# OPERATING EXPERIENCE SUMMARY

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## U.S. Department of Energy
### Office of Environment, Safety and Health
**OE Summary 2003-13**
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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 2003-13

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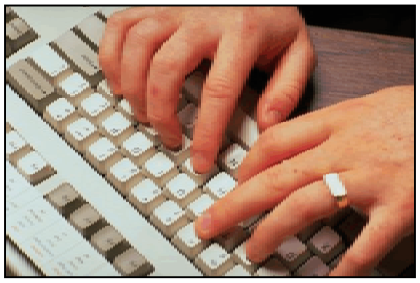

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# *EVENTS*

## *1. ELECTRICAL SAFETY PROBLEMS CONTINUE IN FIRST HALF OF 2003*

The number of reported electrical near-miss events across the DOE complex has increased since September 2002 (Figure 1-1). These near-miss events involved contact with energized electrical sources or potential contact when only one or no barrier remained. The purpose of this article is to notify the DOE complex of the characteristics and frequency of these continuing electrical safety events and to provide lessons learned.

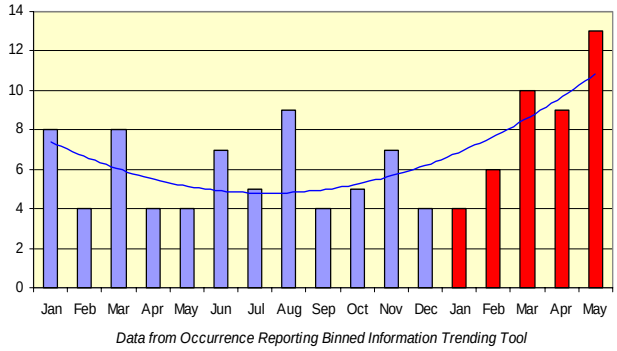


***Figure 1-1. Electrical near-miss events (2003 in red)***

The Office of Environment, Safety and Health reviewed 123 electrical safety events from January 2002 through May 2003. Thirty-seven percent of these events involved electrical intrusions (i.e., excavation, penetration, and cutting activities). The distribution of electrical safety events occurred at 12 field offices (Figure 1-2). Of these events, there were 20 incidents of electrical shock and 5 electrical burns.

Ninety-four percent of the electrical events involved low voltage (less than 600 volts), with the majority being 480 volts and 120 volts. This is to be expected because these voltages are the most prevalent in the workplace, where even non-electrical workers can be exposed (e.g., from electrical plugs, cords, and receptacles that use 120 volts).

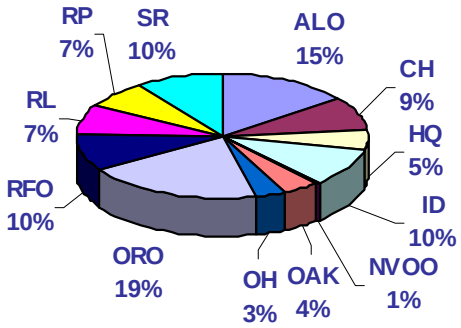


***Figure 1-2. Complex-wide problem***

The number of electrical shocks has remained low. For example, between August 2002 and January 2003, only four electrical shocks were reported. However, in the last 4 months of 2003, shocks occurred at the rate of two per month. Of the 20 reported electrical shocks, only 1 was associated with electrical intrusion-type work. In this event the worker was not wearing personal protective equipment (PPE), which could have protected him. The low number of shocks when energized sources were cut or penetrated is supported by the fact that most workers were wearing PPE, were separated from the source by distance (e.g., using excavating equipment), or were protected by insulated tools.

Shocks during other electrical work resulted because energized sources were not anticipated; therefore, PPE was not worn. In many cases electrical PPE is not prescribed unless energized work is expected; otherwise, the installation of a lockout/tagout and zero-energy check is relied upon to prevent electrical shock.

Failing to verify safe-energy conditions was a problem in 24 percent of the electrical intrusion-type events, but this was the problem in only 3 percent of electrical-specific work. The low incidence for electrical work occurred because zero-energy checks are typically required by electrical lockout procedures. The electrical intrusions resulted from failures when cutting conduit, either from flawed assumptions that the conduit contained de-energized conductors or just simply failing to perform the checks. Zero-energy checks typically did not apply to excavation events because, in most cases, the existence of the hazard was not previously known.

