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The Office of Environment, Safety and Health, Office of Corporate Performance Assessment publishes the Operating Experience Summary to promote safety throughout the Department of Energy 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, 301-903-8008, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction. If you have difficulty accessing the Summary on the Web (URL http://www.eh.doe.gov/paa), please contact the ES&H Information Center, (800) 473-4375, for assistance. We would like to hear from you regarding how we can make our products better and more useful. Please forward any comments to Frank.Russo@eh.doe.gov.

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EH Publishes "Just-In-Time" Reports

The Office of Environment, Safety and Health recently began publishing a series of "Just-In-Time" reports. These two-page reports inform work planners and workers about specific safety issues related to work they are about to perform. The format of the Just-In-Time reports was adapted from the highly successful format used by the Institute of Nuclear Power Operations (INPO). Each report presents brief examples of problems and mistakes actually encountered in reported cases, then presents points to consider to help avoid such pitfalls.

1. Deficiencies in identification and control of electrical hazards during excavation have resulted in hazardous working conditions.
2. Deficiencies in work planning and hazards identification have resulted in electrical near misses when performing blind penetrations and core drilling.
3. Working near energized circuits has resulted in electrical near misses.
4. Deficiencies in control and identification of electrical hazards during facility demolition have resulted in hazardous working conditions.
5. Electrical wiring mistakes have resulted in electrical shocks and near misses.
6. Deficiencies in planning and use of spotters contributed to vehicles striking overhead power lines.

The first six Just-in-Time reports were prepared as part of the 2004 Electrical Safety Campaign. In April, the Office of Environment, Safety and Health published a Special Report on Electrical Safety. The purpose of this report is to describe commonly made electrical safety errors and to identify lessons learned and specific actions that should be taken to prevent similar occurrences. This report can be accessed at http://www.eh.doe.gov/paa/reports/Electrical_Safety_Report-Final.pdf

EH plans to issue more Just-in-Times soon on other safety issues, such as lockout and tagout, fall protection, and freeze protection. All of the Just-in-Times can be accessed at http://www.eh.doe.gov/paa/reports.html.

EVENTS

1. CARELESS FORKLIFT OPERATION CAN BE HAZARDOUS AND RESULT IN DAMAGE

On May 14, 2004, at the Idaho Advanced Mixed Waste Treatment Facility, an operations technician accidentally punctured a waste drum with one of the tines of his forklift while maneuvering to pick up the drum. The drum-handling tine caused a 2-inch-long by ½-inch-wide puncture in the drum, but did not penetrate the inside liner. Personnel evacuated the building as a precaution until a radiological technician verified that there was no contamination as a result of the incident. A patch was placed over the hole, and the drum was placed in an overpack. (Non-ORPS reportable event)

The driver was maneuvering the forklift between two pallets to retrieve the second drum from the end of a pallet. As he turned the forklift, the right tine cleared the drum but as he applied the forklift brakes, the left tine hit the drum. Maintenance technicians checked and adjusted the forklift brakes.

On February 26, 2004, at the Rocky Flats Environmental Technology Site, workers noticed two holes in a metal support column in a building material storage area. The holes were produced by the tines on a large powered industrial truck. Figure 1-1 shows the location of the damaged column. (ORPS Report RFO--KHLL-WSTMGTOPS-2004-0005)

Figure 1-1. Location of damaged support column

The column is located where the forklifts are parked for recharging. Engineers evaluated the damaged column and determined that there was a 12 percent reduction in the ability of the column to support load. The column will be reinforced. Figure 1-2 shows where the forklift tines penetrated the column. All operators of powered industrial trucks, spotters, and their foremen who work in the storage area were briefed on the incident.

Figure 1-2. Penetration damage from forklift tines

On June 6, 2003, at the Oak Ridge Y-12 Site, a forklift, operating in a congested area, backed into and damaged an electrical transformer. The forklift operator did not look behind him and did not have a spotter to assist him. The damaged transformer was not energized at the time and had been removed from a building and placed outside in a paved parking area for use at a job site. (ORPS Report ORO--BWXT-Y12CM-2003-0001)

The transformer, valued at $70,000, was repaired at the cost of $22,036 and transported to the job site for installation. Although the forklift operator in this incident was qualified, he failed to request assistance from assigned spotters and failed to ensure his path was clear before backing up.

