Operating Experience Summary

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Inside This Issue

Worker Injured When Length of Safety Line Exceeds Distance of Fall

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On May 4, 2009, at Pantex, a subcontractor worker attempting to reinstall a lightning protection system as part of a roofing task lost his balance, fell about 13 feet from the roof to the ground, and broke his shoulder. The worker was wearing a safety harness, but the attached self-retracting safety line locked, probably because he had run out nearly all of the line (i.e., about 50 feet). When the line locked, he lost his balance and fell, hitting the ground. When the worker was examined at the emergency room of a local hospital, he was diagnosed with an injury to his spleen in addition to the broken shoulder. (ORPS Report NA--PS-BWP-PANTEX-2009-0029; final report issued June 18, 2009)

The worker, who was at the end of his shift, was reaching out for the lightning protection system, which was alongside the building and stretched across the ground (Figure 1-1). His self-retracting safety line was tied to a cart referred to as a "Texas Hold'um." Figure 1-2 shows the cart used for the roofing task, as well as a representative example of the cart. The Texas Hold'um cart weighs over 1,000 pounds and serves as an anchor point so that workers can attach their lanyards in areas where permanent anchor points are not available.

Self-retracting safety lines work much like a seatbelt, automatically extending and retracting to prevent a slack line while a worker moves from place to place. One end of the line is attached to the worker's safety harness and the other to an anchor point (in this case, the Texas Hold'um cart). If a fall should occur, the line locks immediately to stop the fall after a short distance. The worker was moving from place to place on the roof and had inadvertently run out most of his 50-foot line when it suddenly locked as he stood up to move toward two other workers who were also working on the roof. The locked lanyard knocked him off balance, resulting in the fall.

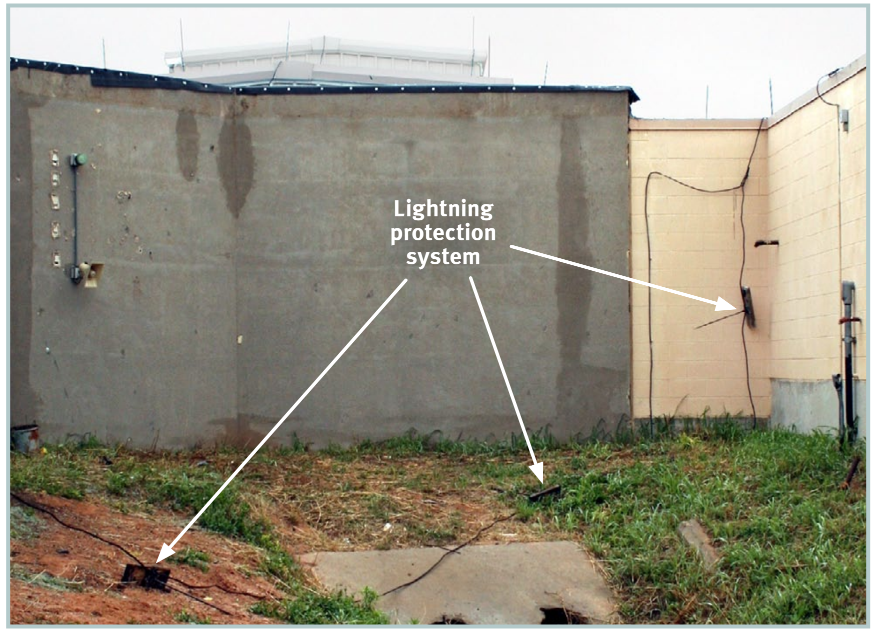


Figure 1-1. Location of lightning protection system

Figure 1-2. Texas Hold'um cart

Figure 1-3 shows the building, location of the cart and worker, and the relative length of his safety line. Because the drop to the ground was only a little over 13 feet, the 50-foot length of the safety line, which was intended to break his fall, allowed him to swing into the ground. When the safety line was unhooked after the accident, it retracted normally.

Investigators identified the following noncompliant conditions.

