OPERATING EXPERIENCE SUMMARY

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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/jit.html.

EVENTS

1. WORKER STRUCK IN FACE BY EJECTED DEWAR PLUG

On September 8, 2004, at the Savannah River Site, a worker was struck on the side of the face by a plug that was ejected from a pressurized nitrogen Dewar (Figure 1-1). Doctors performed a medical evaluation on the worker, including x-rays. They released him after determining there was no injury other than a bruised cheek. The event was reported as a near miss. (ORPS Report SR--WSRC-FSSBU-2004-0005)

Figure 1-1. Dewar involved in the event (next to clipboard)

The worker picked up the 30-liter Dewar to determine if it was empty before he filled it with nitrogen. When he set the Dewar down, the plug popped out, hit him in the face, and shattered. The damaged plug is shown in Figure 1-2; an undamaged plug is shown in Figure 1-3.

The worker was not wearing personal protective equipment (PPE) that would normally be worn while filling the Dewar (gloves, apron, and full face shield). When the incident occurred, site workers were not required to wear PPE when working with empty Dewars.

When Dewars are returned for filling, a small amount of liquid nitrogen typically remains in the flask. Investigators believe that off-gassing

Figure 1-2. Shattered Dewar plug

of remaining nitrogen in the Dewar caused moisture in the air to condense around the mouth of the flask and freeze the plug in place. The plug is normally held by a friction fit that allows venting, but the ice effectively sealed the venting space normally provided by the plug, allowing a pressure buildup. When the worker set the flask down, the ice seal broke, and the plug was ejected.

Investigators also determined that procedures for filling the Dewars did not address either a method for verifying the contents of the Dewar before filling or methods for completely draining the flask.

Figure 1-3. An undamaged plug shown upside-down on clipboard

Corrective actions will include reviewing policies and procedures for accepting empty returned Dewars at the Gas Cylinder Building and determining whether self-venting lids that are less likely to freeze up are available for the 30-liter Dewars.

Cryogenics are extremely cold (-120 to -270°C) and have a high expansion ratio (averaging 800:1) when their physical state changes from liquid to gas. Liquid nitrogen is the most commonly used cryogen. Hazards associated with cryogens include ultra-cold temperatures, flammability, oxygen displacement, and high pressure that can result in container overpressurization. The dangers of working with and handling Dewars that could become pressurized are illustrated by the following past events.

- At the Brookhaven National Laboratory, a Dewar of liquid nitrogen overpressurized as moisture on the cover caused a freeze plug that prevented the Dewar from venting. Pressure eventually built and ejected the cover. There were no injuries. (ORPS Report CH-BH-BNL-BNL-1999-0021)

- At the National Synchrotron Light Source, a Dewar top ruptured and injured two researchers. The Dewar, which contained carbon dioxide (dry ice), became overpressurized because the screw top did not allow gases to vent. When the top blew off, it hit one researcher in the forehead, and the Dewar hit her left thigh and thumb. Her colleague was sprayed in the face with dry ice. (ORPS Report CH-BH-BNL-NSLS-1997-0004)

- At Argonne National Laboratory–East, a 20-liter liquid nitrogen Dewar ruptured, propelling the metal-clad cap of the vessel to the ceiling with sufficient force to damage the cap. There were no injuries. A leak in the inner vessel allowed cryogenic liquid to enter the empty volume between the inner and outer vessel and evaporate, causing pressurization. (ORPS Report CH-AA-ANLE-ANLEET-1996-0001)

- At the Los Alamos National Laboratory a liquid nitrogen Dewar exploded when the inner vessel of the flask overpressurized because of a blocked vent line. The incident resulted in equipment and room damage. There were no injuries. (ORPS Report ALO-LA-LANL-TA55-1992-0045)

These events illustrate the need to wear personal protective equipment when there is a possibility of being exposed to potential hazards such as an unexpected pressurized flask. Personnel who work with cryogenics should have a thorough knowledge of procedures, equipment operation, safety devices, material properties, and the use of personal protective equipment.

