Executive Summary

The Accident

On August 22, 2000, an accident occurred at the U. S. Department of Energy (DOE) Portsmouth Gaseous Diffusion Plant (PORTS) located in Piketon, Ohio. An employee of the IT Corporation (IT) working on an Environmental Management (EM) Technology Deployment Project received serious burns from a violent chemical reaction. The chemical reaction was initiated by the IT Laborer placing crystalline thiosulfate into a five-gallon bucket containing about three gallons of concentrated sodium permanganate solution. The exothermic reaction of the thiosulfate and the permanganate caused a steam bubble to eject the permanganate solution from the five-gallon bucket more than 15 feet into the air. The solution covered the front of the IT Laborer who was standing directly over the bucket. The front portion of the IT Laborer's 100% cotton blue jeans immediately ignited and disappeared into ash. The solution also splattered all over the back of the Driller's Assistant who was standing about 15 feet away adjacent to the drill rig.

The Driller's Assistant felt a burning sensation on his back and quickly went to the safety shower in the IT site office trailer. The Driller's Assistant was not seriously injured and did not require medical attention. The injured IT Laborer's coworkers reacted quickly by drenching him with water and washing his eyes with neutralizing solution. Because of the severity of his burns, the IT Laborer was airlifted to the Ohio State University Medical Center in Columbus, Ohio. He has since been released from the hospital, but he is facing additional medical treatment and physical therapy.

Emergency response to the scene was delayed by a failure to utilize the notification procedure in the Health and Safety Plan (HASP) and because the initial cellular telephone call to the Pike County 911 Operator indicated that the accident was at the Paducah Plant in Kentucky.

On August 23, 2000, the Manager, Oak Ridge Operations (DOE ORO), chartered a Type B Accident Investigation Board to investigate the accident. The Board arrived on site at Portsmouth on August 23, 2000, and they completed the investigation in September 2000. This report was presented to the DOE ORO Manager for acceptance on October 6, 2000.

Background

The project being conducted by IT at Portsmouth was intended to provide in-situ treatment of dense, nonaqueous phase liquids (primarily trichloroethene) in the low permeable Minford and Gallia formations. It required injections of sodium permanganate into the soil at multiple points to achieve treatment. The project site was located outside the plant fence at Portsmouth on the northeast side of the perimeter road above the contaminated groundwater plume.

IT is a subcontractor to UT-Battelle, LLC (UT-Battelle), performing work under an approved EM Technical Task Plan. The work was being performed at Portsmouth

under agreement between UT-Battelle and Bechtel Jacobs Company LLC (BJC), the prime management and integration contractor for the Portsmouth site. Safety for the project site was the line responsibility of UT-Battelle. BJC was responsible for site support and oversight.

UT-Battelle and IT prepared a HASP, a HASP Addendum, and other project documentation which they submitted to BJC to use as the basis for their readiness review for the start up of the project. The project documentation reviewed and accepted by BJC did not identify all the involved hazards. There were no subsequent changes to the project documentation or further BJC evaluations to account for changes in the work processes or incidents that occurred. Project documentation was not current at the time of the accident. Project direction was provided by UT-Battelle, Grand Junction. The project had experienced multiple changes in leadership, with the most recent being less than two weeks before the accident.

Results and Analysis

Prior to field deployment of the project, UT-Battelle submitted its project documentation to BJC for readiness review. On July 19, 2000, the BJC Site Operations Review Committee readiness review team granted UT-Battelle and its subcontractor, IT, permission to proceed with field activities. Due to the complex organizational relationships for the project and the site, roles and responsibilities for project oversight were not clearly established. BJC did not supplement its readiness review with a field review prior to the start of operations or provide adequate field oversight during the execution of the project. No health and safety (HS) oversight was performed by DOE ORO.

The BJC readiness review team did not discover the inadequacies in the project documentation presented by UT-Battelle. The HASP, which was accepted by BJC, established project responsibilities for BJC personnel to serve as Project Manager, HS Manager, HS Advocate, and Subcontractor Technical Representative. The project documentation did not identify all tasks to be performed, resulting in unacceptable hazard analysis and inadequate development and implementation of controls. The preparers of the project documentation failed to obtain and follow the hazard control and personal protective equipment (PPE) recommendations of the permanganate supplier's most recent Material Safety Data Sheets (MSDSs) and fact sheets. Additionally, the hazard analysis did not identify and analyze neutralization of permanganate as a project activity. Because of these failures in the analysis process, the hazard controls in use at the project site were ineffective in preventing or mitigating the accident.