- The worker exceeded the allowable distance that a retractable lanyard should be extended from its anchor point in relation to the anchor point and working surface leading edge.
- The worker was not cognizant of the distance from the anchor point and the amount of cable pulled out of the retractable lanyard. He did not realize that he was almost to the end of the 50-foot cable capacity of the lanyard.
- The worker's supervisor did not verify that the anchor point (Texas Hold'um) was positioned as required for the work being performed and for the roof design.

Workers who use fall restraint systems need to understand that just wearing the equipment and being tied off may not be enough to protect them from a fall. The equipment must be used properly (e.g., the user should always be aware of working angles from the anchor point, working height, and safe working length of the lanyard). Also, workers must use proper techniques and pay careful attention to their fall protection equipment when moving from one location to another to ensure that they do not inadvertently become vulnerable to a fall.

A near-miss event involving improper use of fall protection equipment occurred at Pantex on July 22, 2008, as workers were installing knee braces for roof support. Two subcontractor steel workers were working on the roof above the attic area of the building when a regional Pantex supervisor entered the work area and noticed that they were not using their fall protection correctly. One worker was wearing his safety harness, but his lanyard was lying on the roof several feet from him. The other worker, who was standing on a bridge crane rail, was wearing his body harness and using a lanyard, but he was not tied off. The Pantex supervisor identified the safety violation and called the workers down from the roof. As they were descending, one worker lost his balance and his foot went through the ceiling. Fortunately, the worker caught himself before he fell through the ceiling and into the room below. (ORPS Report NA--PS-BWP-PANTEX-2008-0085; final report issued September 26, 2008)

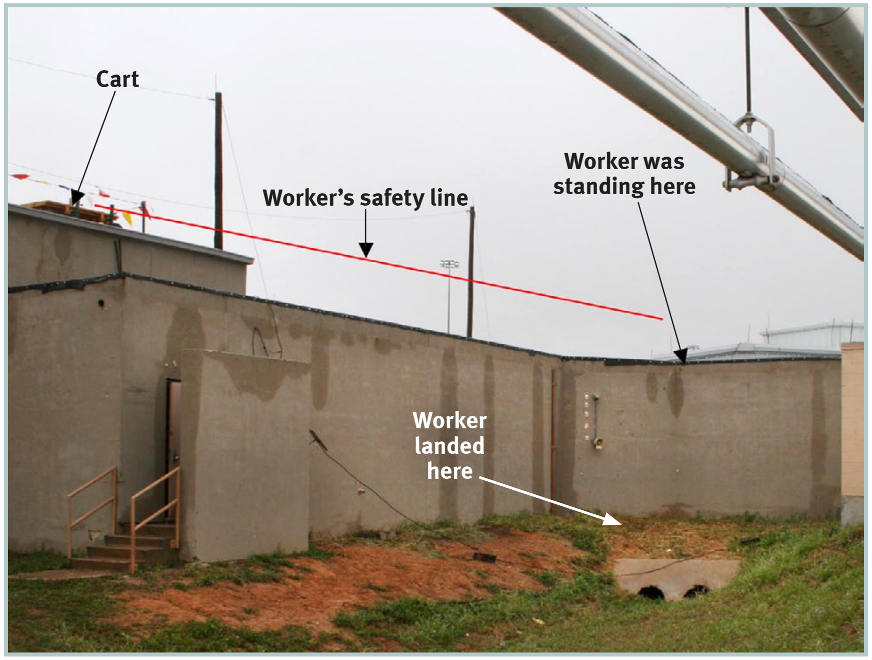


Figure 1-3. Building, location of cart and worker, and relative length of safety line

Investigators determined that because of previous successful work on this project the workers had developed an inaccurate perception of the risks involved and had become complacent.

In addition, investigators believe that both the supervisor and the workers had either forgotten or did not fully understand the requirements of the Activity Hazards Analysis for the task and were more focused on completing the task at hand than on safety.