KEYWORDS: *Dewar, flask, nitrogen, pressurized, near miss, personal protective equipment*

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

2. LOCKOUT/TAGOUT VIOLATION — LOCKING DEVICE DEFEATED

On September 2, 2004, at the Oak Ridge K-33 decommissioning project, a subcontractor failed to follow a lockout/tagout procedure when he operated an electrical disconnect switch that was locked and tagged in the "Open" position. The violation occurred when the subcontractor attempted to verify the adequacy of the locking device on the disconnect switch. No one was injured as a result of this event. (ORPS Report ORO--BNFL-K33-2004-0003)

Subcontractor workers were preparing to perform radiological surveys in the overhead area of a crane bay and needed a crane locked out. The lockout/tagout was required to remove electrical power from the crane rails and prevent crane movement while the subcontractors conducted surveys near these hazards.

The process for implementing the lockout requires that an "authorized employee" (as defined in 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout*), attach a lock to the disconnect switch, then place the key in a lockout/tagout control box and lock the control box. The "affected employee" (in this case, the subcontractor) would then attach his/her lock to the control box before beginning work.

Using the process above, the subcontractors placed their locks on the control box and went to the disconnect switch to verify that the lockout/tagout had been implemented. They found the switch in the open position, the authorized employee's lock installed, and a "Danger – Do

Figure 2-1. Example danger tag

Not Operate" tag in place on the switch (an example danger tag is shown in Figure 2-1). In violation of lockout/tagout procedures, one of the affected employees attempted to operate the switch to verify that it could not be closed; however, the switch closed and energized the crane. When the subcontractors realized the crane was energized, they opened the disconnect switch and reported the problem to a facility electrician. The subcontractor employees were suspended from the project site pending further investigation.

An authorized employee, in the presence of a facility representative and a Safety Officer, later attempted to close the disconnect switch under controlled conditions with the lock installed. The switch did not close when normal and reasonable force was applied.

Unlike circuit breaker/switch handles that have a locking tab next to the handle to prevent the handle from turning, this switch handle has a push button that is depressed by the thumb, which exposes a pin with a hole for a lock. With a lock through the pin, a mechanism on the back side of the switch cover engages and prevents rotation of the switch.

A causal analysis was performed and the following issues were identified.

- The site cranes and crane disconnects are legacy equipment and are over 50 years old, so have the potential to fail from age or fatigue. The locking device used in conjunction with the "legacy" disconnect did not always prevent crane re-energization when subjected to reasonable force.

- The workers violated the site's lockout/tagout procedure; however, some workers were misinformed during formal classroom lockout/tagout training and believed they could physically challenge a switch under lockout/tagout if they did not touch circuit breakers/breaker boxes.

The suspended workers subsequently were reinstated. In addition, the lockout/tagout procedure was revised to clarify requirements, and workers were re-trained on the revised requirements.

Operating or removing tagged-out equipment is never permitted, and tagout devices must clearly warn that operation is not permitted (e.g., "Danger, Do Not Operate"). Lockout devices must be substantial enough to prevent removal without the use of excessive force or unusual techniques. If a component is already tagged (from another lockout/tagout) it must not be operated or removed and its position should be verified by all other appropriate means, such as observation of system parameters or valve position indicators.

Tags and locks should be attached to all isolation devices to clearly indicate that operation is prohibited. In some large, centrally controlled facilities, including most commercial power plants, tags alone are sufficient for protection. This is because of the training that all personnel receive and the strict procedures that govern operation of equipment at these facilities.

Lockout/Tagout Definitions (DOE-STD-1030-96)

- **Affected Person** - Person whose job requires operation or use of equipment on which maintenance is being performed under lockout/tagout, or whose job requires work in an area in which such maintenance is being performed.
- **Authorized Person** - Person qualified through system knowledge and lockout/tagout training, and authorized by the facility to install lockout/tagout on machines or equipment in accordance with facility procedures.
- **Lockout Devices** - Devices that use a positive means, such as a combination or key lock (key locks are preferred), to hold an energy isolating device in the safe position and prevent the energizing of equipment. Hasps, chains, and other devices may be treated as lockout devices when used in conjunction with locks.

