# OPERATING EXPERIENCE SUMMARY

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**U.S. Department of Energy**

**Office of Environment, Safety and Health**

**OE Summary 2003-11**

**June 2, 2003**

The Office of Environment, Safety and Health (EH), Office of Performance Assessment and Analysis publishes the Operating Experience Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

To issue the Summary in a timely manner, EH relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Frank Russo, 301-903-1845, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction.

The OE Summary can be used as a DOE-wide information source as described in Section 5.1.2, DOE-STD-7501-99, *The DOE Corporate Lessons Learned Program*. Readers are cautioned that review of the Summary should not be a substitute for a thorough review of the interim and final occurrence reports.

# Operating Experience Summary 2003-11

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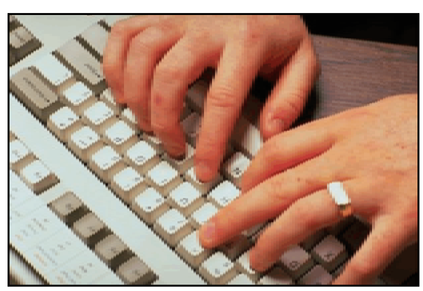

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# EVENTS

## 1. COMMUNICATION AND WORK PLANNING PROBLEMS RESULT IN POTENTIAL ASBESTOS EXPOSURES

On February 6, 2003, at the Sandia National Laboratory, a maintenance work crew cut into insulation material on a condensate line while replacing an isolation valve to repair a leak in the line. The insulation material later tested positive for asbestos, to which the work crew potentially was exposed. The work crew was unaware of the asbestos hazard because of communication and work planning problems. (ORPS Report ALO-KO-SNL-NMFAC-2003-0002; final report filed May 23, 2003)

When the work crew initially began repairing the leaking ½-inch condensate line, they realized that the inlet isolation valve would not close. This required the work scope to be changed to include replacing the valve. The crew informed the work leader that they would have to isolate steam (which would generate some condensate) to replace the valve and that they would have to remove a fitting located close to the valve, which was thought to contain asbestos. The work leader requested the support of an asbestos technician, who was given the original work scope that did not include the valve replacement. The technician believed the insulation material was positive for asbestos; but (based on the incorrect work description) he thought the work activity was located about 2 feet from the material. He decided that the work crew could proceed with the repair as long as they did not disturb the material. This information was communicated to the work leader, but not to the team supervisor.

The work leader directed the work crew to return and complete the work. The work crew was unaware that the insulation material contained asbestos, and the work leader assumed that the insulation material would not be impacted during the work. Still unaware of the asbestos concern, the team supervisor asked the craftspeople to perform the repair work the following evening.

While completing the maintenance work, one of the workers cut the insulation material with a knife. The crew placed the insulation material, along with other debris from the job, in a bucket that contained water from the leaking line, then left for the weekend. When the crew returned to work on February 10, one of the workers notified the work leader that the insulation had been disturbed the previous Thursday, so the facilities asbestos team took a sample of the material for testing.

Samples of the material that were submitted for analysis tested positive for asbestos. An industrial hygienist informed maintenance supervision and management that the material did contain asbestos but, because it was wet, it would not have presented an airborne exposure risk. The insulation material was properly disposed.

Two weeks later, a union representative informed the team supervisor and industrial hygienist that the insulation material was not wet when the workers cut into it. A physician examined the workers and stated that they had received a casual exposure, and he expected no acute or long-term effect. Following further investigation, management learned that one of the maintenance workers had cut into the dry insulation material with a knife to remove it. Miscommunication between the work leader, the team supervisor, and the work crew during pre-job planning led to a series of erroneous assumptions regarding the scope of work, the proximity of the work site to the insulation, and whether or not the insulation contained asbestos.

To prevent similar mishaps, facility management is developing facility asbestos administrative procedures to ensure that personnel who might be working near or with asbestos-containing materials understand the risks and how to work safely. In addition, management ordered corporate and site-specific asbestos hazard training. This training will reinforce appropriate hazard communication, the facility environment, safety and health concerns process, appropriate asbestos exposure response requirements, emergency response contacts, and, most importantly, the site-wide personnel policy of invoking stop-work authority whenever workers discover activities or situations that appear to be unsafe.