A review of the ORPS database identified a number of fall protection events that have occurred across the Complex since 2008, including the following.

- On May 29, 2009, at Brookhaven National Laboratory a subcontractor worker was preparing to drill holes in a support attached to the top of a horizontal beam located approximately 27 feet above the level below. The worker was wearing a fall protection harness and was standing on the outside of the beam with his lanyard connected to the inside horizontal beam. A supervisor suggested that the worker relocate to the inside of the support, which would be a safer work location. The worker reacted defiantly and began to leave the work area. While doing so, he disconnected his fall protection lanyard before he moved from his vulnerable position, violating fall protection procedures. No injury occurred, but for a brief time the worker placed himself in a vulnerable position without having his lanyard attached. The worker was terminated immediately, and management issued a safety stand-down to address safety issues with the work crew. (ORPS Report EM--BHSO-BNL-BNL-2009-0009)
- On December 22, 2008, at Livermore National Laboratory, a technician troubleshooting an alarm fault on a tank indicator system was observed not using fall protection while on top of a 15-foot-high retention tank. The worker exited a caged ladder to improve his view of float switches through a port on top of the tank. Investigators determined that there was a miscommunication between the worker and his supervisor and that the worker was not fully aware of the work control requirements. (ORPS Report NA--LSO-LLNL-LLNL-2008-0070)
- On June 18, 2008, at Sandia National Laboratories, a subcontractor foreman and a journeyman climbed onto the guard rail of a scissor lift approximately 23 feet above the floor without any fall protection equipment. The crew was having difficulty positioning the pipe into a pipe hanger because they could not reach it from the scissor lift, so the journeyman climbed onto the top guard rail of the scissor lift and the foreman climbed onto the middle rail to secure the pipe. The workers were aware of the requirements for working in the scissor lift and that they could have used a taller scissor lift that was in the immediate area to perform the task. Investigators determined that the workers deliberately violated OSHA fall protection requirements. (ORPS Report NA--SS-SNL-NMFAC-2008-0012)

It is important for workers to take responsibility for their own safety, follow all fall protection requirements, and realize the dangers of inattention or complacency when working at heights. A fatal fall in 2008 involved a construction worker on a Manhattan, New York, skyscraper project who fell 400 feet from a working platform while lowering a crane. The worker was wearing a safety harness, but it was not attached to anything. After the accident, another worker at the site stated that he "had a harness on when he was on the ground…but I heard he was not attached—he was not hooked off. If he was hooked off, we have supports along the building and he'd have been attached to that, and then if he fell he'd have been dangling in the air." Investigators learned that the victim had unhooked his harness shortly before he fell. (http://gangbox.wordpress.com/2008/09/05/operating-engineers-killed-in-400-fall-from-crane-in-manhattan/)

Actions that workers can take to protect themselves include the following.

- Follow safe work practices identified in worker training programs.
- Use OSHA-required personal protective equipment and make sure training has addressed its proper use.
- Inspect equipment daily and report any damage or deficiencies to a supervisor immediately.

According to the Bureau of Labor Statistics, falls resulted in 835 fatalities in 2007, an increase of 39 percent since 1992. Statistics show that 733 of the fatalities resulted from falls to a lower level (versus trips and falls), including 132 fatal falls from ladders, 161 from roofs, and 88 from scaffolding. In only about 2 percent of these fatal falls, workers were wearing the correct fall protection and were using it properly. (http://www.bls.gov/news.release/cfoi.t01.htm)

Adequate training is essential for workers who will be working at heights to ensure that they take all appropriate actions to ensure their safety and that they wear and use fall protection properly. OSHA requirements in 1926.503, *Training Requirements,* state that "the employer shall provide a training program for each employee who might be exposed to fall hazards" and that "the program shall enable each employee to recognize the hazards of falling and shall train each employee in the procedures to be followed in order to minimize these hazards." Retraining is also required as necessary, including when "inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill." Specific training requirements are as follows.