Although the subcontractor employees' reason for challenging the adequacy of the lockout device may seem understandable, they should not have ignored the instructions on the tag or violated the procedures that control it. It is important for affected workers to verify that the lockout/tagout provides the level of protection necessary to perform work safely. However, if there is any doubt regarding the isolation points (barriers) or the integrity of the locking devices, the affected person should contact the authorized person (see box) who signed the tagout or the authorizing organization that implemented the lockout/tagout.

Once the lock is in place and the danger tag has been attached, no one should touch the isolating device without authorization. The danger of changing the status/position of a locked or tagged device is that others may have already started work under the protection of the lock and tag and could be accidentally exposed to the hazard they believed was isolated. The time to verify the effectiveness of a locking device is at the time the locking device is installed.

DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, provides guidance and practices that should be considered when planning or reviewing lockout/tagout programs. This guidance follows the intent of 29 CFR 1910 and 1926 (OSHA).

A preliminary list of OSHA violations from October 1, 2003, to June 30, 2004, shows that lockout/tagout is one of the top ten most cited standards, as well as one of the top ten most cited "willful" violations.

This event underscores the importance of strict adherence to the procedures and the process for implementation and approval of lockout/tagouts, and its importance to worker safety. It also underscores the need for awareness of legacy equipment (e.g., aged/fatigued disconnects) that may not operate properly in conjunction with the use of a lockout device. The lockout/tagout program is a critical part of the integrated safety management program, and it works only as well as the degree of discipline and attention to detail that is given by those individuals who use lockout/tagouts for the control of hazardous energy and personnel protection.

NEVER attempt to operate or change the position of a device that is under the control of a lockout/tagout.

KEYWORDS: *Lockout, tagout, LO/TO, locking device, lock, legacy*

ISM CORE FUNCTION: *Perform Work within Controls*

3. PERFORMING WORK WITHIN CONTROLS ENHANCES SAFETY

Written procedures, work plans, work permits, and other information sources provide prescriptive controls designed to protect workers and enhance safety. Failure to perform work within these controls can result in fatalities, injuries, and property damage.

Events reported during 2004 involving work controls included a wide range of activities and addressed areas such as personal protective equipment, dose limits, work permits, lockout/tagout, and working at heights. Some of these occurrences indicate that where work controls were ignored, the results were injuries and near misses. Others indicate that adhering to work controls during a reportable occurrence avoided such consequences.

On February 6, 2004, at the Office of River Protection Tank Farms, a worker removed his sun shade safety glasses while entering a shop so he could see to perform work within the building; however, he failed to don clear safety glasses while inside and sustained a serious eye injury. (ORPS Report RP--CHG-TANKFARM-2004-0006)

The work performed involved removing stanchions from elevated racks and re-positioning them on the shop floor. While performing this repetitive task, a worker prematurely relaxed his grip at the top end of a stanchion post, allowing the weight centered at the base plate to pull the post from his grasp.

Consequently, the stanchion snapped forward into an upright position, and the top of the post struck the employee in the left eye. The modified lock-washer welded to the top of the post inflicted a laceration to the worker's eyelid and serious trauma to the cornea of his eye, requiring surgery. Had the worker been wearing safety glasses, the injury would have been either avoided or substantially reduced. OE Summary 2004-04 discusses this event in more detail.

In contrast, adhering to work controls (i.e., wearing safety glasses) during a reportable occurrence can prevent or limit injuries. On May 5, 2004, at the Hanford Site, a rock penetrated a track excavator windshield, breaking the safety glass. The equipment operator was wearing safety glasses and was not injured. (ORPS Report RL--BHI-REMACT-2004-0004)

The operator was dumping material from an excavator bucket into a waste container when the small rock ricocheted out of the container and struck the cab windshield. The rock broke through the glass windshield, grazed the operator on the left leg, struck the left hand joystick control box, and fell out of the cab onto the ground. Wearing safety glasses prevented an injury to the operator's eye when glass fragments from the windshield entered the cab.