A previous event involving inadequate pre-job identification of asbestos-containing material occurred at the Oak Ridge National Laboratory on December 16, 2002, where a subcontractor was removing white floor tiles, assumed to be asbestos free. The subcontractor believed that only smaller green tiles in another room contained asbestos. The white tiles were newer and had replaced green tile elsewhere. A contractor worker stopped work, informing the subcontractor that analytical results on the white tile indicated that it contained asbestos. Although the analysis was positive for asbestos, air samples in the room were negative. (ORPS Report ORO--ORNL-X10CENTRAL-2002-0015)

*These events illustrate the importance of proper work planning. The work planning process should include a rigorous assessment of all potential hazards. Appropriate controls should be identified for all hazards and communicated to all involved personnel. If the work scope changes for any reason, the hazards need to be reanalyzed accordingly.*

***KEYWORDS:*** *Asbestos, industrial hygiene, maintenance, insulation, stop-work authority, communication, work planning*

***ISM CORE FUNCTION:*** *Define the Scope of Work, Analyze the Hazards, Develop and Implement Hazard Controls*

## 2. *TWO WORKERS INJURED IN CONSTRUCTION ACCIDENT*

On March 20, 2003, at Sandia National Laboratory – Albuquerque, two workers sustained injuries at a building construction site when an unsecured steel beam, being used with a chainfall to lift a metal stairway, slipped sideways and fell. The falling beam struck the job foreman in the right foot, inflicting a serious crushing injury. A support brace attached to the metal stairway hit a journeyman ironworker as it fell, lacerating his left shin. An apprentice ironworker was also struck and knocked to the ground by the falling stairway section, but he was not injured. (ORPS Report ALO-KO-SNL-NMFAC-2003-0005)

The three-person crew of steel erectors was lifting the metal stairway from the ground floor to a landing between the first and second floors. Before the lift, they had placed a 14-foot-long steel beam across the open stairwell on the third floor. The beam, which was not secured from lateral movement, overhung the opening by about 2 feet on either end. A 2-ton manual chainfall was attached to the beam by wire rope slings. The journeyman operated the chainfall from the second floor while the foreman and apprentice on the first floor rigged the stairwell with a 4-inch wide nylon choker sling and attached it to the hook on the chainfall. The journeyman was raising the stairway when the weight shifted while the foreman was trying to maneuver the stairway around an obstruction. This caused the beam to slide off the third-floor stairwell opening.

Paramedics responded quickly to the scene and rendered assistance. The foreman was hospitalized for a severe wound to the metatarsal region of the foot that required three surgeries. The injured journeyman ironworker needed six sutures to close the laceration on his left shin.

Figure 2-1 is a diagram of the structural framing and rigging elements at the construction site immediately before the accident. Figure 2-2 is a photograph of the accident scene showing where the support beam (cross-wise at the base of the stairs) and the stairway section (with the yellow sling strap) came to rest after falling.

A Type B accident investigation of this incident has been completed and is documented in *Type B Accident Investigation of the March 20, 2003 Building 752 Stair Installation Accident at the Sandia National Laboratories, New Mexico,* dated April 2003. The report can be accessed at www.eh.doe.gov/csa/reports/accidents.

The Accident Board determined that the direct cause of the accident was the temporary hoisting beam falling from its rooftop supporting structural beams into the stairwell opening, striking a worker, and dropping the stairway load, injuring another worker. The report states

