OPERATING EXPERIENCE SUMMARY

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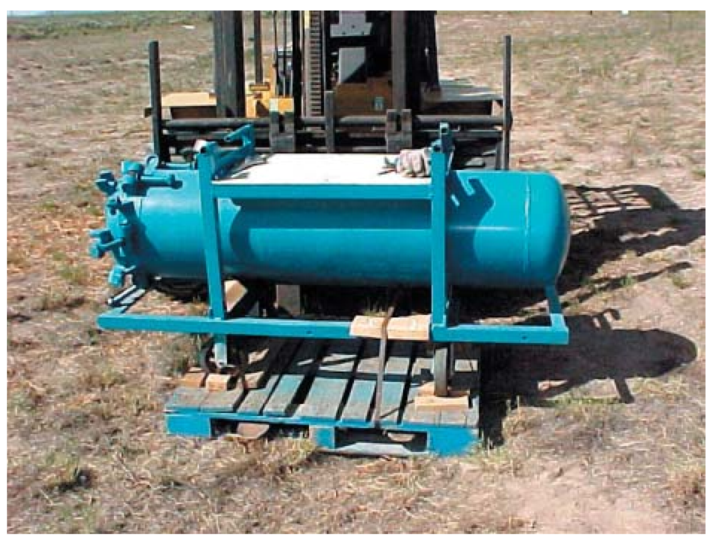

U.S. Department of Energy

Office of Environment, Safety and Health

OE Summary 2004-13

June 28, 2004

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.

1. *NEAR MISS — EXPLOSIVE SQUIB FIRES WHILE BEING CONNECTED*

On May 19, 2004, at the Aiken Technical College Fire Training Lab, a student was injured when an explosive squib fired unexpectedly while he was making electrical connections during a Halon training class. The student had powder residue embedded in his right hand and several small puncture type lacerations on his arm and forehead. The student's injuries were minor, and medical personnel cleaned and bandaged his hand and released him without restriction. (ORPS Report SR--WSRC-SS&ES-2004-0001; final report filed June 21, 2004)

Westinghouse Savannah River Company staff was conducting training at the Fire Alarm and Systems Training (FAST) laboratory. The FAST lab is a partnership between Aiken Technical College and the Savannah River Site Fire Protection Engineering Department. The student (from the Savannah River Site) was connecting the squib to an empty Halex AP-7 Halon cylinder when the accident occurred. The Model CDI98J-001 squib (Figure 1-1), manufactured by Cartridge Actuated Devices Inc., contains a 0.875-gram charge of sealed smokeless powder.

Figure 1-1. Explosive squib

The purpose of the squib (in an actual installation) is to operate the Halon cylinder actuator by the pressure produced from the explosive discharge when the fuse wire, sealed in the squib powder charge, receives an electrical signal from a fire alarm panel. Figure 1-2 shows the configuration of the cylinder, actuator, squib, and electrical connection.

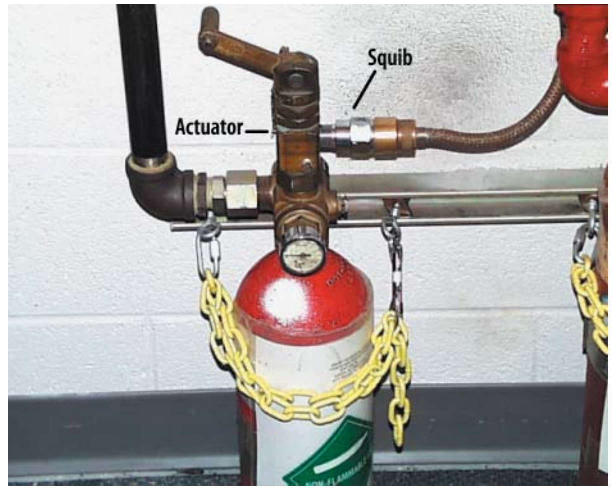

Figure 1-2. Configuration of cylinder, actuator, squib and electrical connection to squib

The student verified that the fire alarm panel was not in alarm condition, then connected the squib to the actuator with a grounding disc attached to the connectors. When the squib was threaded to the actuator, the student removed the grounding disc and attached the electrical connector from the fire alarm panel. As he was securing the electrical connection with a threaded retaining nut, the squib fired, causing the electrical plug portion of the squib to fragment and discharge debris (Figure 1-3). The debris struck the student and was scattered over a 20-foot area. The student was wearing only safety glasses; he was not wearing gloves or long sleeves.