Job site rules, procedures, work permits, and equipment operating manuals generally contain well-defined controls or limits for performing work safely. Sometimes it is necessary to review more than one of these documents before performing work to identify and understand all applicable requirements and to resolve conflicting information or inconsistencies. Failures by supervisors and workers to review all relevant documents and establish unambiguous controls can jeopardize worker safety.

On June 15, 2004, at the Hanford Site, a worker sustained a serious injury while performing carpentry work at a construction project. The worker allowed a drill press to remain running while using an air hose to blow debris off the drill press table. While performing this task, the worker's right-hand leather glove caught on the rotating drill bit causing an amputation of the right little finger at or above the first joint. Investigators determined that the employee failed to turn off the drill press when not actually drilling, as specified by operating requirements. Contributing to this accident was a safety information conflict: wearing leather work gloves is recommended at the construction site to prevent hand injuries; however, manufacturers of rotating equipment often recommend that workers should not wear gloves to avoid this kind of accident and injury. Before performing work, manufacturer's equipment operating manuals must be reviewed in conjunction with job site rules to resolve conflicts and protect workers. (ORPS Report RP--BNRP-RPPWTP-2004-0008)

On August 24, 2004, at the Savannah River Site, personnel were performing a task according to a job-specific radiological work permit. The permit contained a whole body dose rate suspension guide of 80 mrem/hour. The work being performed involved removal of two contaminated items having whole body dose rates of 120 mrem/hr and 90 mrem/hr. Personnel did not recognize that they exceeded the dose rate suspension guide; consequently they violated facility radiological control requirements by not stopping work. Workers monitored their respective electronic personnel dosimeters to ensure that their doses did not exceed authorized limits. Fortunately, no unexpected personnel doses were received. (ORPS Report SR--WSRC-FBLINE-2004-0007)

While performing a specific task, workers may create a situation inconsistent with work controls, thereby jeopardizing their safety and the safety of others. For example, on June 10, 2004, at the Idaho National Engineering and Environmental Laboratory, a worker performing core drilling on concrete from a 5-foot-high platform slipped and fell onto the work platform decking, sustaining an injury to his chin and right leg. (ORPS Report ID--BBWI-TAN-2004-0002).

The job safety analysis for this work identified wet platform surfaces associated with the core drilling as a hazard and prescribed wet vacuum and housekeeping as mitigating actions. Additionally, applicable OSHA regulations require preventing debris from accumulating on raised platforms. After drilling a hole, the worker slipped on a wet slurry of cement that

accumulated on the platform surface created by this work. The worker should have periodically policed the area for debris and used a wet vacuum to keep the work platform dry, either by performing this task himself or by enlisting the aid of a co-worker. In addition, a rubber mat should have been used to avoid a slipping hazard.

These events illustrate the importance of performing work within specified limits. It is imperative that workers understand that work controls may be found in numerous sources and may contain conflicting information. Managers, supervisors, and workers should ensure that before performing work, all applicable work controls are identified, reviewed, and conflicting requirements resolved (e.g., manufacturers' recommendations versus facility general requirements) to be certain that personnel understand how to best protect their safety. Supervisors and workers should be sensitive to hazards that may arise during or from the work being performed, and ensure that work controls address these risks with appropriate mitigating actions.

KEYWORDS: *Safety glasses, personal protective equipment, work controls, work permits*

ISM CORE FUNCTION: *Perform Work within Controls*

4. SAFETY TIPS FOR HEATING WITH ELECTRIC SPACE HEATERS

As the weather turns cold, we become ever more aware of the inadequacies in heating aging facilities and trailers where much of the D&D workforce is housed. Many workers turn to electric space heaters to keep their workspace warm during the work day.

The U.S. Consumer Product Safety Commission (CPSC) reports that, more than 25,000 residential fires are associated with space heaters annually and that more than 300 people die in these fires. These statistics include all types of space heaters, some of which (e.g., kerosene) would not normally be used at DOE facilities. However, the sheer number of fires reported warns of the potential dangers when using portable heaters.

No space heater design can guarantee safety. You are the key!