A few years ago at the Y-12 Site, a forklift operator ran one of the forklift tines into an energized electrical transformer while attempting to maneuver the forklift through a garage bay rollup door. When the left tine of the forklift penetrated the side of the transformer housing, a small amount of blue smoke was seen coming from the transformer. The tine punched a 1½-inch by 6-inch hole in the side of the transformer. (ORPS Report ORO--BWXT-Y12SITE-2002-0003)

There were no apparent flames or fire, but the tine of the forklift had burn marks. Investigators determined that the event was caused by the forklift operator's inattention. During questioning, the operator stated that he was careless and working quickly.

An article in OE Summary 2003-18 reviewed forklift events reported in ORPS during 2003. Seventeen percent of these events involved hitting obstructions. Forklift operators should (1) never back up without first looking behind them, (2) request a spotter when maneuvering in congested areas or where there are overhead hazards, and (3) never butt loads with the forks or rear end of the forklift.

COMMONLY MADE ERRORS DURING FORKLIFT OPERATION

- Driving while load obstructs view
- Taking turns with excessive speed, resulting in tipover
- Leaving forklift unattended and in unsafe condition (e.g., engine running, load raised, parking brake not set)
- Attempting to jump clear of the forklift during a tipover accident
- Failing to wear seatbelt
- Standing on load while it is lifted
- Allowing others to ride on the forklift
- Failing to check for adequate clearance
- Not securing the load
- Failing to keep loads low and balanced
- Failing to determine the weight of load
- Failing to maintain the forklift center of gravity within the vehicle stability triangle
- Failing to maintain a safe distance from dock and ramp edges
- Failing to keep the load "uphill" when traveling on ramps or grades

OSHA regulation 29 CFR 1910.178, *Powered Industrial Trucks*, contains safety requirements related to the operation of fork trucks (forklifts), including operator training requirements.

DOE-STD-1090, *Hoisting and Rigging*, Chapter 10, "Forklift Trucks," provides direction concerning forklift inspections, testing and operations. Section 10.5, "Operations," provides important guidance on general operator conduct when operating forklift trucks, including loading and traveling.

These events demonstrate the importance of safely operating powered industrial trucks such as forklifts. Drivers need to operate forklifts in a controlled manner and to maintain a safe distance from objects in all directions, including overhead. Damage from forklift impact can be considerable, resulting in costly cleanup, unnecessary repairs, or even total loss.

KEYWORDS: *Forklift, fork truck, powered industrial truck, tines, industrial operations, material handling*

ISM CORE FUNCTIONS: *Perform Work within Controls*

2. FOLLOWING PROCEDURES IS ESSENTIAL TO SAFETY

On April 30, 2004, at Sandia National Laboratory's Plasma Material Test Facility, operators reported an elevated x-ray level from a Radiation Generating Device (RGD). An operator who entered the room to adjust the instrument discovered above normal radiation levels (1mR/hour) using a Geiger-Muller counter. Investigators determined that the operators failed to follow a procedural requirement to request that a Radiological Control Technician (RCT) perform a survey before energizing the RGD and that radiation leaked through an unshielded electrical feedthrough on the vacuum tank. The operators' personal dosimeters showed no dose, and there were no injuries, equipment loss, or environmental impact. (ORPS Report ALO-KO-SNL-6000-2004-0003)

The procedure requires an RCT to perform surveys for x-rays after a vacuum-tank configuration change. In this event, as soon as the elevated radiation levels were reported, operators shut down the RGD and shielded the feedthrough. When they re-energized the RGD, the RCT performed the required surveys and determined that radiation levels were within acceptable limits. Although operator's dosimeters showed no dose, operations were shut down until a review could be completed.