As a result of this event, the Fire Protection Services immediately stopped all use of live

Figure 1-3. Debris expelled from inside electrical connection on squib

squibs in training. A team was assembled to critique the event and investigate what caused the squib to fire.

The investigation team considered several possible scenarios but could not positively determine the primary cause of the accident. One scenario involved static discharge as an ignition source. During the event, the fire alarm panel indicated several ground-fault trouble alarms that could have been caused by a bare squib conductor coming in contact with ground. The student could have developed a static charge as he moved across the carpet, and the squib could have been ignited through a static discharge between the bare squib conductor and ground. A panel malfunction could also have ignited the squib; however, investigators found no evidence of a malfunction. Also, the team ruled out high temperature because of the large heat sink provided by the actuator. In addition, the student did not sense a high temperature while handling the actuator.

The other issue of concern was the failure of the squib at the electrical connection, which resulted in the flying debris that injured the student. When the Halex actuator was disassembled, investigtors found it was difficult to move the plunger and that a large amount of powder residue had collected inside the actuator. Normally the actuator is inspected following a Halon discharge. However, this training system is attached to an empty cylinder, and a program was not established to check the function of the actuator following a squib firing. Therefore, powder residue continued to accumulate after each firing of the squib, and the actuator was never cleaned. Team members believe that inadequate venting through the actuator allowed pressure to build up inside the actuator and squib until failure. The accumulation of powder residue and its ability to degrade the actuator's performance were not recognized as a hazard in the training setup.

Corrective actions included stopping all live firing during training to prevent classroom accidents. The activity hazard analysis and work instructions were revised to require wearing safety glasses, faceshield, and gloves when working on fire protection squib systems. A precaution to stay clear of the line of fire was also included in the hazard analysis.

In addition, requirements were included to wear electrostatic ground straps when replacing or installing squibs and to perform a hazardous energy control lockout on the fire circuit before installing a squib. No lockout had been required because the connection involved only a 24-volt plug.

The work instructions were also revised to include inspecting and manipulating the Halon actuator movement before replacing a squib. The DOE *Explosives Safety Manual* (DOE M 440.1-1) will be reviewed for guidance on minimum safe distance between radio frequency (RF) transmitters and explosive devices and to determine if these precautions apply to working on fire protection squib circuits. Engineering calculations determined that any RF energy induced on the squib would have been well below the safe "no fire" level.

A former site maintenance mechanic reported finding a squib that had failed in a similar manner. The retaining nut was still on and the plug was broken but not ejected. The squib manufacturer reported having received unconfirmed reports of a squib discharging through the electrical plug.

This event calls attention to two important issues. The first is the failure to check the actuator to ensure that continuous use did not degrade its operation (e.g., the accumulation of powder residue). The second issue (i.e., the use of live explosives) underscores the need to assess training value versus any risk to students and instructors. Trainers need to consider all hazards and failure mechanisms when conducting live demonstrations, particularly if there is a potential for injury. Performance of a job hazard analysis will ensure that appropriate safeguards, such as personal protective equipment, are in place before activity begins.

KEYWORDS: *Explosive, squib, training, injury, fire protection, Halon*

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

2. *LESSON LEARNED: DISLODGED AIR PURIFYING RESPIRATOR FILTER*

Powered Air-Purifying Respirators (PAPRs) protect workers by filtering particulate contaminants pulled through a filter by a battery-powered blower. If the filter is not in place, the respirator offers no protection. On May 11, 2003, at the Brookhaven National Laboratory (BNL), a worker in an airborne contamination area was potentially exposed to radiological contamination when the Type HE OptiFilter XL® filtering cartridge became dislodged from the blower on a Mine Safety Appliances (MSA) Model OptimAir® MM2K with an Advantage 3000 facepiece (Figure 2-1).

