OPERATING EXPERIENCE SUMMARY

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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.

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.

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.

Operating Experience Summary 2003-21

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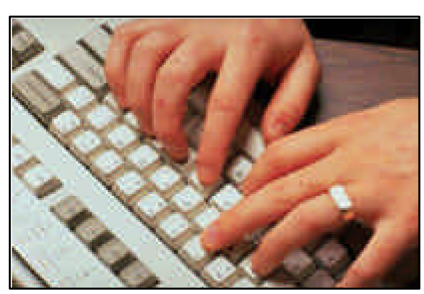

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EVENTS

1. NEAR MISS AS ALLIGATOR SHEAR ACTUATES UNEXPECTEDLY

On August 19, 2003, at the Oak Ridge Y-12 Plant, an operator was using an alligator shear in a glovebox when it malfunctioned and unexpectedly actuated. The operator quickly pulled his hand clear of the shear, but not before it cut through the glovebox glove and the tips of two anti-contamination gloves on the operator's left hand, making a ½-inch slice in the gloves. No injury resulted from this near-miss incident. (ORPS Report ORO--BWXT-Y12NUCLEAR-2003-0035)

Figure 1-1 shows a typical alligator shear (not the one used at Y-12). The shear that malfunctioned was used to cut metal stock up to ½-inch in thickness and was approximately 40 years old. The manual safety switch used to actuate the shear was spring loaded to return to the open (de-energized) position when released by the operator. A check of this switch following the incident revealed that it occasionally hangs up in the closed (energized) position, and if the foot safety switch remained pressed, a second actuation of the shear could occur without additional operator action. No procedures were violated during this incident, and the worker involved was following the appropriate radiological work plan. Following the incident, alligator shear operations were suspended, and access to the area was controlled by postings on the glovebox containing the alligator shear and on the access door to the room containing the glovebox.

Figure 1-1. A typical alligator shear

In addition to identifying the faulty manual actuation switch as a likely cause of the malfunction, investigators examined records associated with the shear to try to determine the condition of the machine. They reviewed maintenance records, vendor manuals, and engineering drawings, but none contained information that shed light on other possible causes of the malfunction. They also conducted interviews with machine operators and supervisors who had used the alligator shear. Several people reported that they had experienced a "double-clutching" problem with the machine, where it would actuate a second time without operator intervention after completing a shear action. Each individual indicated that they had reported the "double-clutching" malfunction to supervisory personnel when it occurred. Several of the operators remembered that maintenance personnel had inspected the machine after these malfunction events, but they did not know what repairs or adjustments had been performed, if any.

Based in part on the fact that machine operators reported that the shear had been known to "double-clutch" without activation by the operator, investigators determined that the direct cause of the incident was a malfunction of the machine. A communication problem related to malfunctions of the machine contributed to the incident. The "double-clutching" problem was known to a few operators and supervisors, but it was not common knowledge and was not identified in the job hazards analysis associated with the alligator shear.

Investigators identified a management problem as the root cause of the occurrence. Managers failed to act on the reported machine malfunctions to (1) eliminate the hazard by repairing the machine, (2) establish administrative controls on the hazard based on the inclusion of the known malfunction in a job hazards analysis, or (3) install a safety shield to prevent operators from getting their hands near the blade path.

Corrective actions resulting from this incident included the following.

- Repair the manual shear activation switch to eliminate the "double-clutching" malfunction.
- Design, fabricate, and install a safety shield to prevent operators from getting their hands near the blade path of the shear.
- Purchase two manufacturer's operation manuals for the alligator shear; one for operator use and one for the engineering files.
- Evaluate other equipment in the building to see if there are any similar problems that need to be addressed.
- Review the maintenance history of the alligator shear to determine why the reported malfunction of the machine was not corrected.
- Brief appropriate workers and supervisors on the importance of identifying safety concerns to management personnel.
- Generate a list of safety concerns associated with equipment and track the resolution of these safety concerns in a database.