A search of the ORPS database discovered several recent events where workers failed to follow procedures. On December 3, 2003, at the Fernald Waste Pits Project, a heat trace malfunctioned, resulting in a chain of events that caused equipment damage and a shutdown. Some elements of this event would have been mitigated if operators had followed the alarm response procedure. When the heat trace malfunctioned during thermal drying unit operation, the resulting high-high alarm was acknowledged without proper action, and the recirculation pump shut down. The control room operator tried to restart the pump but was unsuccessful in raising the water level. Because there was insufficient cooling water flow, the subcool quench off gas exit temperature started to rise and it, too, sent an alarm. Again, the alarm was acknowledged, but no one followed the response steps in the Alarm Response procedure. Eventually the system interlocks stopped the feed to both dryers and the system stabilized. However, equipment damage occurred when a control room operator started the recycle pump and a fitting failed, spraying water over equipment, causing a re-heater temperature controller to fail, and wetting the Train A HEPA filter. Although there were no injuries or exposures to radiological or hazardous materials, failure to respond to the alarms resulted in equipment damage and process shutdown. (ORPS Report OH--FN-FFI-FEMP-2003-0038)

On December 2, 2003, at Pantex, production technicians and material handlers did not follow a Standing Order directing them to notify the Operations Center for verification before moving a nuclear explosive out of the facility. The notification is necessary to ensure that move windows and warning flags are in the proper position before the move. In this instance, all other aspects of the move were performed correctly, and there were no hazards to personnel during the move. However, it became evident during the ensuing assessment that procedural noncompliance was a recurring problem during material moves, and operations were suspended. New procedures will be developed that clearly define who is responsible for notifying the Operations Center and include the notification on a checklist. (ORPS Report ALO-AO-BWXP-PANTEX-2003-0060)

On October 29, 2003, at the Hanford Sludge Water Retrieval and Disposition project, a field supervisor violated the O_2 alarm response procedure when he directed work to continue after one worker's O_2 monitor alarmed, then cleared. This was not the first time the work had been performed, but it was the first time workers wore the O_2 monitors, because of the possibility that the work area could contain up to 3 cubic liters of residual argon gas from previous activities. Both the procedure and work package required workers to evacuate in case of an O_2 alarm. The worker and RCT apparently understood the requirement, but the Field Supervisor did not. Workers and supervisor alike, however, violated the basic conduct of operations tenet, “Believe your indicators.” In this case, they should have believed the monitor that alarmed, then cleared, and evacuated the area. Subsequent investigation verified that argon gas would not have leaked into the facility and that the monitor had malfunctioned; however, workers did not know that at the time. No matter what caused the alarm, the O_2 monitor was alerting the workers to something important, and they should not have taken a chance by staying in the work area. (ORPS Report RL-PHMC-SNF-2003-0046)

Also in October 2003, at the Y-12 site, a qualified operator performing a 24-hour inventory used the correct procedure, but skipped several steps. As a result, he missed the direction to don the personal protective equipment (PPE) designated in the Radiological Work Permit for all work in and around heavy water. His assumption that the PPE instructions would immediately precede the steps and his failure to abide by the requirement for step-by-step procedural compliance placed him and the trainee accompanying him at risk. (ORPS Report ORO--BWXT-Y12SITE-2003-0040)

These events underline the importance of thoroughly understanding required steps in procedures that apply to an evolution. They also point out the importance of following procedures step-by-step from the beginning.

KEYWORDS: *Failure to follow procedures, conduct of operations*

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

3. WORKER INJURY FROM UNSAFE LADDER USE

On April 21, 2004, at the Stanford Linear Accelerator Center, a coil of communication cable with a 7-foot long by ¾-inch diameter splice enclosure accidentally fell down a manhole, striking a worker who was standing about 4 feet from the base of the fixed manhole ladder. The worker sustained two facial lacerations near his right eye. He was treated and released for work later the same day. The incident occurred while a co-worker, who was standing on the ladder with his shoulders in the manhole opening, was attempting to hand three coils of cable with splice enclosures up to a third worker who was kneeling at ground level. During the transfer, one of the cables with enclosure was dropped. (ORPS Report OAK--SU-SLAC-2004-0003; final report filed May 14, 2004)

Investigators reviewed the electrical job hazard analysis form and saw that it did not address ladder use or the potential for falling objects. They also determined that the worker put himself at risk by handing cables up to his co-worker while standing on the ladder and by climbing the ladder with the cables strung over his shoulder. Both of these actions violated the site ladder safety policy. In addition, other workers at the surface watched the worker on the ladder but did not stop the work. The facility manager recommended refresher training in ladder safety and in employee stop work activity authority. The Safety, Health, and Assurance Department is updating the ladder safety policy to address stand-clear areas and the need for hardhats to protect against falling objects. The injured worker's department also plans to purchase equipment for raising and lowering items safely.