When the worker realized that the filter was no longer in the respirator, he immediately exited the airborne contamination area. After doffing his personal protective equipment (PPE) and successfully passing through a radiological portal monitor unit, health physics personnel surveyed the worker for facial contamination and performed both a bioassay and whole-body count. The results indicated that no radiological threshold was exceeded, but BNL management directed that an investigation should be conducted. As a precaution, subsequent entries into the area were suspended, pending investigation into the cause of the filter loss.

During the investigation, BNL personnel examined the equipment and contacted MSA to discuss the incident and to ascertain whether MSA knew of any similar incidents when using this particular model. MSA informed BNL that this was the first reported case of a filter loss.

The PAPR involved in this incident has a plastic filter that attaches to a plastic blower unit by a threaded connection that requires one and one-quarter revolutions to full tightness. A gasket seals the filter to the blower. The unit does not have a positive locking mechanism or a mechanism indicating that the filter has fully contacted the gasket.

Investigators examined several possible scenarios to determine the condition that caused the loss of the filter, including the following.

Figure 2-1. Powered Air-Purifying Respirator unit

- A forceful blow to a fully seated filter can dislodge the filter from the blower when sufficient force is applied to the filter. However, the amount of force needed would have been very noticeable to the worker wearing the mask. While this scenario is possible, it is not likely in this case because the worker did not report any event of this nature.

- A fully seated filter can be dislodged if there is contact with a surface in a manner to cause the filter to become unthreaded. Full contact in a scraping motion along the circumference of the filter on a very abrasive or tacky surface over a distance exceeding 12 inches (30.5 cm) is needed. Additionally, in the case of a well-seated filter, a great deal of break force is needed to initiate unthreading. While this scenario is possible, it is not likely in this case because the worker did not report any event of this nature.

- A failure of the worker to fully tighten the filter can result in the filter being loose enough to become unseated. Unless the filter makes full contact with the blower unit, so as to compress the gasket, the filter could conceivably become dislodged by head movements and blower vibration. This scenario is a possible cause because the worker installed the filter while wearing double gloves, so tactile function and dexterity would have been decreased.

- Mis-threading the filter to the blower unit in a manner that allows the filter to attach without being fully seated is possible if the unit is not properly aligned. In this scenario, the filter can remain on the blower and permit a negative pressure fit check but become dislodged with relatively minor forceful contact of the filter with a surface. Because the worker installed the filter while wearing double gloves, the tactile function to detect improper installation would have been decreased. Because the facepiece was already donned, direct line of sight of the threading of the filter was not possible. BNL investigators concluded that cross-threading of the filter is the most likely scenario to explain the event.

Since this event, an MSA representative has trained BNL workers on how to assemble the respirators and filters, how to properly don the facepiece, and how to prevent common errors in the use of the equipment. A manufacturer's representative for another PAPR used at BNL conducted similar training on their unit.

An outcome of this training and the BNL investigation has been a change in the mechanisms for donning PPE. Before this event, workers donned the facepiece without the filter installed and taped the facepiece to the protective clothing suits to maximize protection from particulate infiltration. The filter was not installed until the last step to minimize breathing resistance for the worker. As a result of training and written instructions from MSA, workers now install the filter before they don the facepiece, and the unit is powered while they complete the dressing-out procedure. By assembling the filter before donning the mask and gloves, workers can ensure that they have maximum visibility and dexterity. This procedure also allows for close inspection of the seating of the filter.

BNL management has instituted an upgrade to its sitewide training program to include detailed instructions on the assembly and points of concern for each respirator style used. The improvements include hands-on training in cartridge assembly and development of practical qualification criteria to verify proficiency.

This event underscores the need to follow manufacturer's instructions on the installation of cartridges. Installing the cartridge as the last step on PPE dress-out reduces worker stress, but it increases the chance of a failure to properly seat the filter in the unit. The need to maximize the reliability of the respirator assembly needs to be the highest priority.