Employees must be trained in the following areas:

a) nature of fall hazards in the work area;
b) correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems;
c) use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems;
d) role of each employee in the safety monitoring system when the system is in use;
e) limitations on the use of mechanical equipment during the performance of roofing work on low-slope roofs;
f) correct procedures for equipment and materials handling and storage and the erection of overhead protection; and
g) employees' role in fall protection plans.

Additional OSHA regulations for various types of elevated work are shown in the textbox below. An OSHA Quick Card on fall protection can be accessed at http://www.osha.gov/Publications/3146.html.

OSHA Fall Protection Requirements

The following list shows the OSHA regulations for various types of elevated work.

- 29 CFR 1910 Subpart D, *Walking-Working Surfaces*
- 29 CFR 1910 Subpart F, *Powered Platforms, Manlifts, and Vehicle-Mounted Platforms*
- 29 CFR 1926 Subpart M, *Fall Protection*
- 29 CFR 1926 Subpart X, *Ladders*
- 29 CFR 1926.451, *Scaffolds*
- 29 CFR 1926.760, *Fall Protection* (for steel erection activities)

Those who work at heights must take responsibility for remaining alert to any hazards and for wearing the proper fall protection equipment, using it correctly, and complying with all safety procedures. Workers should be properly trained before working at heights, and a trained safety monitor should be colocated at the work site at all times to ensure that work is being performed safely. When working at heights, workers must remember that safety is paramount and that they should avoid complacency, even if they have performed similar work safely many times.

KEYWORDS: Fall protection, fall, injury, self-retracting lanyard

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

Careful Work Planning Required for Tasks in Confined Spaces

2

Several recent events across the Complex that involved workers performing tasks in confined spaces have had a similar causal factor—inadequate work planning.

On March 13, 2009, at Los Alamos National Laboratory, tenants in an area adjacent to an equipment room experienced a burning sensation in their eyes and tingling skin. These symptoms were traced to paint fumes following an application of epoxy to the pan of an air washer in the equipment room. When investigators reviewed the work documentation for the task post-event, they identified a number of discrepancies in work planning. (ORPS Report NA--LASO-LANL-BOP-2009-0005; final report issued March 31, 2009)

Investigators learned that the work was conducted in a designated confined space without a confined space permit. They also learned that use of respiratory protection was not required for the work, although the Material Safety Data Sheet (MSDS) for the epoxy stated that a respirator should be used. An industrial hygienist was not involved in the pre-job planning, as required, and thus the need for respiratory protection was not identified.

On December 22, 2008, at the East Tennessee Technology Park, two workers were cleaning the bottom inside surface of a 45-foot-high vertical cylinder when they felt dizzy. The workers exited the cylinder and recovered quickly. Work on the cylinder was terminated and all confined space entry was placed on hold pending an investigation. (ORPS Report NE-ORO--USEC-K1600-2009-0001; final report issued February 3, 2009)

The cylinder the workers were cleaning had a closed top, so they used a ladder to enter it from the bottom, which was about 4 feet above floor level. While the first worker was cleaning, his co-worker left the work area to obtain additional supplies. He returned to find the first worker outside the cylinder complaining of dizziness. The second worker then climbed the ladder and went into the cylinder to continue working. He was at chest height in the cylinder for less than 10 seconds when he also felt dizzy and climbed out.

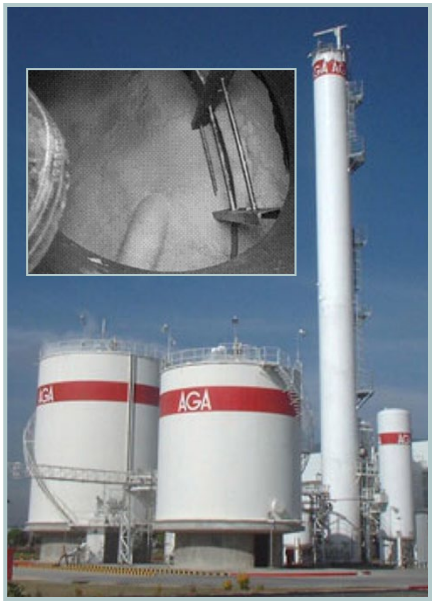
The bottom of the cylinder is located in a large open pit area that is well ventilated and has five oxygen monitors. The monitors detected no lack of oxygen in the cylinder. Shortly after the event, however, the workers realized that their dizziness was the result of nitrogen inhalation and that the nitrogen purge system had not been turned off before they entered the cylinder.