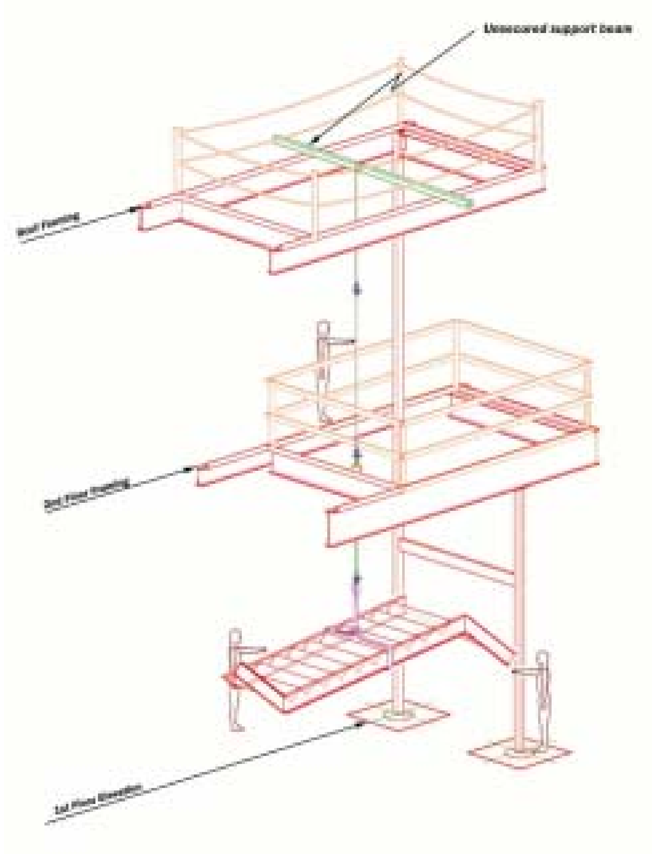


***Figure 2-1. Structural diagram with rigging elements***

that the root cause of the accident was that "installation of the temporary hoisting beam and movement of the load during the lift were not performed in accordance with the requirements of [OSHA regulation] 29 CFR 1926," [*Safety and Health Regulations for Construction*.]

Contributing causes identified by the Accident Investigation Board included the following.

- Sandia managers did not fully define and communicate their expectations regarding task-specific hazards analysis to subcontractors.

- Roles and responsibilities in Sandia construction management specifications were not clearly communicated to those in project management.

- Sandia managers did not clearly communicate construction safety oversight roles and responsibilities to their staff.

- Sandia managers did not clearly communicate their expectations for the content and conduct of safety meetings to their subcontractors.

- Sandia managers did not ensure subcontractor compliance with the weekly construction inspections required by Sandia construction management specifications.

- The content of Sandia construction inspections was not sufficiently detailed in terms of safety-specific issues.

Judgments of Need identified by the Accident Investigation Board included the following.

(1) Sandia needs to ensure that subcontractors more fully implement the requirements of the Sandia construction management specifications in the areas of:

   - task-specific hazards analysis;

   - effective safety meetings that communicate activity-specific hazards analysis and controls to workers;

   - job-site safety inspections at appropriate frequencies that focus on compliance with OSHA regulations in 29 CFR 1926 (http://www.osha.gov/pls/oshaweb/owastand.display_standard_group?p_toc_level=1&p_part_number=1926&p_text_version=FALSE); and

***Figure 2-2. Construction site ground level after accident***

- verification of safety practices at this and similar construction work sites.

(2) Sandia needs to ensure that the Sandia construction safety and project management personnel clearly understand and implement the site construction management specifications in the areas identified in item (1) above.

(3) The DOE Sandia Site Office needs to establish clear roles and responsibilities concerning construction safety management in the areas identified in item (1) above.

(4) Sandia needs to enhance its accident scene preservation practices.

*This accident highlights the consequences of ineffective communication of safety management requirements and expectations in the management chain from the DOE Sandia Site Office to the Management and Operating contractor to the subcontractor, where the work is actually performed. The task-specific hazards analysis, scoped and performed by the subcontractor with little direction or oversight, did not identify all the hazards that could be encountered. Effective controls of the hazards (e.g., securing the temporary hoisting beam) were not identified or implemented. The work was not performed within the established site construction management requirements, which mandated compliance with specific OSHA regulations. The flow-down of safety management requirements and expectations from DOE site Management and Operating contractors, where the responsibility resides, to subcontractors remains a continuing problem within the DOE complex.*

***KEYWORDS:*** *Construction safety, hoisting and rigging, personnel injury, safety management, hazards identification and control*

***ISM CORE FUNCTIONS:*** *Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls, Provide Feedback and Continuous Improvement*

## *3. GROUNDING DEVICE NOT COVERED UNDER LOCKOUT/ TAGOUT*

On April 28, 2003, at the Idaho Test Reactor Area, subcontractor electrical supervisors removed a lockout/tagout (LO/TO) and recommended re-energizing a 4,160-volt switchgear without realizing that a grounding cluster (personnel safety ground device) was still installed. The grounding cluster was not listed on the LO/TO Record Sheet as required. The coordinator for the electric utility upgrade discovered the still-installed grounding cluster before the switchgear was re-energized. He immediately issued a stop work order, thus avoiding potential damage to the circuit breaker cabinet and potential injuries to personnel. (ORPS Report ID-BBWI-TRA-2003-0003)

Personnel safety grounding devices are applied to de-energized circuits to provide a low-impedance path to ground. Should circuits become energized while personnel are working in proximity to them, the grounding devices protect them against shock hazards and flash burns. Safety grounding devices also provide a means of safely draining off static and induced voltages from other sources. A grounding cluster ties together multiple phase buses to a single grounding point.