KEYWORDS: *Powered Air-Purifying Respirator, PAPR, respirator, respiratory protection, respirator filter loss*

ISM CORE FUNCTIONS: *Develop and Implement Hazard Controls, Perform Work within Controls, Provide Feedback and Improvement*

3. HOISTING AND RIGGING EVENTS CONTINUE TO OCCUR

In January 2004, the Office of Environment, Safety, and Health published *Department of Energy Hoisting and Rigging Events*. The tasks involved in hoisting and rigging work—lifting, moving, and laying down heavy loads—require careful planning, preparation, and implementation by planners, spotters, and operators, among others. The Department's hoisting and rigging report described commonly made errors from past incidents in an attempt to identify lessons learned and recommend specific actions workers can take to prevent recurrence. However, despite dissemination of the Special Report, hoisting and rigging-related events have continued to occur across the Complex in the 6 months since the report was released.

On June 23, 2004, at Sandia National Laboratory, an overloaded 10-ton, overhead bridge crane failed during Proto 2 tank removal. The bottom of the tank had been tack-welded to structural I-beams. After the plating material was cut and workers attempted the lift again, they discovered that the plate was also welded at the center. Because the plasma torch operator was under the tank and was wearing a positive pressure hood, he was unable to communicate clearly with the crane operator. The crane operator continued the lift until the rope failed. The rope was rated for the original scope of work (i.e., lifting the plate after it was cut from the I-beams). (ORPS Report ALO-KO-SNL-NMFAC-2004-0003)

On June 7, 2004, at Oak Ridge National Laboratory, failure to plan work as a critical lift[1] instead of an ordinary one resulted in a load being dropped near two workers. Workers noticed binding of a load, jogged the crane, and successfully cleared the rail from the wedge guide, but the rail began tilting off-horizontal, causing the load to shift. When the 1-ton hoist tilted, and the load shifted, C-clamps and a restraining rope failed. The hoist dropped 12 feet, coming to rest approximately 5 feet from the two workers (Figure 3-1). Neither worker was injured. (ORPS Report ORO--ORNL-X10NUCLEAR-2004-0003)

Figure 3-1. Location of hoist following dropped load

On May 11, 2004, at the Hanford Site Groundwater Protection Project, workers attempted to remove 128 feet of drill casing using a wire rope sling and a method referred to as "bump and pull." This method involves creating tension on the choker, releasing it, and then pulling the choker up tight to loosen an item (in this case, the drill casing). During this movement, the wire rope sling separated. There were four workers in the area, but none of them was injured. Investigators learned that workers had expressed concern about wire rope sling maintenance, but no one had exercised their stop work authority. (ORPS Report RL--PHMC-GPP-2004-0002)

The subsequent investigation and root cause analysis revealed multiple causal factors, including the following.

- The "bump and pull" method of removing the casing meets the definition of "shock loading," which the Site Hoisting and Rigging Manual prohibits.
- The sling did not have a tag providing manufacturer's and load test information, as required by the Site Hoisting and Rigging Manual.
- There was no documentation of inspection or maintenance on the failed rope sling.
- The inspection process did not meet the criteria specified in the subcontract, nor did it meet the requirements in the Site Hoisting and Rigging Manual for below-the-hook lifting devices.
- Personnel were not adequately trained on inspection procedures, and existing training did not meet OSHA standards as required by the subcontract.

On May 3, 2004, at Hanford, the Design Authority noticed that a chain hoist used to move Spent Nuclear Fuel within the K-West basin did not have a current inspection sticker. The procedure requires operations personnel to perform a pre-use check on the hoist that includes ensuring that certifications are current. That inspection had not been performed when the hoist was used on April 30 or the discrepancy would have resulted in a stop work order. (ORPS Report RL--PHMC-SNF-2004-0017)

On March 3, 2004, at Sandia National Laboratory, site management issued a Stop Work Order against steel erection activities as a result of multiple safety inadequacies. On February 25, workers failed to maintain control of a 1,000-pound bundle of steel decking material, which fell 20 feet when a worker pushed it too hard and it came out of its rigging. Instead of stopping and notifying supervision,

[1] OSHA Standard 29 CFR 1926.751 defines a critical lift as a lift that (1) exceeds 75 percent of the rated capacity of the crane or derrick, or (2) requires the use of more than one crane or derrick.

workers simply re-rigged the material and re-lifted it. (ORPS Report AL-KO-SNL-1000-2004-0001)

Although there is no clear trend among these events, each one underscores a lesson from the Special Report on Hoisting and Rigging. The report is available online at www.eh.doe.gov/HR_INPO_Style_FinalDraft_01-20-04.pdf

Personnel involved in H&R work should ensure that the following actions have been completed before work begins.