Investigators determined that the root cause of this event was inadequate job planning. Working conditions for the task were not properly evaluated, and there was no pre-job briefing. In addition, a confined space entry permit was not obtained and applicable procedures were not followed. Had the appropriate steps been completed before the work task began, the nitrogen purge system would have been turned off before the workers entered the cylinder.

Another confined space event in the Complex occurred on October 29, 2008, at the Savannah River Site, where a welder who had been repairing leaks at the bottom of a 3,000 gallon water tank was exposed to manganese above the ACGIH Threshold Limit Value (TLV). Results of an analysis of the worker's personal exposure sample indicated an exposure of 0.60 milligrams per cubic meter; the TLV is 0.20 milligrams per cubic meter.

Although a confined space permit was obtained and industrial hygiene staff provided continuous atmospheric monitoring and direction regarding ventilation within the confined space, investigators determined that local exhaust ventilation was ineffective in preventing weld fumes from entering the welder's breathing space. They also determined that the welder should have been wearing a respirator, but the requirements for the work task did not include use of a respirator. (ORPS Report EM-SR--SRNS-SIPS-2008-0003; final report issued February 11, 2009)

A 2007 industry confined space event in Bogota, Colombia, resulted in the death of two workers from nitrogen asphyxiation. In that event a nitrogen purge was in operation at the time a worker entered a cold box (Figure 2-1) to photograph an argon re-boiler. Investigators believe that the worker lost consciousness and a second worker apparently tried to rescue him and also died. A work permit had not been issued for the task. This event is discussed in OE Summary 2008-01.



OE Summary 2008-01 also discusses a review of confined space issues reported to ORPS over a 7-year period between 2000 and 2007, which indicated that nearly 50 percent of the events occurred because entry requirements either were not established or were not followed. Figure 2-2, taken from the article, shows the distribution of commonly made errors.

Figure 2-1. Cold box (inset) and Bogota plant where workers died of nitrogen asphyxiation

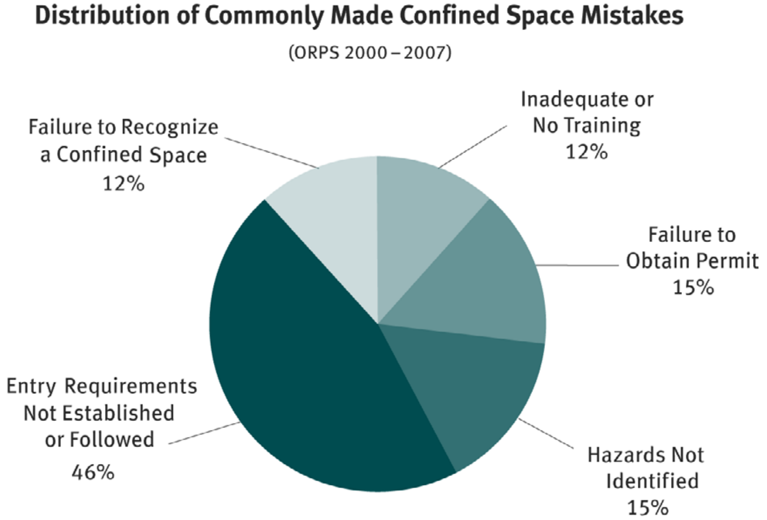


Figure 2-2. Distribution of commonly made confined space mistakes
2000–2007

More recently, a Lessons Learned submitted to the DOE Lessons Learned database (Lessons Learned ID: 2009-SR-SRNS-0007) reported on a study conducted by a Savannah River Site (SRS) Confined Space Improvement Team. The Team reviewed SRS confined space procedures, policies, and training, as well as both DOE Complex and industry-related confined space lessons learned. The purpose of the study was to develop improvements to the SRS confined space program. Among the "themes" the team identified were the following.