A previous event involving a worker being injured on a ladder occurred on May 6, 2003, at Rocky Flats. A subcontractor D&D worker fell from a 10-foot ladder while using a reciprocating saw to cut notches in overhead ductwork. The saw kicked back, knocking the worker off balance, and he fell over 6 feet, sustaining minor injuries to his elbow, hip, and knee. (ORPS Report RFO--KHLL-771OPS-2003-0008)

Although the subcontractor's work package specified that either ladders or a manlift could be used to access the ductwork and the pre-job briefing addressed ladder safety, investigators acknowledged that work planning was deficient. The reciprocating saw was selected for notching because of the weight and awkwardness of portable band saws and the fact that keyhole saws bound up when cutting stainless steel. However, the potential for saw kickback or loss of balance was not addressed.

Another ladder incident occurred on April 14, 2003, at Los Alamos, where a subcontractor D&D worker fractured his lower right leg when he became entangled in an 8-foot fiberglass stepladder. He was standing about halfway up the ladder using a cutting torch to cut pipe. The pipe fell and struck debris, which knocked the ladder over. (ORPS Report ALO-LA-LANL-HEMACHPRES-2003-0001)

Subpart X of the OSHA Standard for Construction, 29 CFR 1926, addresses all aspects of ladder safety. The following specific citations contain requirements that very likely would have prevented the three events described above.

- **1926.1053(b)(20)**: When ascending or descending a ladder, the user shall face the ladder.
- **1926.1053(b)(21)**: Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder.
- **1926.1053(b)(22)**: An employee shall not carry any object or load that could cause the employee to lose balance and fall.

The text box below contains tips on using ladders safely. These tips were taken from the websites of the Consumer Product Safety Commission (http://www.cpsc.gov) and from the Center to Protect Workers' Rights (http://www.cpwr.com).

These events illustrate the importance of thorough work planning to ensure ladder safety. Before ladders are used, all potential hazards should be identified and addressed. Also, any unsafe actions should be stopped immediately.

USE LADDERS SAFELY

- Choose the right equipment. Scaffolds or scissor lifts are safer to work from than ladders.
- Two people should set up a ladder.
- Check a ladder before using it; recheck it if it has been unattended.
- Set a ladder on firm, level ground; otherwise, secure it by lashing it to a secure surface, placing large boards under the feet, or having someone hold it.
- Keep the area around the ladder clear.
- Always face a ladder when working on it — or moving up or down.
- Always have 3-point contact (such as one hand and two feet).
- Never work from the top or top step of a stepladder, or from any of the top three steps of a straight or extension ladder.
- Keep your body centered between the side rails of the ladder — so you don't tip over the ladder.
- If possible, use a personal fall protection system attached to a secure anchor point on a building when working from a ladder.
- Do not hold objects in your hand when moving up or down a ladder. Attach objects to your tool belt or pull them up on a line.
- Do not use a ladder in windy weather.
- Never move a ladder while someone is on it.
- Lower the top section of an extension ladder before you move it.

KEYWORDS: *Ladder safety, fall, injury, overhead*

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

4. TAKE STEPS TO PREVENT ACETYLENE LEAKS

On April 6, 2004, at the Idaho National Engineering and Environmental Laboratory, a craft person observed a small flame near a valve on a cylinder containing acetylene gas. The craft person had just finished using a cart-mounted oxygen-acetylene torch and while closing the isolation valve on the acetylene bottle, felt heat through his glove. He saw a small 1-inch-long flame that appeared to originate from the valve stem and packing nut (see Figure 4-1). The craft person warned others to evacuate the area while he turned the valve handle again to verify the valve was shut. The flame did not immediately extinguish. Firefighters who responded to the incident saw no flames and did not detect any leaks using a flammable gas detector. (ORPS Report ID--BBWI-SMC-2004-0003; final report filed May 18, 2004)

Workers removed the cutting torch cart from the building, capped the acetylene cylinder, and returned the cylinder to the vendor for examination. They also checked other oxygen-acetylene torch systems at the site for leaks, identifying several that were leaking. One cylinder was leaking at the same location (the valve stem packing nut) as the one in the incident; another leaked at the regulator threads. Tightening the packing nut and regulator stopped both leaks. The gas bottle vendor stated that occasional leaks at the packing nut can be expected.