Two events involving space heaters at DOE sites were reported in ORPS. One of these events, which occurred about 13 years ago, involved a fire in an office cubicle in a laboratory area. A worker had been using a space heater (set on "High") and forgot to turn it off at the end of the workday. The unattended heater ignited an office chair left too close to it, and the fire spread to other combustibles in the area. Fire Department personnel extinguished the fire, and no one was injured. However, the estimated cost of the occurrence was $14,615, including cleanup and replacing damaged equipment, repairing flooring, and repainting. (ORPS Report ORO--MMES-Y12DEFPGM-1991-5221)

On November 31, 2001, at Hanford, an employee plugged a space heater into a receptacle, received a minor shock, and observed arcing at the receptacle. The employee later noticed a skin irregularity on the third finger of her right hand and complained of a burning sensation on the knuckle of that finger, as well as aching in her right arm that extended into her neck. She was treated for an electrical burn at the First Aid Station and released. (ORPS Report RL--BHI-GENAREAS-2001-0009)

Electricians inspected the heater cord and found that the insulation was broken at the interface with the plug. The most likely explanation for the broken insulation is that employees pulled on the cord to unplug the heater rather than grasping the plug, which caused the insulation to separate from the plug. It is also possible that furniture set against the plug while it was connected to the outlet caused the cord to bend sharply, causing the insulation to crack. Supervisors discussed this event with employees to raise their awareness about potentially unsafe conditions that can exist in office areas.

The CPSC provides some common-sense tips for those who use space heaters, including the following.

Before You Use That Space Heater, Ask Yourself...

- Was the heater approved by an approved testing lab (e.g., Underwriters Laboratory)? The lab's seal should be affixed to the heater.
- Does your space heater have an automatic safety shut-off in case it's tipped?
- Are the cord and plug in good condition?
- Is the heater 3 feet away from jackets, papers, and flammables?

- Do not use an old heater or one with a stiff, frayed, or worn cord or plug. Electrician's tape is not a fix — be safe and purchase a new heater.

- Select a space heater that has been tested by an independent testing laboratory, such as the Underwriters Laboratory or one identified in the Nationally Recognized Testing Laboratory Program list on the OSHA website. Tested heaters are required to meet specific safety standards, and manufacturers are required to provide use and care information to the consumer.

- Select a space heater with a guard around the heating element.

- Place the heater on a hard, level surface; do not run the cord under a rug or carpet.

- Ensure that objects such as paper and clothing are at least 3 feet away from the heater.

- Do not use an extension cord unless absolutely necessary. A light-duty, household extension cord used with high-wattage appliances such as space heaters may start a fire. If you must use an extension cord, use one marked #14 or #12 AWG (American Wire Gauge) bearing the seal of an independent testing laboratory. The number tells the thickness or gauge of wire in the cord; the smaller the number the thicker the wire. Never use a cord marked #16 or #18 AWG.

- Make sure the plug fits snugly into the electrical outlet; a loose plug can overheat.

- Do not assume a ground fault circuit interrupter (GFCI) is broken if a heater is plugged in and the GFCI trips. To avoid a severe shock, stop using the heater and have it checked, even if it seems to be working properly.

- Always turn the heater off when you leave your office or cubicle. Some workers find it useful to post a reminder sign at their doorway.

Since 1991, manufacturers have included performance requirements to enhance the safety of portable heaters. For example, some heaters have a tip-over switch that will turn the heater off automatically until it is placed upright. Others have indicator lights to let the user know the heater is plugged in or turned on. Some even have proximity sensors that turn the heater off when objects come too close.

DOE Order 420, *Facility Safety*, requires all sites to have a fire safety program and procedures that govern a variety of activities from smoking to hot work in order to decrease fire risk. Site Fire Department personnel perform work area walk-arounds to ensure compliance with applicable building codes and National Fire Protection Association codes and standards. They will inspect for heat-producing appliances such as coffee pots and space heaters and will check to ensure that only inspected space heaters are in use. Keep in mind that requirements at your site may include having an additional inspection tag or tamper-indicating device on portable heaters.

If you have any questions about the safety of your heater, buy a new one. If you have questions about requirements in your facility, check with your site's fire officials.

KEYWORDS: *Space heater, electric heater*

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

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