Personnel on the UT-Battelle project site did not comply with the HS requirements stated in the project documents. The UT-Battelle HS Officer, who was on the project the day of the accident, had not signed the project HASP. No one took responsibility for ensuring that critical project documents were controlled and kept up to date. Basic occupational HS and hazardous waste site deficiencies were

allowed to continue unabated and unmitigated on the project site.

Conclusions

The Board concludes that this accident and the resulting injuries were preventable. This accident highlighted deficiencies in numerous aspects of safety management and emergency preparedness for the project.

The direct cause of the accident was the introduction of crystalline sodium thiosulfate into a five-gallon bucket containing concentrated sodium permanganate solution. Neither the UT-Battelle and IT line managers who were responsible for the workers' safety nor the BJC readiness review team adequately understood or analyzed the hazards of the job site. Therefore, they did not assure that adequate hazard controls were in place.

The Board identified four root causes for the accident.

- UT-Battelle, BJC, and IT management failed to analyze the hazards for all field activities. This failure resulted in inadequate development and implementation of control measures for and knowledge of the potential hazards.

- UT-Battelle, BJC, IT, and the IT subcontractors' project personnel failed to implement the hazard controls and requirements stated in the project documents.

- DOE ORO, UT-Battelle, BJC, and IT management did not establish clear roles and responsibilities for the planning, execution, and oversight of the project.

- DOE ORO, UT-Battelle, BJC, and IT management did not establish or ensure a safety culture that implements Integrated Safety Management (ISM) and encourages personnel to stop and re-enter the analysis phase when a change or unexpected condition arises.

Judgments of Need

Judgments of Need are the managerial controls and safety measures determined by the Board to be necessary to prevent and/or minimize the probability or severity of a recurrence. They flow from the causal factors, which are derived from the facts and analysis. Judgments of Need are directed at providing guidance for managers during the development of corrective action plans. See Table ES-1 for a list of the Judgments of Need.

Table ES-1: Judgments of Need

No.	Judgments of Need	Related Causal Factors
JON 1	BJC and UT-Battelle management need to ensure that unambiguous roles and responsibilities are established for every project from conception through field implementation.	• The roles and responsibilities for BJC, UT-Battelle, and IT were not clearly understood or executed. • Work control processes were inadequate. • There was no document control instituted for the project. • Compliance with basic HS requirements was not enforced on site. • The HASP, HASP Addendum, and Activity Hazard Analysis (AHA) were not in compliance with the MSDSs. • Turnovers for roles specified in the HASP and HASP Addendum were not effective, nor were they documented by changes to the documentation. • UT-Battelle failed to ensure ISM was established and maintained by its sub-contractors. • Field implementation of documented controls and assumptions was inadequate.
JON 2	BJC, UT-Battelle, and IT management need to ensure line management understands their responsibility for safety, including a safe work environment with personnel always being aware of the potential hazards and the freedom to call a time out for evaluation of an activity or situation that raises questions especially questions as to whether the event/activity has been properly addressed in the project documentation.	• The roles and responsibilities for BJC, UT-Battelle, and IT were not clearly understood or executed. • Lessons from previous incidents and other chemical accidents within DOE were not learned. • Management did not assure a safety culture where workers were willing to stop work and to re-enter the hazard identification and analysis phases when unexpected conditions were encountered. • Personnel knowledge and experience were with using