The number of reported electrical lockout/tagout events has also increased since January 2002. Seventeen percent of the electrical safety failures involved problems with lockout and tagout of electrical sources, which is a concern because the most effective safety barrier against electrical sources is to de-energize them and control them with a lockout/tagout.

The number of reported events in which inadequate job planning was a contributing factor has steadily increased since January 2002. Electrical work requires precise hazard identification to ensure that all sources of energy are known and that effective barriers, such as a lockout, are put in place. The work scope should be clearly stated and the work instructions thorough enough to perform the tasks safely. It is important to ensure that personnel performing electrical work are knowledgeable, well trained, qualified, and supervised. This is particularly important when relying on skill-of-the-craft.

The majority of electrical safety events occurred during maintenance and construction resulting from inattention to detail and failure to follow procedures. Many events involved experienced electricians.

***COMMONLY MADE ELECTRICAL SAFETY ERRORS***

- Working on energized equipment or circuits without authorization or PPE
- Failing to verify safe-energy conditions
- Encountering unexpected sources of energy not identified during planning
- Failing to use a lockout/tagout
- Making wiring errors and failing to identify them by testing
- Leaving unsafe conditions (e.g., electrical hazard from improper grounding)
- Relying on inaccurate drawings
- Failing to perform utility locator surveys
- Not having or not following penetration and excavation permits

Figure 1-3 shows an incorrectly wired welding receptacle that resulted in a severe electrical shock in May 2003. (ORPS Report ALO-LA-LANL-NUCSAFGRDS-2003-0002)


***Figure 1-3. Wiring error caused shock***

Management should expect that work performed by a journeyman electrician will be error-free and not left in an unsafe condition. If an error is made (e.g., while wiring a piece of equipment, plug, or receptacle) it should be expected that the electrician will catch the error when checking his work to ensure correct voltages and grounding. This can be quite challenging at times, as Figure 1-4 demonstrates.

***Figure 1-4. Electrical nightmare***

The number of electrical intrusion events in 2002 is down 27 percent from the previous year. However, during the first few months of 2003, electrical intrusions have occurred at the rate of 3.6 events per month. Figure 1-5 shows a conduit containing an energized 110-volt wire that

was cut during demolition in February 2003. (ORPS Report OH-MB-BWO-BWO04-2003-0002)

*Figure 1-5. Cut electrical conduit during*

The following guidance and recommendations should be considered when planning and conducting work involving electrical safety.

**Communicate Safety Concerns** – Workers should pass on relevant and accurate information regarding electrical safety issues to coworkers and supervision.

**Plan Jobs Thoroughly** – Electrical planners need to use accurate drawings and consult subject matter experts regarding the as-built configuration of electrical systems and facility equipment.

**Perform Pre- and Post-job Briefings** – Conduct briefings to ensure electrical safety hazards are identified, the work scope is understood, and barriers (lockouts) are in place and adequate; and critique job performance to identify areas for improvement.

**Perform Self-Checking and Safe-Energy Checks** – Workers should identify correct components, procedures, and tools before performing tasks and should determine the energized status of equipment.

**Stay Focused on the Task at Hand** – Workers need to ensure their attention is focused on the safety-significance of the task and remain alert for potential distractions, while maintaining a questioning attitude.

**Take the Time** – Workers should avoid hurrying through tasks, which could lead to errors, particularly when working with energized equipment.

**Subcontractor Responsibilities** – Hold subcontractors, who perform electrical or excavation work, responsible for their actions, and ensure work is performed in accordance with site safety requirements, procedures, and permits.

**Exercise Stop-Work Authority** – Workers need to exercise their responsibility to stop work when faced with uncertainty and obtain guidance from supervisors or subject matter experts before proceeding.

**Electrical Safety Committees** – Site electrical safety committees should address emerging electrical safety issues, benchmark other sites' programs, share best practices, and explore new technologies used for locating concealed electrical hazards.