A search of the ORPS database for other near-miss or personnel injury events in machine shops revealed several similar occurrences. On April 8, 2003, at the Oak Ridge Y-12 Site, a mechanic performing work with a lathe was using a key to adjust the chuck jaws when the lathe unexpectedly actuated and trapped his hand between the rotating key and a sharp edge on the lathe body, cutting and bruising the little finger on his left hand and severely bruising his left palm. Investigators discovered that the mechanic had placed the control lever in the neutral position, but had failed to turn the lathe off, possibly to save time. (ORPS Report ORO--BWXT-Y12SITE-2003-0015)

In another near-miss incident, on October 16, 2002, at the Oak Ridge Y-12 Site, a stainless steel part was thrown from the rotating table of a vertical turret lathe when unanticipated stored energy beneath the part caused it to come loose. The 150-pound part was propelled approximately 15 feet across the room, but did not cause any personnel injuries. Because of the potential for serious injury to nearby workers, an investigation similar to a DOE Type B investigation was conducted. (ORPS Report ORO--BWXT-Y12NUCLEAR-2003-0070; OES 2002-22)

Information on machine tool safety and guarding can be found in the Code of Federal Regulations, 29 CFR 1910 Subpart O, *Machinery and Machine Guarding*. This regulation, and other OSHA regulations intended to control hazards in the workplace, can be accessed at http://www.osha.gov.

GOOD PRACTICES FOR WORKING WITH MACHINE TOOLS

- Remember that safety is your principal responsibility—your personal safety and the safety of others in the area.
- Don't assume that the machine you are using has safety interlocks because other machines do.
- Be familiar with the design features and operational limitations of the machine you are using.
- Report hazardous conditions and malfunctions to supervisory personnel and follow up to ensure that corrective actions are taken.
- Be aware of conditions and the status of machines around you.
- Stop work if you encounter an unexpected hazardous condition while using a machine.

These events underscore the need to continually control the hazards associated with machine shops by following procedures and paying close attention to the status of the nearby machines. When an operator takes a shortcut, he is often exposing himself to a higher probability of injury. In the April 2003 event at Y-12, the opera-

tor moved the control lever to neutral to adjust the lathe chuck but did not turn the machine off, perhaps because he did not considered it necessary. This shortcut resulted in a serious injury. Also, the ISM core safety management function "Provide Feedback and Continuous Improvement" failed in the August 2003 incident. The "double-clutch" malfunctioning of the machine had apparently been reported to management personnel several times, but was not corrected.

KEYWORDS: *Near miss, alligator shear, machine malfunction, maintenance, communication of safety issues, job hazard analysis, machine shop*

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

2. WORKER INJURED WHEN FILE CABINET FALLS OVER WHILE BEING MOVED

On August 26, 2003, at the Savannah River Site, a worker was moving a standard five-drawer file cabinet on a dolly when the cabinet fell over and struck another worker just above the back of his right knee causing a serious injury. The injured worker was standing nearby and involved in another task. The file cabinet was not positioned correctly on the dolly and was not secured. (SELLS Identifier: 2003-SR-WSRC-0017)

The workers involved in the accident were performing two different jobs in the same area of an HVAC shop. The injured worker and a third worker were organizing tools while the other worker moved the file cabinet. The task of moving the file cabinet and the co-workers' activities were not coordinated in the space. Investigators determined this was a contributing cause of the accident.

The worker tipped the file cabinet forward to slide the dolly underneath (Figure 2-1). A 72-pound metal anchor plate had been bolted to the rear of the cabinet to provide stability when it was standing alone or was not secured to another cabinet. This additional weight was not identified as a hazard.

Figure 2-1. Loading cabinet on dolly (reenactment)

The worker tilted the dolly back to take the load and lifted the cabinet off the floor (Figure 2-2). The dolly was placed too far to the left of the cabinet, such that the heavy anchor plate was off center. This caused the file cabinet to fall to the right and strike the co-worker as it fell to

Figure 2-2. File cabinet lifted off the floor

the floor. The top corner edge of the file cabinet tore through the worker's blue jeans and caused a deep laceration that required more than 20 sutures to close.

A more appropriate dolly with a strap for securing the load had been used by this work group the previous day but was not used in this case (Figure 2-3).

