OPERATING EXPERIENCE SUMMARY

Inside This Issue

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The Office of Environment, Safety and Health (EH), Office of Analytical Studies, 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.

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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.

EVENTS

1. ELECTRICAL NEAR MISS DURING WALL PENETRATION

On June 24, 2003, at the DOE North Las Vegas facility, a construction worker installing guardrails on a masonry wall inadvertently cut through an energized 120-volt conductor in a lighting circuit, tripping a circuit breaker. Work planners did not identify the conduit because the hidden conductor was beyond the depth capability of the survey instrument they used. Although the worker could have received a severe electrical shock, no injuries resulted from this near-miss event. (ORPS Report NVOO--BN-NLV-2003-0003; final report filed October 7, 2003)

Before work began, workers used a Hilti Ferroscan FS10 (Figure 1-1), "Quickscan," survey to identify any hidden obstructions in the wall, but the scan did not indicate the presence of wiring. The construction worker was drilling holes for guardrail supports when his drill bit penetrated the ½-inch metallic conduit and tripped the circuit breakers. Apparently, the workers who performed the pre-work survey did not understand the limitations of the "Quickscan," which only scans to a depth of 4 inches. The wiring was approximately 6 inches inside the wall. Other available methods such as survey instruments, drawings, construction records, and personnel knowledge were not used.

Figure 1-1. A Ferroscan FS10

In accordance with site procedures, the subcontractor requested and obtained a blind penetration permit. The permit required managers to verify that the estimated locations of utility obstructions were marked on the structures to be penetrated. Contractor management personnel did not comply with this requirement because it was "standard practice" for the workers drilling the holes to identify the locations of obstructions and avoid them, based on their experience and knowledge.

Investigators determined that the direct cause of the occurrence was that work planners did not identify the presence of the energized conductor. They also identified several contributing causes for the occurrence, including (1) using a Ferroscan "Quickscan" survey instrument under conditions where it could not produce a meaningful reading; (2) considering non-compliance with the blind penetration permit requirements a "standard practice"; and (3) failing to mark the location of hidden utilities on the structure to be penetrated.

Corrective actions identified as a result of this incident included the following.

- Procure scanning survey equipment that is compatible with the conditions encountered in the facility.
- Provide training for all personnel who use the survey scanning equipment on the specific operating characteristics and limitations of the equipment.
- Provide briefings on the requirements of the blind penetration permit to appropriate personnel.
- Develop a checklist of good practices and incorporate it into the blind penetration permit process.

Intrusions into unidentified, energized electrical conductors continue to present hazardous conditions to workers at DOE facilities. Two such events occurred within 8 days of each other in October 2003. On October 22, 2003, at the Pantex Plant, workers hand-excavating a small hole near a building door discovered some broken conduit containing electrical cables. Workers were trying to determine whether the cables were abandoned when an electrical arc/flash occurred. No electrical shocks or other injuries resulted from this incident. (ORPS Report ALO-AO-BWXP-PANTEX-2003-0050)

On October 14, 2003, at the Mound Plant, a crafts worker removing conduit as part of a demolition activity inadvertently cut into an energized 110-volt electrical conductor. In spite of procedures to the contrary, neither the work supervisors nor the crafts worker performed a zero-energy check on the electrical conductors before starting the removal task. No injuries resulted from this incident. (ORPS report OH-MB-BWO-BWO01-2003-0004)

Electrical intrusion incidents continue to occur in the DOE complex. Recent OES articles on the topic of inadvertent electrical intrusions include the following.

- Heavy Cable Trench Cover Dropped on Energized Power Cable (OES 2003-20, October 6, 2003) — As a worker attempted to replace a heavy trench cover plate, it slipped from his hands into a cable trench and damaged a 480-volt power cable, creating an arc/flash to ground.

- Cabinet Anchor Bolt Penetrates Energized Cable (OES 2003-19, September 22, 2003) — Workers installing an equipment cabinet inadvertently pushed an anchor bolt through a thin concrete floor into an electrical raceway, shorting a 480-volt cable to ground and creating an arc/flash that tripped a circuit breaker.