*The 123 electrical safety events from January 2002 thru May 2003 resulted primarily from human failures where procedures were not followed or where workers did not focus on the task at hand. Error-prone situations are predictable, manageable, and preventable. The most effective defenses against events are communication of expectations and positive reinforcement of desired behaviors. Management needs to take appropriate disciplinary actions when necessary to enforce safety requirements. To achieve improvements in human performance, management needs to focus not only on individual behaviors at the worker level, but should also consider the impact of organization and management on human behavior. Workers and supervisors must work in concert. Supervisors need to be responsible for knowing, implementing, and enforcing electrical safety policies and directives and for providing a safe work environment for the personnel they supervise.*

***KEYWORDS:*** *Electrical safety, job planning, near miss, shock, wiring, grounding, lockout, tagout*

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

## *2. NEAR MISS – WORKER ON ELEVATED PLATFORM FALLS INTO LADDER OPENING*

On February 18, 2003, at Argonne National Laboratory – East (ANL–E), a worker inadvertently stepped into a fixed ladder opening on a platform 40 feet above the roof of a boilerhouse and fell about 5 feet before he caught himself on the ladder. The worker narrowly avoided serious injury and sustained only a lacerated leg and a bruised hip. Workers did not lower a manually-operated, hinged hatch cover to close off the opening after they climbed the ladder to the platform. They also did not use the guard chains that were provided to protect the opening. (ORPS Report CH-AA-ANLE-ANLEPFS-2003-0001, final report filed May 9, 2003)

Two subcontractor workers were tasked with calibrating an opacity monitor located on the 40-foot-high working platform on an 80-foot-tall effluent stack. The two workers were allowed to go up to the elevated platform without an ANL–E escort, even though neither worker was familiar with the opacity monitors on this stack. After the fall, the workers completed the task, descended the ladder, and entered the boilerhouse. A supervisor in the utility systems department called 911. Argonne Fire Department paramedics responded and examined the injured worker, who refused any further medical treatment.

Investigators interviewed the workers following the occurrence. They were unable to explain why they did not close the hatch cover or use the guard chains. However, the worker who fell stated that the visitor safety glasses he was wearing over his regular glasses had interfered with his vision. Investigators also reviewed the risk classification for the work and the job safety analysis (JSA) for the task and determined that the risk classification was incorrect. The risk had been classified as moderate, rather than high, which is the proper classification for elevated work. Also, the work was performed under a generic JSA intended to address work performed at ground level instead of the task-specific JSA for elevated work required in the contract. A high-risk classification for the task would have initiated a more detailed review of the work plan and a higher level authorization.

Investigators identified the direct cause of the incident as personnel error; namely, the worker inadvertently stepping into the uncovered, unguarded ladder opening. Contributing causes for this occurrence included the following.

- Deficiencies in the design of the ladder opening through the platform – Guard features to protect against falls were not in place.
- Deficiencies in the JSA provided to the contractor – The subcontractor used a generic JSA that was not specific to the task.
- Deficiencies in the generic JSA provided to the subcontractor – The generic JSA did not instruct workers to close the hatch over the ladder opening or install the guard chains.
- Deficiencies in the pre-job briefing – Sufficient time was not spent to describe the task and instruct the workers on how to perform it safely.
- Deficiencies in task authorization and supervision – The moderate (rather than high) risk classification for the task allowed for lower-level authorization and less supervision.

Investigators determined that a management problem was the root cause of this incident. They identified deficiencies in planning and scoping, as well as in designating work assignments. They determined that work planning was inadequate because a moderate risk level was assigned to the task rather than the more appropriate high risk level. Work scoping was deficient because the JSA should have been task-specific, not generic. The JSA should also have been discussed during the pre-job briefing to allow a review of the job hazards and to require the workers performing the work to sign off on the JSA. Proper work assignments were not established because it was decided that both subcontractor workers would go up to the platform without the ANL–E escort.

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

- Communicate the following to all utility systems department foremen.

  1. All utilities service contracts are to be categorized as high risk.

  2. The subcontractor is responsible for preparing the JSA, with assistance from ANL–E personnel.

  3. All JSAs must be job-specific and must be properly approved before work is initiated.

- Place "DANGER – Close Hatch While on Platform" signs on the 40-foot stack working platform.

- Require a division environment, safety, and health representative to review all JSAs for accuracy and completeness before approval.

Occupational Safety and Health Administration (OSHA) safety requirements applicable to this event include 29 CFR 1910, subpart D, *Walking-Working Surfaces*, and 29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*. OSHA requirements can be accessed from the web at http://www.osha.gov. The 29 CFR 1910.23 regulations address protection for floor openings, including the use of hinged covers and removable standard railings. These features were available, but not used, on the 40-foot-high platform in this incident.