Figure 2-3. Dolly with strapping mechanism and rear support

Investigators determined that the balance point of the load was not correct. The file cabinet was lifted from the side instead of from the rear so that the heavy anchor weight would be centered low on the dolly and positioned over the axle. A more detailed report on this event can be obtained from the SELLS website at http://tis.eh.doe.gov/ll/.

A similar event occurred at Rocky Flats involving improper load balance and placement. A handyman was moving a personnel contamination monitor (PCM2) on a four-wheel handtruck when the monitor fell over and hit an electrician causing a minor abrasion to his neck. Investigators determined that one side of the PCM2 was heavier than the other and that it had been positioned on the handtruck such that its center of gravity was not in line with the midline of the handtruck, resulting in an unstable configuration. (ORPS Report RFO--KHLL-PUFAB-1998-0021)

Handtrucks and dollies typically do not appear to be equipment that could cause accidents or result in injuries, but they can. Common accidents include:

- hitting a person or object,
- smashing hands or fingers against solid objects when maneuvering through tight spaces or doorways,
- running over toes,
- causing muscle or back injury from improper use,
- losing control on inclined surfaces, or
- falling off the edge of loading docks.

HANDTRUCK AND DOLLY SAFETY

- Keep the center of gravity of the load as low as possible.
- Place heavy objects below lighter objects.
- Place the load so that it is carried by the axle and not the handle.
- Load only to a height that will allow a clear view ahead. If the load is too high, then two people are needed; one to push and one to guide.
- Load evenly to prevent tipping.
- Let the dolly carry the load (user should only balance and push).
- Always move at a safe speed.
- Do not exceed the weight capacity of the handtruck or dolly and do not exceed the weight capacity that you can safely manage.
- Use equipment that is appropriate for the load being carried (e.g., two-wheel, four-wheel, cylinder cart).
- Use straps and chains (cylinders) to secure the load.

Handtrucks and dollies are found and used throughout the workplace, and in some cases are used by people who have no experience or training in material handling. Accidents often are a result of complacency, inattention, or just overlooking the obvious. The Bureau of Labor Statistics for 2001 reported 24,259 injury cases involving the use of carts, handtrucks, and dollies in private industry.

These events underscore the importance of ensuring that handtrucks and dollies are used safely. Proper selection of material handling equipment, which is appropriate for the load, is very important. It is also a good practice to ensure that the loading and unloading areas, as well as the travel route, are clear of obstructions and personnel who are not directly involved in the material handling activity.

KEYWORDS: *Handtruck, dolly, cart, material handling, injury*

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

3. WORKER INJURED WHEN CORRODED STEP BREAKS

On September 3, 2003, at the Savannah River Site, a worker performing a routine equipment walkdown fell and cut a 6-inch-long gash in his left shin when a metal exterior stair broke under his weight. Defective welds, coupled with corrosion, caused the step to break. All steps and platforms in the area were roped off and secured following the incident. (ORPS Report SR--WSRC-FDP-2003-0005)

The worker walked across a permanently installed metal walkway to cross over some piping and began to descend the four-step metal stairs to the ground. As he placed his weight on the second step from the top, it broke loose, and the worker hit his left shin on the inside edge of the third step as he fell through the steps. Although the worker needed 25 stitches to close his wound, holding onto the handrail during his descent probably saved him from a more serious injury. Figure 31 shows the stairs, after the incident, with the broken step on the ground.

Figure 3-1. Stairs after the incident, with the broken step on the ground

The steps, made of galvanized grating and structural supports, were welded, not bolted, to the stair framework. The stairway had not been repaired since it was constructed. Figure 3-2 shows the badly corroded area where the stair tread attached to the frame of the stairs.

When the stairs were inspected following the incident, inspectors determined that they had not been properly constructed, and the defective tread support weld caused the step to give way when the worker stepped on it. Construction drawings specified using a 3/16-inch fillet weld all around the tread to attach it to the support, but tack welds were used instead. Inspectors also found defective support welds on two simi-

Figure 3-2. Corrosion where stair tread attached to the frame

lar sets of stairs in the area. Welds on the failed tread support and some other supports were completely corroded away.