- Near Miss: Underground Electrical Cable Snagged and Cut (OES 2003-18, September 8, 2003) — Construction workers using a grader with a ripper blade snagged and subsequently cut an energized 120-volt electrical cable that provided power to a nearby facility.

- Worker Cuts Energized Conductor Mistakenly Marked for Removal (OES 2003-14, July 14, 2003) — An ironworker performing demolition work received a mild electrical shock when he cut a conduit that contained an energized 120-volt electrical conductor. The conduit had been mistakenly marked for removal with spray paint.

- Electrical Conduit Punctured by Steel Rod (OES 2003-14, July 14, 2003) — A construction laborer using a steel rod while excavating a trench near an electrical substation inadvertently punctured an electrical conduit that contained an energized 480-volt electrical conductor. The conductor was not damaged, and the laborer was not injured.

Information on electrical safety practices within DOE can be found in the Electrical Safety Report, dated May 21, 1999, and published by the EH Office of Performance Assessment and Analysis. OSHA requirements on design safety standards for electrical systems and on safety-related work practices are presented in 29 CFR Part 1910, Occupational Safety and Health Standards, Subpart S, *Electrical*. OSHA standards are accessible from http://www.osha.gov.

GOOD PRACTICES FOR AVOIDING HAZARDOUS ELECTRICAL INTRUSIONS

- Perform a thorough investigation of the locations of all electrical conductors in the blind penetration planning process.
- Use multiple sources of information (not just one) to identify the locations of hidden electrical conductors (e.g., scanning surveys, drawings, and local knowledge).
- Know the capabilities and limitations of the survey instrument used to locate conductors hidden in walls, floors, etc.
- Use the proper survey instrument for the conditions of the survey.
- If the requirements contained in procedures or permits are unworkable, get the requirements changed instead of ignoring them.
- Mark the estimated location of the hidden conductors on the structure to be penetrated.
- Perform work within the boundaries of the approved penetration permit.

These events underscore the need to follow procedures and pay attention to detail to prevent electrical intrusion events. Make sure that the survey instrument you are using is suitable for *the task and ensure that scanning instruments can meet the necessary depth requirements to locate an obstruction. If requirements in permits cannot be met, revise the requirements; rather than choosing lack of compliance as "standard practice."*

KEYWORDS: *Electrical hazards, blind penetrations, penetration permit, scanning surveys, Ferroscan survey, electrical intrusion*

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

2. FIRE SUPPRESSION SYSTEM FOUND IN DEGRADED CONDITION

On October 14, 2003, at Los Alamos National Laboratory, a fire protection pipefitter discovered a loss of fire water pressure to the fire suppression system that protects offices in a building. The pipefitter was conducting semi-annual preventive maintenance on the fire suppression system at the time of discovery. Investigators found that a block valve, which provides water to the fire suppression system, had been left closed from a previous operation. (ORPS Report ALO-LA-LANL-ADOADMIN-2003-0004)

A site support subcontractor (KSL Services) fire protection crew, consisting of two electricians and the pipefitter, was performing scheduled maintenance on the system. The pipefitter verified that a post indicator valve for the fire suppression system was open, then opened an inspector's test valve and noticed that the system pressure dropped to zero. The crew contacted the KSL Utilities Group, and one of their pipefitters found the closed block valve. This block valve, which is located in the utilities infrastructure, connects service water to the fire protection system through the post indicator valve. The utilities pipefitter determined that only residual water pressure was feeding the post indicator valve and the building sprinkler system. He opened the block valve and restored water pressure to allow the fire protection workers to complete the maintenance tasks.

The block valve is part of the service utility and is owned by the KSL Utilities Group and is not part of the fire protection preventive maintenance; therefore, it was not checked by the fire protection crew. As part of the investigation, utilities pipefitters observed that the block valve was painted *blue*, incorrectly indicating it was part of the service utility line and not part of the fire protection system where it would have been painted *red*. Fire protection systems drawings do not show the block valve. Utilities personnel stated that they generally leave the block valve in the open position and do not use it for system isolation. Therefore, it is not included in their preventive maintenance program.

Investigators do not know what work activities were conducted since the fire suppression system was last tested 6 months ago that could have resulted in closing the block valve. Even if that is never learned, this event brings into question both configuration control and organizational control of the fire protection system.