A search of the ORPS database for similar events revealed an event that occurred on August 20, 2002, at the Stanford Linear Accelerator Center, where a worker tripped, fell into an access opening for a fixed ladder in a utility shaft, arrested his fall after a few feet, and fractured his shoulder. OSHA requirements for guards surrounding fixed ladder access openings were also violated in this incident. (ORPS Report OAK--SU-SLAC-2002-0009, *Operating Experience Summary* 2002-25)

A non-DOE accident involving a fall occurred in August 1996 at a privately-owned and operated wood-burning electricity generating plant. A worker was fatally injured when he fell from an elevated platform on a 140-foot-high plant emissions stack. In the last of a series of legal actions on this fatal accident, the plant owner/operator was cited for a violation of the fall protection requirements of OSHA regulation 29 CFR 1910.23 (Decision, Occupational Safety and Health Review Commission, Docket No. 97-0152, September 29, 1999).

*These occurrences reinforce the need to observe OSHA requirements for fall protection safety features around fixed ladder access openings. In each of the two cited DOE events, the injury sustained could have been much more serious had the worker fallen completely into the access opening. In the ANL-E incident, deficiencies in the job planning and pre-job briefing were identified by investigators as causal factors. However, working safely is ultimately the responsibility of the individual worker. There are no known methods to reliably eliminate human carelessness and the failure to take simple precautions, two factors that frequently contribute to serious injuries and fatalities in the workplace.*

***KEYWORDS:*** *Work planning deficiencies, job safety analysis, elevated working platform, unprotected ladder opening, fall protection, OSHA standards, near miss*

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

## 3. HEPA FILTERS DEFACED WITH GRAFFITI

On May 27, 2003, at the Rocky Flats Environmental Technology Site, a facility representative inspecting a main exhaust filter plenum found that eight high-efficiency particulate air (HEPA) filters had been damaged. Further investigation revealed that decontamination and decommissioning (D&D) workers defaced the HEPA filters with graffiti about 10 days earlier (Figures 3-1 and 3-2). (ORPS Report RFO--KHLL-771OPS-2003-0010)

The building, once one of the most heavily contaminated areas at the site, is undergoing D&D.

***Figure 3-1. One of the defaced HEPA filters***

Its ventilation system is a single-pass system. The final stage (the last barrier before entering the environment) consists of 399 HEPA filters and is credited in the authorization basis with a filter stage removal efficiency of at least 90 percent.

Because there was no work in progress in the areas these filters serviced, the contractor entered a Limiting Condition for Operation action statement and suspended operations until Filter Services personnel could perform efficiency testing. They inspected the filters and reported that 34 of them needed to be replaced. Of these, 14 had been damaged by graffiti, and they suspected an additional 40 filters were damaged as well. Tests on half of the 40 suspect filters indicated that they were operating at a sufficient efficiency level and did not need to be replaced. Filter Services reported that the credited filter stage removal efficiency of 90 percent was not compromised; only the margin of safety was impacted. At the same time that the damaged filters were replaced, the facility manager declared that the facility was operationally clean, and DOE concurred. This declaration closed out the Limiting Condition for Operation action statement. Management elected to test in-place aerosol efficiency as a best management practice during the remaining radiological D&D work at the facility.

***Figure 3-2. Another HEPA filter showing damage***

Two D&D workers admitted to defacing the HEPA filters, and were disciplined. Project management also briefed the crew involved in the filter plenum D&D work on the purpose and importance of the filter plena as well as the authorization basis requirements. They also reemphasized site policies, rules, and federal laws related to destruction of government property. A Site Safety Toolbox notice was published on the site Intranet and discussed with all work crews.

*This occurrence demonstrates that, even in facilities undergoing D&D, safety systems must remain in place – both to provide the protection they are designed to afford and to satisfy the facility's authorization basis. In addition to the fact that it is illegal to destroy government property, damaging safety systems can negatively impact worker safety or the environment.*