Investigators determined that defective tread support welds, coupled with corrosion, caused the step to give way. Corrective actions taken following this event included inspecting all outside metal steps and platforms and evaluating them for safety issues. Site safety personnel also issued a Lessons Learned Special Information Notice about the incident. The Notice is an attachment to a lessons-learned report (2003-SR-WSRC-0015) published by the Society for Effective Lessons Learned Sharing (SELLS) and can be accessed at the SELLS website via the following link: http://tis.eh.doe.gov/ll/listdb.html.

A similar event, involving a ladder platform, occurred at Portsmouth Gaseous Diffusion Plant. A ladder crossover platform about 30 feet above the ground gave way and fell when a fireman stepped onto it. Fortunately, the fireman was able to hold onto a ladder rung and sustained only minor bruises. Investigators determined that a platform grating support angle iron welded to the grating failed. They attributed this to environmental conditions that caused the welded joint to deteriorate. There was no formal procedure requiring a routine, systematic inspection of fixed exterior ladders. (ORPS Report ORO--MMES-PORTSAFEGR-1991-1007)

Following the incident at Portsmouth, inspectors found several exterior ladders that were corroded at tack weld locations and in general had deteriorated because of environmental stress and time. They identified the winter/summer, freeze/thaw cycle and the fact that bolts or clamps were not used to secure the grating platforms as contributing factors to the event.

Exterior stairs and interior stairs in corrosive environments should be inspected frequently to ensure that they have not degraded and are safe to use. Replacing stairs in locations where corrosion is a problem with those made of corrosion-resistant materials should also be considered. Corrosion-resistant materials, such as fiberglass composites, are commercially available and can provide long-term protection against corrosion from acids and other chemicals. These materials can be used to replace metal stair treads, grating, and flooring both in areas in proximity to corrosive chemicals and in outdoor locations, where corrosion resulting from weather changes is a problem.

SAFETY TIPS FOR METAL STAIRWAYS

- Inspect exterior stairs and interior stairs located in corrosive environments periodically to ensure that they are safe for use.
- Verify that bolts on bolted supports are at least 3/8-inch in diameter and are not significantly corroded.
- Remove defective stairs from service until they are repaired/modified.
- Inspect welds on tread supports to ensure they are adequate.
- Install 3/8-inch-diameter galvanized bolts and nuts on tread supports where welds are defective.
- Use full-fillet welds rather than tack welds when constructing metal stairs in areas where corrosion may be a problem.
- Consider replacing metal stairs with stairs made of corrosion-resistant materials.

Defective stairs should be removed from service and modified to ensure they are safe for use. Recommendations in the SELLS lessons-learned report about this event include inspecting exterior stairs in corrosive environments for defective fabrication and corrosion of tread support welds and installing 3/8-inch-diameter galvanized bolts and nuts in tread supports with inadequate welds.

These events illustrate the importance of maintaining a safe and functional infrastructure. Perform periodic inspections to assess the material condition of infrastructure systems, and address problems associated with aging and environmental effects. Normal weather cycles, with the resulting freeze/thaw patterns, can cause exterior stairs to deteriorate over time, making them unsafe for use. Interior stairs in proximity to corrosive chemicals also may become corroded and unsafe. Defective stairs should be roped off and removed from service until they have been repaired or replaced.

KEYWORDS: *Lesson learned, corrosion, exposure, inspection, maintenance, welds*

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

4. FAILURES TO IMPLEMENT LESSON LEARNED RESULT IN NEAR MISSES

On September 17, 2003, at the Hanford Liquid Waste Processing facility, workers loosened a locking ring on a waste drum and the lid blew off, hit the ceiling, struck a worker on his hard-hat as it fell, then glanced off his hands. Preliminary test results indicated that the buildup of methane gas generated from organic decomposition pressurized the drum liner. Corrective actions from a similar event that occurred at another Hanford facility in 1995 advocated the use of a drum harness or restraining device, yet this facility did not use them. (ORPS Report RL--PHMC-200LWP-2003-0003)