If the system had been re-energized with the grounding cluster in place, the circuit breaker might have detected the ground fault and tripped. However, if the breaker did not trip under these conditions, the 4,160-volt power source could have destroyed the breaker, damaged the breaker panel, and injured nearby personnel.

The contractor's LO/TO procedure requires identifying grounding clusters as a line entry on the LO/TO Record Sheet and issuing a Danger tag for each cluster. The LO/TO Record Sheet listed one grounding cluster at the 4,160-volt circuit breaker, as required by the procedure. However, the electrical subcontractor had installed their own grounding cluster on the switchgear as a precaution against induced voltage. This cluster was not recorded on the approved LO/TO, and was not controlled by any configuration management process. Preliminary indications are that Occupational Safety and Health Administration (OSHA) requirements were violated in this incident, possibly including 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*, which requires a thorough inspection of the work site after the work is completed and before clearing the LO/TO for removal. Such a post-work inspection was either not performed or performed inadequately in this case.

Preliminary indications concerning why the second grounding cluster was not included in the LO/TO documentation suggest that either subcontractor personnel believed OSHA rules allowed them to install a grounding cluster for their protection without adding it to the LO/TO Record Sheet or they made an error and forgot to include the second grounding cluster in the documentation.

Compensatory and corrective actions resulting from this event include the following.

- The contractor issued a formal stop work order to the subcontractor for any work involving lockout/tagout.
- The subcontractor must prepare and present a corrective action plan for contractor senior management approval before the stop work order on LO/TO work will be lifted.
- A LO/TO has been installed on the 4,160-volt circuit breaker that requires approval by the contractor ATR Operations Manager to clear.
- The contractor will implement a requirement that its maintenance organization personnel perform an independent validation that the new high-voltage system is fully functional and ready for operation before authorizing removal of the LO/TO.

A search of the ORPS database for events involving grounding clusters or grounding bars, which perform the same function, revealed several events similar to the April 28, 2003 incident at the Idaho Test Reactor Area. On October 19, 1998, at the Savannah River Site, Site Utilities Department personnel installed a single point, undocumented lockout/tagout on a 13.8-kV line. Construction personnel subsequently installed grounding clusters downstream of the LO/TO in violation of procedures that prohibit installing grounding clusters in conjunction with an undocumented lockout/tagout. No injuries or equipment damage resulted from this event. (ORPS Report SR--WSRC-SGCP-1998-0013)

On October 10, 2000, at the Los Alamos National Laboratory Accelerator Complex, an electrical transformer was seriously damaged when an electrical technician re-energized a 4,160-volt circuit breaker cabinet that had an undocumented grounding bar installed across all three terminals. When the system was re-energized, phase-to-phase arcing occurred across the breaker terminals. No injuries resulted from this event, but repair costs for a damaged electrical transformer exceeded $35,000. (ORPS Report ALO-LA-LANL-ACCCOMPLEX-2000-0010)

*These events underscore the need to control the use of grounding clusters or grounding bars through a formal, documented LO/TO process or some other configuration management system to ensure that they are removed before equipment is re-energized. Subcontractors need to have not only an understanding of OSHA requirements associated with electrical safety, but also detailed knowledge of the contractor electrical safety requirements that they are obligated to meet, including LO/TO requirements. Before an installed LO/TO is cleared for removal, knowledgeable subcontractor and contractor personnel should complete a thorough review and walkdown of the system to ensure that it is in a configuration that allows the safe restoration of the potentially hazardous energy source.*

***KEYWORDS:*** *Lockout/tagout, grounding cluster, procedural violations, potential equipment damage, potential personnel injury*

***ISM CORE FUNCTIONS:*** *Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls*

## 4. *COMBUSTIBLE MATERIALS NEAR TORCH CUTTING CATCH FIRE*

On May 1, 2003, at the Savannah River Site, a contractor worker discovered a small smoldering fire consisting of insulation and wood pieces next to a building undergoing demolition. A subcontractor work crew had been cutting with an oxyacetylene torch nearby earlier in the day, and a fire watch had been posted until 30 minutes after torch work was complete. The worker extinguished the fire with water. No injuries or environmental impact resulted from this event. (ORPS Report SR--WSRC-FDP-2003-0008)

The fire is thought to have been caused by a hot piece of slag falling from the building foundation into a small pile of debris, which included extremely dry wood pieces. No one detected smoke during the 30-minute period of surveillance after torch-cutting operations ceased or during the remainder of the period that personnel stayed in the area (approximately 10 minutes). Torch cutting and welding activities typically generate a lot of sparks and hot slag, as shown in Figure 4-1.