The causal analysis has not been completed, and corrective actions have not been determined as yet. However, possible solutions could include removing the block valve from the system or changing ownership of the valve from the utilities organization to the fire protection organization. This would require retagging the valve, painting it the appropriate color, and adding it to fire protection drawings and procedures.

Degraded fire protection systems have occurred at other sites within DOE. On July 15, 2003, at a Kirtland Air Force Base hangar, a fire protection specialist noticed that water valves for the deluge system were all closed and not tagged. He learned that the system was isolated in July 2002 because of concerns regarding inadvertent activation while the hanger was used as a concession area during a 4th of July celebration. There were no records of the systems status, and fire department personnel did not report that the system was not responding to electronic tests during the year the system was isolated. Corrective actions included replacing the current system with a closed-head action system with new sensors and requiring monthly inspections of the deluge system. (ORPS Report ALO--OTS-TSS-2003-0001)

FIRE SUPPRESSION SYSTEM ALIGNMENT PRACTICES

- Ensure maintenance procedures require complete lineup checks before restoring systems to service following maintenance or testing.
- Ensure all critical fire suppression systems valves are operable and in their correct positions.
- Require visual verification of valve positions during alignment checks.
- Perform periodic walkdowns of fire suppression systems to verify valve status. If necessary, add status checks to operator or protection force round sheets.
- Maintain configuration control of fire suppression systems (e.g., accurate as-built drawings).
- Include signoffs for fire protection inspectors on check lists.
- Ensure that all fire protection valves are controlled to assure their proper alignment (e.g., locks, tags, or tamper switches).
- Ensure fire suppression valves are properly tagged and color coded.

Causal factors for other events reported in ORPS where incorrect system alignment impaired the ability of fire protection systems to function included: (1) the failure to conduct post maintenance testing, (2) the failure to verify correct valve positions, and (3) the lack of formality in procedures and checklists. The National Fire Protection Association Standards NFPA 13HB-96, *Automatic Sprinkler System Handbook*, and NFPA 25, *Inspection, Testing and Maintenance of Water-Based Fire Protection Systems*, provide valuable guidance maintaining water-based fire suppression systems.

DOE Order 420.1A, *Facility Safety*, requires that contractors develop comprehensive programs for the inspection, testing, and maintenance of fire protection systems. Additional guidance is contained in the *Implementation Guide for DOE Fire Protection Programs* (G-420.1/B-0). The DOE Fire Protection Website (http://tis.eh.doe.gov/fire) contains model "Operability Requirements" for fire protection systems as well as inspection, testing, and maintenance procedures.

These occurrences underscore the importance of maintaining positive control over the position of critical valves in fire suppression systems. Misalignment of a fire suppression system threatens human safety, as well as equipment and processes. Facility and process safety analyses frequently take credit for the ability of these systems to limit the release of radioactive materials or hazardous materials under fire conditions. Fire suppression systems are an important part of the facilities loss prevention and safety program and should be under the control of a single dedicated organization.

KEYWORDS: *Fire protection, fire suppression, isolation, degraded, impaired, preventive maintenance, configuration control*

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

3. SPRAY LUBRICANTS CAN CAUSE FIRES IN PAPER SHREDDERS

On October 15, 2003, at the Los Alamos National Laboratory, a sheet of paper covered with spray lubricant started a fire in an office paper shredder. A computer support technician shredding documents sprayed the paper with an aerosol lubricant and placed it into the shredder. The lubricant flashed, blew the top off the shredder cabinet, and ignited a fire in the shredder cabinet. The technician's left forearm was slightly singed. (ORPS Report ALO-LA-LANL-MATSCCMPLX-2003-0002)

The technician sprayed Fellowes® Silicone Spray Shredder Lubricant (Figure 3-1) on the paper to prevent the shredder from clogging. Liquified petroleum gas (LPG) is used as the propellant for the silicone spray, and the label on the can warns that it is extremely flammable. The instructions on the spray can direct users to insert a spray extension tube into the nozzle, place the

Figure 3-1. Fellowes Silicone Shredder Lubricant

extension into the throat of the shredder, and liberally spray across the cutters for 1 to 2 seconds.