A drum harness (Figure 4-1) or lid restraining device (Figure 4-2) would have prevented the lid from flying off uncontrolled. In fact, other facilities at Hanford use drum harnesses routinely, having implemented a lesson from a 1995 event at the T Plant, where a drum lid, locking ring, and internal 90-mil drum liner lid were explosively propelled upward, landing several feet away when an operator pulled on the locking ring of the drum. There were no personnel injuries. One of the corrective actions taken was to investigate the use of lid restraining devices. (ORPS Report RL--WHC-TPLANT-1995-0025)

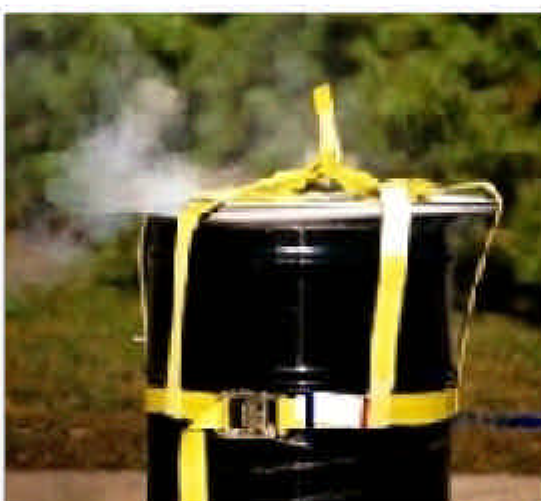

Figure 4-1. A drum harness

Figure 4-2. A lid restraining device

The independent assessment team investigating the 2003 event identified four previous submissions to the DOE Lessons Learned database that specifically dealt with the issue of pressurized drums. These lessons warned personnel to treat all drums as potentially pressurized and advocated the use of lid restraining devices. The lessons can be accessed at the DOE Lessons Learned web site (URL http://www.tis.eh.doe.gov/ll). Their titles and identifier numbers are listed below.

- *Drum Lid Ejection due to Environmental Pressurization*, Identifier RFETS-02-0021

- *Near Miss Involving Removal of Drum Lid*, Identifier L-2000-OR-BJCETTP-0205
- *Bulging Drum Video and Research Data*, Identifier 1999-LA-LANL-ESH7-0004
- *Nitric Acid Causes Drum Over-Pressurization*, Identifier Y-1997-OR-LMESY12-0701

Examples of failure to implement lessons learned have occurred in other activities that resulted in near misses or serious injuries. On October 14, 2003, at the Rocky Flats Environmental Technology Site, a radiological control technician (RCT) was struck on the back of his self-contained breathing apparatus by a fork truck moving an intermodal waste container to a laydown area. Neither the fork truck operator nor the spotters who were assisting him in the extremely congested area saw the RCT, who was standing in the laydown area. The spotters attempted to communicate with the fork truck operator using hand signals, and failed to maintain a clear line of sight with the fork truck. (ORPS Report RFO--KHLL-ENVOPS-2003-0003)

This event bears startling similarity to an event reported in OE Summary 2003-03 that occurred at the same facility. A waste technician was nearly struck by a fork truck that was attempting to maneuver through the very congested remediation tent. Investigators identified inadequate radio communication, the spotters losing sight of the fork truck, and the area congestion as causal factors. Corrective actions were to evaluate using radios, require spotters to maintain a clear line of sight, and move some operations out of the tent to ease congestion.

Another example occurred at the Stanford Linear Accelerator Center (SLAC), where a systems engineer fell from a ladder and sustained serious head injuries requiring hospitalization. A Type B Accident Investigation Board determined that management had not addressed deficiencies identified in four previous ladder-related accidents dating back to 1997 and therefore had not developed and implemented work control processes that would prevent future events. These previous events resulted in significant injuries to personnel, such as a broken arm and dislocated shoulder, compound elbow fracture and knee hematoma, and a fractured femur and a hairline fracture in a lumbar vertebra (ORPS Report OAK--SU-SLAC-2003-0001; OE Summary 2003-06)

These events illustrate the importance of learning from previous experience and taking prompt corrective action. Near misses are often precursors to significant events involving severe injuries. Browsing the Lessons Learned database or the OE Summary are two ways to learn from the mistakes of others.

KEYWORDS: *Lesson learned, near miss, waste drum, drum harness*

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