***Figure 4-1. Typical torch cutting operation***

The procedures and job hazard analysis required removal of all combustible material in the affected area, as well as requiring a fire watch to remain in the area for 30 minutes after the work was complete. Investigators determined that the subcontractor failed to remove all combustible materials.

The subcontractor has changed the requirements for activities involving welding or torch cutting near combustible materials. These changes, summarized below, most likely would have prevented the fire had they been implemented. Figure 4-2 illustrates sparks from torch cutting falling on combustibles at a construction site.

***Figure 4-2. Sparks falling onto combustible material***

- Combustible material will be moved or doused with water to reduce the risk of fire.

- A fire watch will remain at the scene for 45 minutes after torch cutting and welding activities are complete instead of for 30 minutes.

- Personnel will perform a post-job inspection of the area at the end of each shift in which torch-cutting or welding activities took place to ensure that smoldering materials are not inadvertently left behind.

The contractor submitted a lessons-learned summary of the event and corrective actions to the DOE Lessons Learned web site. This lesson may be retrieved at http://www.eh.doe.gov/ll/lldb/detail.CFM?Lessons__IdentifierIntern=2003%2DSR%2DWSRC%2D0011. This lesson was discussed with project personnel and included in the pre-job briefing before work resumed. In addition, project management emphasized the importance of removing or protecting combustible material in the immediate area where torch-cutting work takes place.

OE Summary 2002-18 described another fire from sparks coming in contact with combustible material that took place at the Lawrence Berkeley Laboratory on May 17, 2002. Sparks from torch-cutting work fell into a 1-inch opening in a steel plate and started a fire. A ladder, dry leaves, and electrical cables ignited. Although no one was injured, the fire caused more than $10,000 damage, in addition to research revenues lost during the 2 weeks the cyclotron was shut down. (ORPS Report OAK--LBL-OPERATIONS-2002-0002)

A similar fire resulting from torch-cutting work occurred at the Idaho National Engineering and Environmental Laboratory on May 13, 2002. A fire broke out on a roof near where cutting and welding had taken place earlier. Cardboard boxes placed on the roof a week earlier ignited. (ORPS Report ID--BNFL-AMWTF-2002-0004)

DOE/EH-0196, Bulletin 97-3, *Fire Prevention Measures for Cutting, Welding, and Related Activities,* describes the fire protection measures necessary for those activities including isolation and protection of combustibles. The Safety Bulletin can be obtained at http://tis.eh.doe.gov:80/docs/bull/links.html.

29 CFR 1910.252, *General Requirements*, states that "cutting or welding shall be permitted only in areas that are or have been made fire safe." Section (a)(2)(vii) requires relocating combustible materials at least 35 feet from the work site. Where relocation is impractical, combustibles shall be protected with flameproofed covers or otherwise shielded with metal or asbestos guards or curtains. Subpart I, Appendix B, "Non-Mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection," states that walkdowns of work areas should be performed to identify hazards before work begins.

The National Fire Protection Association (NFPA) publications *Industrial Fire Hazards* and *Standard for Fire Prevention During Welding, Cutting, and Other Hotwork* provide guidance for the removal and protection of combustibles during welding and cutting activities. NFPA publications are available for purchase at http://www.nfpa.org.

*These occurrences demonstrate the hazardous nature of torch-cutting and welding activities. Flying slag and sparks can cause slow-smoldering fires that can remain undetected even after the fire watch surveillance period is over. It is crucial that, in addition to the fire watch, all combustible materials are removed from the area, doused in water, or completely protected by a fire blanket.*

***KEYWORDS:*** *Torch cutting, welding, smoldering, fire, combustibles*

***ISM CORE FUNCTIONS:*** *Develop and Implement Hazard Controls, Perform Work within Controls*