***KEYWORDS:*** *High-efficiency particulate air (HEPA), filter plenum, graffiti, ventilation system*

***ISM CORE FUNCTION:*** *Perform Work within Controls*

## *4. FALL FROM STEEL SCAFFOLDING DURING DISASSEMBLY*

On June 5, 2003, at the Miamisburg Closure Project, a construction worker tripped on a protruding bolt while disassembling a 16-foot-high steel-frame scaffold and fell through an opening at the top of the scaffolding. The worker fell 9 feet before the lanyard inertia-braking mechanism arrested his fall. Before he tripped and fell, the worker had extended the retractable lanyard approximately 5 feet. Had the lanyard been extended any further, the worker could have fallen all the way to the ground. The worker was not seriously injured, but he struck the scaffold as he fell and sustained arm and back abrasions. (ORPS Report OH-MB-BWO-BWO04-2003-0008)

The frame of the scaffold was used to support an airlock and the worker had removed ¾-inch plywood panels used as roofing for the airlock. He was wearing a fall protection harness and had secured the 20-foot retractable lanyard to a tie-off point at his feet because a shoulder-height tie-off point was not available. The lanyard was extended about 5 feet when he tripped on one of the bolts used to attach the plywood panels to metal trusses and fell. Figure 4-1 shows the scaffold and a man-lift, where a second worker was stationed to assist in the task. When the lanyard arrested his fall, the worker swung back and forth with his feet approximately 3 feet off the ground. His co-workers immediately helped him to the ground and detached the lanyard. They determined he had no injuries other than abrasions. The worker declined any additional medical attention.

***Figure 4-1. The worker fell from the top of this steel-frame scaffold***

Investigators determined that the direct cause of this incident was that the worker tripped on a bolt protruding from a structural component of the scaffold. They determined that the contributing causes were process- and equipment-related. The work plan should have been changed when it was determined that there was no tie-off point for the fall protection lanyard above shoulder height, and an alternative, less hazardous method of performing the disassembly process should have been used. Using the man-lift instead of letting the worker perform the disassembly task from the top of the scaffolding would have been feasible and less hazardous.

The following recommended compensatory or corrective actions resulted from this occurrence.

- Replace the self-retractable lanyard with a fixed-length 6-foot lanyard while performing this task.
- Use retractable lanyards only in the proper circumstances, (i.e., where they cannot be extended such that they are longer than the distance to the ground).
- Always use tie-off points for the fall protection lanyard that are at or above the shoulder height of the worker.
- Conduct briefings emphasizing the need to comply with fall protection requirements and perform inspections of safety equipment (e.g., check the length of the lanyard vs. the distance to the ground).
- Ensure that the method used to perform potentially hazardous work is the safest one available.
- Ensure that all work tasks are properly planned, with the hazards ana-

lyzed and hazard control methods identified and properly implemented.

A search of the ORPS database for other events when fall protection lanyards worked properly, but minor injuries occurred, revealed the following. On August 3, 2000, at the Savannah River Site, workers were removing sections of deck grating on an elevated platform to access a cooling water pump at a cooling tower. A worker wearing a fall protection harness attached to a lanyard lost his balance and fell through an opening where grating sections had been removed. The lanyard arrested the worker's fall and suspended him approximately 7 feet above the ground. A loose piece of grating subsequently fell through the opening and struck the worker, causing an open wound to his left leg. (ORPS report SR--WSRC-FDP-2000-0001)

On July 27, 1999, at the Argonne National Laboratory–West site, workers wearing fall protection harnesses attached to lanyards were removing panels from the roof of a building being dismantled. As a worker was pushing a piece of roof panel across a steel support strut, he lost his balance and fell through the sheetrock ceiling of the room below, then fell another 3 feet, before his fall was arrested by the lanyard. He ended up suspended in his safety harness straddling a metal ceiling joist, and sustained abrasions to his left leg and right arm. (ORPS report CH-AA-ANLW-TREAT-1999-0003)

*These occurrences illustrate the importance of using safe practices for elevated work, including the use and proper implementation of fall protection equipment. In the Miamisburg Closure Project occurrence, when it was discovered that no acceptable tie-off point for the fall protection lanyard was available, the plan to have a person on the scaffold should have been revised, rather than using a tie-off point at the worker's feet. Also, using a retractable lanyard was inappropriate because it could have been extended to a point that would have negated the fall protection and allowed the worker to fall all the way to the ground. These occurrences also illustrate that sometimes the benefit from fall protection is not injury avoidance, but rather changing a potential fatality to a minor injury. We should not lose sight of the fact that properly selected and implemented fall protection equipment does work in protecting the lives of workers.*

***KEYWORDS:*** *Fall protection, injury, safety harness, lanyard, fall, safe work practices, elevated work*

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