The technician held the can in a horizontal position and sprayed the lubricant onto the paper, without using the extension tube. The instructions on the spray can did not indicate that the equipment should be de-energized when using the lubricant, so the technician did not turn the shredder off before he sprayed the lubricant.

The technician resumed shredding, and about 5 minutes later, the flash occurred. He immediately stepped back, saw a flame in the cabinet of the shredder, and used a halon fire extinguisher to extinguish the fire. Figure 3-2 illustrates the burned shredder.

Following the event, facility personnel contacted Fellowes and learned that they discontinued making the lubricant in 1995, but not because of safety concerns. The Material Safety Data Sheet (MSDS) for the silicone lubricant states that it is considered non-flammable, but page 3 of the MSDS indicates a fire index value of 4 be-

Figure 3-2. The shredder after the fire

cause of the LPG propellant, which has a 1.8 percent lower explosive limit. If the can is held vertically as it is being used, the propellant remains in the can; however, the flammable LPG can escape if the can is held at an angle (or horizontally, as the technician held it).

Shredders can pose a fire hazard if they are lubricated when hot. The Navy Safety Center website publishes, *Fathom*, an online publication that included an article on the potential shredder fire hazards. An intelligence specialist was shredding documents and decided to oil the shredder. He lubricated the hot machine and continued shredding. The shredder began making strange noises, and suddenly blue flames shot from the shredder. Unfortunately, the in-

USING SHREDDERS SAFELY

- Ensure that users are trained to operate shredders safely.
- Each shredder should have an operator's manual nearby for reference. If there is doubt as to which lubricants are safe to use, contact the manufacturer.
- Shred only paper and do not lubricate shredders when the equipment is hot.
- Label shredders to warn users about the risk of fire or explosion when applying lubricants.
- Use lubricants in accordance with the manufacturer's recommendations.

telligence specialist tried to blow them out, blowing flames through the shredder and igniting the storage bag full of shredded paper. His department head was working in the same office and quickly unplugged the shredder.

The intelligence specialist attempted to use a CO_2 fire extinguisher to smother the flames, but his department head recognized the hazard of using the oxygen-displacing CO_2 extinguisher in an enclosed office space. The department head then stamped out the burning shreds. Afterward, the intelligence specialist found that someone had shredded plastic along with paper, which may have contributed to the shredder overheating.

A Canadian Safety Digest also recently described a flash fire involving a paper shredder. A worker used spray lubricating oil and activated the rollers to maximize the effect of the lubricant. He did not realize that the spray lubricant, and other similar lubricants, was highly flammable and was not approved for use in paper shredders. The shredder operator's actions caused the switch unit to spark at every position. The sparking ignited vapors from the lubricant and caused a flash fire. Fortunately, the shredder operator suffered only minor burns on his face. Damage to the shredder was also relatively minor.

These events illustrate a potential fire hazard that can exist in an office environment. Shredders are commonly used machines and can become hot after much use. Users should be aware that flash fires can occur. They can prevent this possibility by using the right equipment for the job, in accordance with manufacturer specifications.

KEYWORDS: *Shredder, paper, flammable, lubricant*

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

4. NEAR MISS EMPHASIZES THE NEED TO INSPECT LADDERS BEFORE USING

On October 21, 2003, at the Savannah River Site, a heating, ventilation, and air conditioning (HVAC) technician narrowly avoided injury when the stepladder he was descending failed and he jumped off. The 10-foot yellow fiberglass ladder had been obtained from an outside storage rack earlier that morning. Although the ladder was inspected before use, no deficiencies were identified. (SELLS Identifier 2003-SR-WSRC-0018)

A radiological controls inspector climbed the ladder to perform a radiological survey and get a swipe from ductwork before HVAC technicians measured airflow. The radiological controls inspector could not reach the top of the duct, so the HVAC technician climbed up to get the swipe. As he stepped onto the fourth rung from the bottom, he heard a loud popping noise, and the ladder bowed to the left and began to tip over.

Following the incident, inspectors found cracks in the right front and rear legs (Figure 4-1) and along the right and left front legs where the spreader bar is attached to the ladder side rails (Figure 4-2).