- Hazardous atmospheres were not recognized (e.g., conditions in the confined space, adjacent areas that affected the confined space, or areas immediately outside the confined space resulting from conditions inside, such as nitrogen purge).

- Hazards of the work or confined space were not discussed with workers (both in cases with and without confined space entry permits).
- Attendant responsibilities were not upheld (e.g., when individuals were reassigned midway through a task/entry or multiple workers were assigned the responsibility and assumed their co-attendants were performing the duties).
- Work scope was changed after work planning was complete and controls were established. In some cases change in work scope should have reclassified the confined space as permit-required, but did not. This resulted in an inadequate review of the hazards and controls for the task.
- Inadequate controls based on historical knowledge of the tasks or confined space conditions. Assumptions were made based on previous tasks that did not possess the same hazards or for spaces that were dissimilar in size or ventilation rates.
- "Entry" not clearly understood by workers. Workers did not have a thorough understanding that a confined space "entry" did not necessarily mean a full body entry. Partial entries, such as head or hands/arms/feet, were not considered entry by the workers and did not initiate a thorough confined space review.
- Air monitoring was not performed. This occurred for several reasons, including inadequate recognition of hazardous atmospheres, insufficient resources (equipment and trained personnel), miscommunication with personnel performing air monitoring, and inadequate confined space permit requirements.

Careful, in-depth planning is an integral part of safe confined space entry. Job planning should have identified and prepared workers for the hazards of each of the "themes" identified by the SRS team. When planning a confined space entry, it is essential to identify all hazards, assess the risks, and develop appropriate controls to address the risks. Hazards and methods for mitigating them should be included on the confined space entry permit, along with any additional information that will help ensure worker safety.

OSHA confined space regulations in 29 CFR 1910.146, *Permit-required Confined Spaces*, require employers to develop and implement "the means, procedures, and practices necessary" for safe permit-required confined space entry operations (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9797). An informational bulletin on OSHA confined space requirements and their implementation can be accessed at http://www.osha.gov/Publications/osha3138.html.

Careful, in-depth work planning is a key element of safe confined space work. All hazards must be identified and methods for mitigating them must be developed and communicated clearly to workers. Workers must have clear guidance for safe confined space entry and exit and must be provided with all personal protective equipment (PPE) required for their safety. Work in a confined space should never be undertaken without first obtaining a confined space permit, and industrial hygiene personnel should be included in planning efforts to determine the appropriate measures needed to ensure proper ventilation and appropriate PPE.

KEYWORDS: Confined space, work planning, respiratory protection, ventilation, PPE, illness

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

Legacy Beryllium Carries Potential for Contamination and Exposure

3

In April 2008, Los Alamos National Laboratory (LANL) workers moved crated equipment from Sandia National Laboratory to LANL. The manifest indicated that the contents were contaminated with beryllium, but the exterior of the crate was not so labeled. Receiving personnel at LANL did not notice the information about beryllium contamination on the manifest. They opened the crate and saw the "beryllium contamination" label on the plastic-wrapped equipment inside, so they re-secured the crate and had it moved to another facility for storage pending decontamination. In October 2008, swipes of the equipment indicated beryllium contamination above trigger levels. Management decided that extent-of-condition sampling should be performed in the facility where the crate was stored and in its previous onsite location. A worker who was knowledgeable about the facility and its storage history requested that swipes also be taken in a Vault-type Room (VTR) that had been inventoried in 2001. At that time sample swipe results for the VTR were below the trigger level, so the room was declared clean and removed from the baseline inventory. (ORPS Report NA--LASO-LANL-LANL-2008-0006; final report issued May 13, 2009)

On November 17, 2008, LANL industrial hygienists collected 34 samples from the storage facility. Because all 34 samples exceeded the trigger level for a non-beryllium area, sample collection was broadened to an institutional extent-of-condition review. Swipes taken in other facilities indicated that there was also beryllium contamination in areas previously believed to be clean. As a result, investigators interviewed personnel to establish a facility history and determine who had accessed the vault, identifying a series of beryllium contamination events in the facility and the VTR since 2000.

