known incidents have been identified and characterized in some cases. Additional spill or discharge areas are likely to be discovered. Both known and currently undiscovered contaminated soil could pose hazards to workers as construction, environmental restoration, and decontamination and decommissioning activities increase.
- **Planning for Disposition of Chemicals.** DOE has significant quantities of hazardous and specialty chemicals that are no longer required to support ongoing activities. DOE facilities also have a wide range of smaller quantities of laboratory chemicals. At many sites, there is little incentive to reduce the inventory of chemicals that are no longer needed. The lack of systematic inventory planning and control increases DOE’s overall vulnerability to worker exposures and environmental releases. Furthermore, chemicals held in the absence of continuing need may be viewed as

waste by Federal and State regulatory agencies and could be subject to the requirements of the Resource Conservation and Recovery Act.

- \* **Chemical Storage Practices.** Improper chemical storage practices are in use at many DOE facilities. Appropriate chemical storage practices should consider such factors as the adequacy and integrity of chemical containment (e.g., tanks, drums, secondary containment), segregation of incompatible chemicals, ventilation, temperature and humidity controls, fire protection, and protection from weather. A reluctance to dispose of inventories of hazardous materials that are no longer needed has exacerbated problems associated with the storage of chemicals. Further, chemicals are often stored in aging facilities that are neither properly designed nor equipped for chemical storage.
- **Condition 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. In many instances, safety and essential support systems (e. g., utilities and ventilation systems) have not been effectively maintained, thus decreasing the margin of protection provided to workers, the public, and the environment against chemical hazards. Deficiencies due to inadequate maintenance budgets and the change in DOE mission have resulted in an increased number of “surplus” facilities (i.e., facilities declared by DOE program offices to be available for other uses).
- **Abandoned and Residual Chemicals.** Chemicals and chemical residues 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 residues. These conditions have created vulnerabilities that are exemplified by workers inadvertently coming into contact with hazardous chemicals or chemical residues, particularly during decontamination and decommissioning operations; by increased public access to areas and facilities containing chemical hazards; and by environmental releases of hazardous chemicals due to degradation of abandoned facilities or equipment.

- ***Inventory Control and Tracking.*** Although most DOE sites have systems in place to record and monitor onsite chemical inventories, some systems do not provide up-to-date information on chemical quantities and locations. The absence of comprehensive inventory control systems creates the potential for exposure of workers to hazardous chemicals that are not known to be present; fires and explosions due to mixing co-located, incompatible chemicals; and diminished effectiveness of emergency response plans due to unidentified chemical hazards.

## **Management Weaknesses**

Analysis of facility-specific, site-specific, and generic vulnerabilities identified during this effort indicates several areas of weakness in DOE's management of chemical safety. The Chemical

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### **Management Weaknesses**

- **Emphasis on, Commitment to, and Implementation of Chemical Safety Programs**
- **Management of Aging Facilities**
- **Transition of Facilities from Active Status to New Missions or to Decontamination and Decommissioning**
- **Budget Decision Making for Chemical Safety**

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Safety Vulnerability Review identified four management system weaknesses that significantly contribute to the perpetuation of these vulnerabilities.

- ***Emphasis on, Commitment to, and Implementation of Chemical Safety Programs.*** Many physical deficiencies and programmatic weakness can be partially attributed to an overall lack of management emphasis on, commitment to, and strategic planning for chemical safety. This area of weakness is evidenced by the low priority accorded to chemical safety issues, by the dispersal of chemical safety

requirements among numerous Federal regulations and DOE Orders and the inadequacy of guidance for their implementation, and by inadequate consideration of chemical safety in strategic and program planning. As a result, the structure and formulation of chemical safety programs at sites throughout DOE are not well articulated or comprehensively defined, are not integrated with other safety functions, and are often neither implemented fully nor applied consistently.

- **Management of Aging Facilities.** DOE has a significant number of aging operational facilities that store or process chemicals. Many aging facilities present chemical safety vulnerabilities because physical structures, support systems, and equipment have deteriorated rapidly due to insufficient priority for facility maintenance; facilities being used for chemical storage were not designed for that purpose and do not meet existing safety requirements; and chemical practices currently being used do not meet regulatory and departmental 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. Weaknesses in the current transition process include lack of clearly understood and accepted facility ownership and ownership responsibilities; failure to remove chemical residues; loss of corporate knowledge (i.e., operating histories and as-built drawings) at DOE facilities; and inadequate configuration management.
- **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. This weakness is a result of several factors. Current funding approaches used by sites make it difficult to establish comprehensive chemical safety programs; guidance and requirements for budgeting chemical safety activities are not well defined; many resource allocation decisions do not adequately consider chemical risk; and funding for maintenance of aging facilities and for facility deactivation does not receive adequate priority.

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**A number of commendable practices representing “pockets of innovation and excellence” have been identified. Application of these practices should and will be encouraged throughout the DOE complex.**

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### **Commendable Practices**

The Chemical Safety Vulnerability Review also identified a number of commendable practices at DOE sites, including innovative activities, programs, or management systems that have merit and may have the potential for further application. These practices represent “pockets of innovation and excellence,” and their visibility and application should and will be encouraged throughout the DOE complex. (See Appendix O.) Major categories of commendable practices observed in the field involve efforts to reduce inventories of hazardous chemicals, management programs to increase awareness of the hazards associated with chemical operations, and site recognition of the need for better characterization of chemicals and hazards.

### **Management Response Plan**

The complex-wide implications of the generic vulnerabilities and management system weaknesses identified during this review are addressed in a management response plan that was coordinated by the Office of Environment, Safety and Health and collectively developed by DOE Headquarters program offices and affected field organizations. The management response plan is being released under separate cover concurrent with this report.

The Department acknowledges that chemical safety has not historically received the attention and rigor accorded to other safety issues, such as radiation protection; this fact is borne out by the significance of the vulnerabilities and management system weaknesses identified by this review.

To resolve these problems, DOE is undertaking a number of programmatic initiatives designed to improve the overall state of chemical safety. The development and implementation of management response plans by DOE Headquarters and field organizations, plus the increased visibility of commendable practices and emphasis on successful private-sector chemical safety initiatives, should form the basis for providing meaningful and lasting solutions to problems associated with chemical safety and achieving an effective chemical safety program that can be applied consistently throughout the Department.

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# *Contents*

i	FOREWORD
iii	EXECUTIVE SUMMARY
1	INTRODUCTION
16	SUMMARY OF VULNERABILITIES
46	MANAGEMENT SYSTEM WEAKNESSES
62	COMMENDABLE PRACTICES
65	SUMMARY OF MANAGEMENT RESPONSE PLAN
67	CONCLUSIONS
68	GLOSSARY OF CHEMICAL TERMS

**NOTE:** Two volumes of appendixes accompany this report.