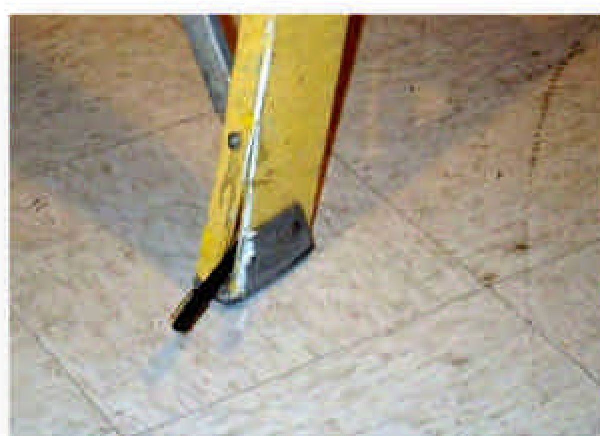


Figure 4-1. Cracked ladder foot

Investigators believe that the right foot of the ladder began to split at the bottom, allowing the ladder to bow out to the left. This in turn placed

Figure 4-2. Cracks in the ladder's leg

abnormal stress on the ladder spreader bar, causing the split in the left leg of the ladder. Part of the right front foot of the ladder appeared to have worn away as though it had been dragged while being moved, and the unsealed fiberglass edges were exposed. This is where investigators believe the ladder began to split.

Investigators believe that this was the first time the ladder had been used in a long time, and it had been exposed to the elements and sunlight while stored in the outside storage rack. Information labels on the ladder had worn away.

Inspectors conducted mass inspections of ladders in adjoining facilities following this incident. Managers continue to emphasize that users must inspect ladders before they use them and must follow the requirements in the site procedure for ladder and scaffold safety.

Facility personnel published an article that describes inspection areas for fiberglass ladders. The following text box contains excerpts and photographs from that article.

Failed fiberglass ladders have injured workers in private industry as well. In July 1997, an electrician working on an AT&T-owned building fell from an 8-foot fiberglass stepladder and fractured his left leg when the lower portion of the support side of the ladder split. The electrician had noticed the ladder on the wall in a room where he was working and simply began using it without inspecting it. Following the incident, inspectors found the ladder had structural splits and fractures that apparently originated near the foot of the support side of the ladder. The electrician has had multiple surgeries since his fall and will live with significant permanent impairment.

This event illustrates the need for thorough ladder inspections before use, especially ladders that have been in storage for a long period of time or exposed to the elements. Fiberglass ladder failures, in particular, can result in serious injury.

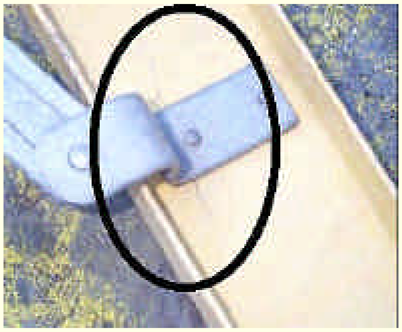
KEYWORDS: *Fall, fall protection, inattention to detail, ladder*

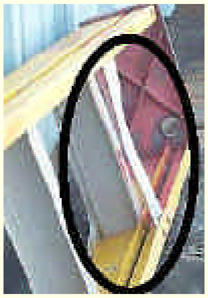
ISM CORE FUNCTIONS: *Analyze the Hazards, Develop and Implement Hazard Controls*

INSPECTING LADDERS FOR SAFETY

- Scrape a fingernail along the surface of ladder structures to discover cracks forming that may not be easy to see.

- Check areas that have been drilled (e.g., to attach metal fittings with rivets). Areas that have been drilled become vulnerable to cracking.





- Look for bent back supports where someone may have attempted to stand.

- Check the feet of the ladder to ensure that the rubber feet are intact and that metal hardware is undamaged. The feet absorb the shock of contact with hard surfaces and can crack and split.

- Check for dents in the ladder rungs. When a round tube becomes bent, the bent area becomes the weakest point.

- Never paint a fiberglass ladder. Paint can disguise cracks that are beginning to form.