Investigators determined that the triggering event (i.e., the discovery of contamination on the crated equipment) was not the source of the contamination. The investigation has not determined the source(s) of the multiple avenues of beryllium contamination. However, they have postulated that a possible source was legacy beryllium and beryllium parts stored and then moved out of the facility and VTR, which had been declared clean.

Investigators determined that several long-standing issues led to this event, including the following.

- **Inadequate facility turnovers** at several points since 2000 presented missed opportunities to perform a detailed inventory for the next responsible organization. In 2004, for example, no information was provided to the new managing organization about facility status or about any indication of beryllium contamination. There also was no evidence that a walkdown had been performed during the turnover from one organization to the other.
- **Lack of documented inventory** required reliance upon the knowledge of facility workers about contamination and processing histories. As a result, the contamination hazards were not well known; thus, controls were inadequate.
- **Loss of workers knowledgeable about the facility** occurred during worker transfers and organizational changes. In 2000, after the Cerro Grande fire, for example, personnel knowledgeable about the VTR were moved out of the facility. Dependence on worker knowledge impacted facility safety.

- **Inconsistent survey follow-up and data entry** occurred after surveys in 2002 and 2006 found contamination in the VTR; however, no one swiped surrounding areas. If additional surveys had been performed, peripheral beryllium contamination would have been found and the areas controlled. In addition, surveys were not consistently entered into the beryllium database.
- **Inconsistent handling of areas declared clean** led to uncertainty. LANL procedure requires a baseline hazard inventory with swipes for all former beryllium areas and beryllium-contaminated areas. Based on the results of the swipes, the area can be removed from inventory, cleaned below action levels, or posted as a beryllium contamination area. However, releases were not formally documented and follow-up sampling of former beryllium areas was not conducted; therefore, there was no way to determine whether controls were adequate.

This series of events demonstrates the importance of a good inventory control system that identifies and tracks the location of all contaminated and hazardous materials. It also demonstrates the problems that occur when detailed walkdowns are not conducted before facility turnovers. Without careful inventories and walkdowns in the LANL facilities, the incoming organizations inherited unknown problems and held invalid assumptions about materials and contamination. Those assumptions prevented management from instituting additional controls.

The widespread beryllium discoveries at LANL also demonstrate the importance of securing areas suspected of being beryllium areas and documenting their status. Above all, workers and work planners must treat all areas of older facilities as potential sources of beryllium contamination and must plan and protect themselves accordingly. Work planning that considers all the "what ifs" and unknowns is crucial for facilities or sites that have changed contractors and where workers with process knowledge have retired and been replaced with workers who may not know about beryllium contamination, as demonstrated by the following events.

On October 3, 2008, as part of a Lawrence Livermore National Laboratory (LLNL) HEPA filter and ducting upgrade project, a subcontractor removed a return air grille and placed it in a bag, assisted by a technician who later returned to swipe the grille to determine beryllium levels before disposal. One week later, swipe results indicated the grille was contaminated above the release limits, indicating that the subcontractor had potentially been exposed. Investigators determined that the worker who handled the beryllium-contaminated item was not an Authorized Beryllium Worker. Requirements for work with the potential for beryllium exposure must be clearly defined and followed to ensure that hazards are controlled. (ORPS Report NA--LSO-LLNL-LLNL-2008-0051)

This grille removal event is particularly disturbing because it happened a year after multiple beryllium events were reported at LLNL. Subsequent corrective actions and lessons learned were not effective in raising worker awareness to prevent recurrence. One of the earlier LLNL events involved workers who removed, handled, and cut ducting that was later found to have beryllium contamination. Work control process weaknesses and lack of communication between facility personnel were identified as the root causes of the event. During job-scoping the presence of beryllium on elevated surfaces was not considered. (ORPS Report NA--LSO-LLNL-LLNL 2007-0059) Additional details about LLNL beryllium contamination events can be found in OE Summary 2008-07.