- *Carefully scope, plan, and walk down the activity.*
- *Ensure that training is complete and current.*
- *Perform all pre-work inspections.*
- *Ensure scheduled maintenance has been performed on equipment.*
- *Check the rated capacity of equipment.*
- *Be prepared for unforeseen conditions.*
- *Communicate clearly when new conditions are found.*
- *Stop work when necessary.*

To ignore even one of these steps may predispose the operation for failure.

KEYWORDS: *Hoisting and rigging, loads, crane, sling, lift*

ISM CORE FUNCTIONS: *Define Scope of Work, Analyze the Hazards, Develop and Implement Hazard Controls*

4. GOOD PRACTICE: CONDUCTING DRILLS HELPS WORKERS RESPOND TO ADVERSE EVENTS

On June 24, 2004, at the Idaho National Engineering and Environmental Laboratory (INEEL), site management declared a site area emergency when subcontractor workers discovered a leak in one of six 1950s-era pressurized cylinders containing hydrogen fluoride (HF). Hydrogen fluoride is an extremely corrosive, irritating gas that can quickly cause respiratory injury and death.Workers were moving the cylinders from a staging area to a temporary exclusion area when they discovered the leak. Because they had performed a drill for this scenario twice before actually moving the cylinders, the workers were able to respond promptly and appropriately to the leak, and no one suffered an HF exposure. (ORPS Report ID--BBWI-LANDLORD-2004-0006)

When the workers discovered the leak, they made the necessary notifications, placed the cylinder into a nearby overpack cylinder (Figure 4-1) they had staged for unexpected leaks, performed initial stabilization of the area, and evacuated. About 90 minutes later, the site area emergency was terminated.

When performing drills earlier in the week, the workers learned a number of lessons that helped them evacuate in an orderly fashion. For example, having overpack cylinders nearby helped the workers respond quickly to the leak. Also, during the first drill the workers left the area on foot. During the critique for the first drill, the workers stated that they should have used the vehicles at the site, so they reviewed the way in which the parked vehicles near the job site were staged. They decided that instead of parking the cars facing the site and locking them, they should park them facing the road, with the doors unlocked and the keys in the vehicles. This modification to the original plan facilitated immediate egress and prevented HF exposures.

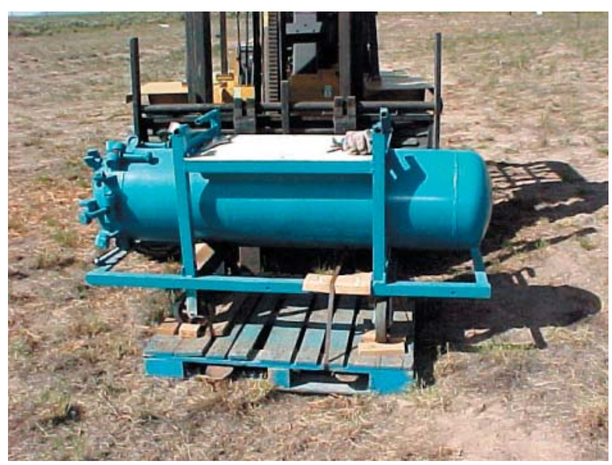

Figure 4-1. Overpack containing the leaking cylinder

Other positive actions the workers took are listed below.

- The site being remediated is under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), remediation action plan. When the CERCLA study was complete, the site contracted a company experienced in safely unearthing and moving cylinders of this type to handle the cylinder move.

- Although another, previously remediated site at INEEL was known to have HF cylinders that had to be moved, the contents of the cylinders at the current remediation site were identified in the CERCLA study as "construction and industrial gases." The HF cylinders were not identified until after workers began remediation activities.

- The workers wore chemical suits and positive-pressure supplied-air respiratory protection. They also had self-contained breathing air packs for emergency use.

This event illustrates the value of performing drills, even for known configurations. Performing drills before executing work allows workers to visualize any adverse events and plan how to respond to them appropriately.

KEYWORDS: *Good practice, hydrogen fluoride, cylinder, emergency, CERCLA*

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

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