Because of this incident, the site compressed-gas handling procedure will be revised to incorporate a requirement to leak-test flammable gas bottles after installation or changeout. Investigators have not conclusively determined the ignition source. The most probable source is the high pressure (>15 psi) acetylene self-ignited as it escaped from the cylinder, which was at 100 psi. Auto-ignition of escaping acetylene is a known phenomenon and documented in the Material Safety Data Sheet for acetylene.

Figure 4-1. Fire originated between the isolation valve and packing nut

Acetylene (C_2H_2) is used almost universally as a gas for welding and cutting. Even though it is very common, acetylene is extremely dangerous. When mixed with pure oxygen in a torch, the flame can reach 5,700°F. Acetylene is chemically unstable, which makes it very sensitive to excess pressure, excess temperature, mechanical shock, or static electricity. It is very easy to ignite and burns at a very fast rate. The explosive range of this gas, when mixed with air, is from 2.5 percent to 82 percent—the widest of any commonly used gas. Acetylene is so reactive it can form explosive compounds when in contact with copper, brass, copper salts, mercury/mercury salts, silver/silver salts, and nitric acid. Acetylene is colorless but its presence can be detected by its garlic-like odor.

A January 15, 1995, lessons-learned report describes a similar event that occurred at Hanford. Pipefitters were soldering copper pipe in a fabrication shop when they noticed flames emanating from the stem near the regulator on an acetylene cylinder. A firewatch used a dry chemical extinguisher to put out the flames. (SELLS Identifier 1995-RL-WHC-0001A)

The cylinder was returned to the vendor for examination. The vendor found no evidence of carbon residue at the packing nut, fusible plug, or cylinder valve seat. Hoses were checked for leaks, and none were found. An examination of the regulator found a frozen adjusting nut, but nothing that would have contributed to a fire.

Although the results of the investigation were inconclusive, the fusible plug could have been defective, the valve packing nut could have been loose, or the regulator connection to the cylinder may have leaked. More information on this event is available from the Lessons-Learned website.

Other events involving leaking acetylene gas cylinders have occurred at DOE sites. At Brookhaven National Laboratory for example, a leaking cylinder was discovered in a gas cylinder storage warehouse. Investigators determined that excessive movement or agitation during shipment resulted in a leak through the cylinder packing material (ORPS Report CH-BH-BNL-BNL-1992-0023). At Rocky Flats, a cylinder that had recently been delivered was found to be leaking. A soap-solution check of the service valve and fusible relief plug showed bubbles, indicating a faulty relief plug. (ORPS Report RFO--EGGR-SUPPORT-1992-0035)

It is industry practice to install fusible relief plugs on acetylene bottles. The plugs are hollow bolts filled with lead that melts to allow the gas to escape if the cylinder is involved in a fire. Additional information concerning cylinder/fuel gas storage requirements can be found in NFPA 51, *Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*.

These events illustrate the need to check fittings and connections for leaks on acetylene and other compressed-gas cylinders. Acetylene leaks, no matter how small, can have serious consequences. Leaking cylinders can be caused by corrosion, loose components (e.g., packing nuts), dropping a cylinder, or striking a pressure relief plug. The Compressed Gas Association recommends that a leak test be conducted before each use. Site and facility procedures for using gas welding and cutting equipment should require inspections to ensure that leaking or damaged components are identified and repaired.

KEYWORDS: *Acetylene, cylinder, leak, flame, relief plug, bottle, regulator, fitting*

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

ACETYLENE SAFETY PRACTICES

- Never use a leaking cylinder.
- Always store acetylene and oxygen separately.
- Always store acetylene cylinders vertically. Acetylene cylinders are packed with porous rock that is saturated with acetone.
- Use a leak detection fluid to check fittings and connections for leaks.
- Never attempt to store or inject acetylene gas into any type of vessel, tank, or enclosure.
- Acetylene gas regulators should not exceed a setting of 15 psig.
- Flame arrestors and check valves should be installed at both the torch base hose connections and at the regulator hose connections.
- Close the cylinder valve before shutting off the regulator to bleed gas from the regulator.
- If cylinders are not used for a period of time, remove the gauges and regulators and cap the cylinders.

Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
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
SELLS	Society for Effective Lessons Learned

Units of Measure	
AC	alternating current
DC	direct current
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards 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
RCRA	Resource Conservation and Recovery Act
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement

Miscellaneous	
ALARA	As low as reasonably achievable
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control