In May 2008, the Office of Health, Safety and Security (HSS) published a Causal Analysis Review, *Legacy Beryllium Contamination* (DOC ID: 05-12-08), which focused on the 2007 ductwork contamination event at LLNL, among other events. Of particular note at LLNL was the fact that after beryllium processing, wipe-downs were performed to a height of 8 feet, but no consideration was given to beryllium contamination that remained above that arbitrary level (i.e., on walls, piping, and light fixtures). The HSS report also discusses an event at Sandia National Laboratory, where a prime construction contractor knew that ductwork was beryllium contaminated, but did not pass that information down to the sheet metal subcontractor. The subcontractor crew did not wear the correct PPE to protect them from a potential exposure because they had not been told about the beryllium contamination. The HSS publication can be accessed at http://www.hss.energy.gov/CSA/CausalAnalysisReview-Beryllium05-12-08.pdf.

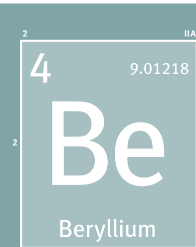
Comprehensive work planning and hazard communication are essential elements of preventing occupational exposures to beryllium, and workers must be aware of the risks. When working in an area where there is potential for exposure to legacy beryllium, workers should have a questioning attitude and should ensure that the hazards analysis and work plan require appropriate protective equipment. Using the "prevent events" information outlined in an HSS Safety Advisory, *Beryllium Exposure Awareness* (Safety Advisory 2008-01, February 2008), can help ensure a safer workplace. The Safety Advisory, which also lists additional sources of information on beryllium exposure, is available at http://www.hss.energy.gov/CSA/csp/advisory/SAd_2008-01.pdf.

The requirements for the Department's beryllium disease protection program are found in 10 CFR 850, *Chronic Beryllium Disease Prevention Program (CBDPP)*, which is available at http://www.gpo.gov/nara/cfr/waisidx_01/10cfr850_01.html. The regulatory requirements of 10 CFR 850 cross-reference DOE directives and industry consensus standards that contain detailed guidance for implementing specific requirements in 10 CFR 850. Explanations and examples for meeting the basic requirements for developing and implementing a CBDPP are outlined in *Implementation Guide for Use with 10 CFR 850* (DOE G 440.1-7A) which can be accessed at http://www.hss.energy.gov/HealthSafety/WSHP/be/guide/beguide/beguide.html.

These events underscore the potential dangers that historical operations may hold for today's workers. During the Cold War, operations and processes at most DOE sites were classified, and workers familiar with the material locations at those sites have long since retired. Without documentation to guide them, today's workers must be vigilant and maintain a questioning attitude. Never assume a work area is clean; its history may be revealed only when swipes are taken and analyzed.

KEYWORDS: Beryllium, legacy, swipes, work planning

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



Beryllium **use** does not mean beryllium **exposure** if:

- engineered controls are in place;
- adequate work planning is performed;
- workers follow the work plan; and
- everyone practices good housekeeping.

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Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CPSC	Consumer Product Safety Commission
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
INPO	Institute for Nuclear Power Operations
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration

Units of Measure	
AC	alternating current
DC	direct current
mg	milligram (1/1000th of a gram)
kg	kilogram (1000 grams)
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
TWA	Time Weighted Average
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards Analysis
JSA	Job Safety Analysis
NOV	Notice of Violation
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act

Miscellaneous	
ALARA	As low as reasonably achievable
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
MSDS	Material Safety Data Sheet
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SME	Subject Matter Expert