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		potassium permanganate in lieu of sodium permanganate. Training was not adequate to inform personnel of the difference.
JON 3	BJC, UT-Battelle, and IT management need to ensure that all activities to be performed are identified and the appropriate Subject Matter Experts (SMEs) perform a hazard analysis to determine potential hazards, resulting in the development and implementation of controls.	• The hazards associated with the chemicals on site and appropriate PPE were not adequately identified and analyzed. Proper controls were not developed and implemented. • Field implementation of documented controls and assumptions was inadequate. • The work planning and readiness review processes were inadequate. • The roles and responsibilities for BJC, UT-Battelle, and IT were not clearly understood or executed. • Lessons from previous incidents and other chemical accidents within DOE were not learned. • The HASP, HASP Addendum, and AHA were not in compliance with the MSDSs. • Personnel knowledge and experience were with using potassium permanganate in lieu of sodium permanganate. Training was not adequate to inform personnel of the difference.
JON 4	BJC needs to evaluate the adequacy of its readiness review process to ensure that technical correctness, complete hazard identification and analysis, development and implementation of controls, and readiness on the part of field personnel and equipment to actually execute the activity/project are reviewed prior to granting permission to proceed.	• The hazards associated with the chemicals on site and appropriate PPE were not adequately identified and analyzed. Proper controls were not developed and implemented. • The work planning and readiness review processes were inadequate.

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		• Field implementation of documented controls and assumptions was inadequate. • Lessons from previous incidents and other chemical accidents within DOE were not learned. • There was no document control instituted for the project. • Compliance with basic HS requirements was not enforced on site. • The HASP, HASP Addendum, and AHA were not in compliance with the MSDSs. • Personnel knowledge and experience were with using potassium permanganate in lieu of sodium permanganate. Training was not adequate to inform personnel of the difference.
JON 5	BJC, UT-Battelle, IT, and IT's subcontractors field personnel need to ensure complete implementation of all controls and requirements contained in project documents and that only activities with appropriately documented and approved hazard analysis are performed.	• Field implementation of documented controls and assumptions was inadequate. • Training on the hazards of the chemicals on site was not effective. • Work control processes were inadequate. • No document control was instituted for the project. • Compliance with basic HS requirements was not enforced on site. • The HASP, HASP Addendum, and AHA were not in compliance with the MSDSs. • Turnovers for roles specified in the HASP and HASP Addendum were not effective, nor were they documented by changes to the documentation. • Personnel knowledge and

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JON 6	UT-Battelle management needs to ensure that expectations for implementation of requirements, especially HS requirements, set forth in subtier contracts are properly communicated to and executed by field personnel.	• The roles and responsibilities for UT-Battelle, and IT were not clearly understood or executed. • The contracting process did not adequately implement ISM requirements. • UT-Battelle failed to ensure ISM was established and maintained by its subcontractors.
JON 7	DOE ORO, BJC, and UT-Battelle management need to ensure oversight of operations is instituted from design and development through actual field performance and delivery of the desired product.	• The work planning and readiness review processes were inadequate. • Field implementation of documented controls and assumptions was inadequate. • DOE ORO and the PORTS Site Office failed to establish unambiguous lines of authority and responsibility for HS at all organizational levels. • The roles and responsibilities for BJC, UT-Battelle and IT were not clearly understood or executed. • UT-Battelle and IT management did not assure a safety culture where workers were willing to stop work and to re-enter the hazard identification and analysis phases when unexpected conditions were encountered. • Compliance with basic HS requirements was not enforced on site. • Turnovers for roles specified in the HASP and HASP Addendum were not effective,

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JON 8	DOE ORO line managers need to ensure an unambiguous DOE line of authority is established for all projects. Once the line of authority is established, clear oversight roles and responsibilities need to be in place and implemented.	• DOE ORO and the PORTS Site Office failed to establish unambiguous lines of authority and responsibility for HS at all organizational levels. • Communication between the various DOE organizations was not adequately performed. • The work planning and readiness review processes were inadequate. • The contracting process did not adequately implement ISM requirements. • Compliance with basic HS requirements was not enforced on site.
JON 9	DOE ORO line management needs to evaluate the addition of Facility Representative(s) (FR) and/or additional HS SMEs to the DOE PORTS Site Office.	• DOE ORO and the PORTS Site Office failed to establish unambiguous lines of authority and responsibility for HS at all organizational levels. • Communication between the various DOE organizations was not adequately performed.
JON 10	DOE ORO needs to ensure personnel performing FR responsibilities are adequately qualified.	• Communication between the various DOE organizations was not adequately performed.