OPERATING EXPERIENCE SUMMARY

Inside This Issue

- *Two events involving abrasive wheel failures resulted in near misses to personal injury*
- *A worker fell into a ladder access opening and fractured his shoulder*
- *An apprentice mechanic narrowly escaped serious injury when a 30,000-pound bus fell off a jack stand*
- *Reciprocating saw kicked back and lacerated a worker's larynx*
- *A 5-pound chain sprocket fell from a rollup door and landed 1 foot from a security officer*

U.S. Department of Energy

Office of Environment, Safety and Health

OE Summary 2002-25

December 16, 2002

The Office of Environment, Safety and Health (EH), Office of Performance Assessment and Analysis 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, time permitting, 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, 301-903-1845, 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 2002-25

TABLE OF CONTENTS

EVENTS

Visit Our Web Site

Please check our web site every two weeks for the latest OE Summary. The Summary is available, with word search capability, via the Internet at www.tis.eh.doe.gov/paa. If you have difficulty accessing the Summary at this URL, 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.

ATTENTION OE SUMMARY E-MAIL NOTIFICATION SUBSCRIBERS

We have a new process for receiving e-mail notification when a new edition of the OE Summary is published. If you are a current subscriber, you will need to re-subscribe if you wish to continue receiving notification. The process is simple and fast. Both current and new subscribers can sign up at the following URL: http://tis.eh.doe.gov/paa/subscribe.html.

If you have any questions or problems signing up for the e-mail notification, please contact Steve Simon at (301) 903-5615, or e-mail address steve.simon@eh.doe.gov.

EVENTS

1. CUTOFF WHEEL FAILURES RESULT IN NEAR MISS TO INJURY

On June 13, 2002, two separate incidents occurred at DOE sites involving spinning abrasive wheels that became missile hazards. At the Fernald Environmental Management Project, an abrasive wheel came off a cutoff saw, struck two parked cars, and almost hit an employee walking between them; while at the Oak Ridge National Laboratory, a cutoff wheel on a grinder failed during operation and flew across a room. No one was injured during either of these incidents. (ORPS Reports OH-FN-FFI-FEMP-2002-0020, final report filed 07/17/2002; ORO--ORNL-X10CENTRAL-2002-0007)

At Fernald, a laborer supervisor had demonstrated how to change the abrasive wheel on a Stihl Model TS-760 Cutquick™ cutoff machine (saw) just before the incident occurred. The wheel is held in place by a bolt through a double-tabbed thrust washer that is tightened against the wheel using a wrench. According to the supervisor, the wheel was properly installed and torqued onto the spindle. The cutoff saw (Figure 1-1) has a 6.42-horsepower engine with a maximum spindle speed of 5,350 rpm, and the 14-inch-diameter abrasive wheel is rated for a maximum speed of 5,460 rpm.

Figure 1-1. Gas-powered cutoff saw and abrasive wheel

After the wheel was installed and the guard was in place, a laborer took the saw outside, set it down on the pavement, and started the engine to allow it to warm up. At that same time, a project manager pulled into a parking space approximately 40 feet from where the saw was sitting and got out of his car. He could hear the saw running loudly nearby at high speed. After getting something from the trunk, he heard the laborer yell. The manager looked up and saw the blade in the air, coming down directly toward him. He lunged forward several steps, while the blade bounced off the hood of a car next to him, traveled another 6 feet through the air, hit the driver's side of his car (Figure 1-2) where he had been, then fell to the ground and spun out its remaining momentum.

Figure 1-2. Impact damage to manager's car

The laborer stated that the thrust washer had fallen off and the abrasive wheel spun forward on the pavement about 15 feet, then went airborne and traveled about 25 feet before it hit the two cars.

Investigators believe the spindle bolt backed out of the spindle threads because the engine was revved repeatedly during startup. A manufacturer's representative said that rapid deceleration could apply left-hand rotational torque to the spindle bolt, causing it to spin out of the spindle during startup if the saw blade was decelerated rapidly (e.g., revving the engine repeatedly or a rough-running engine). Witnesses heard the engine being accelerated and decelerated repeatedly before the incident occurred. In addition, the saw had not been operated for more than a year and could have been running roughly.

As a corrective action, the contractor will revise training for this saw to include specific steps that ensure (1) the abrasive wheel is properly torqued, (2) the engine is correctly warmed up, and (3) the spindle bolt is verified tight after ini-

tial startup of the saw following wheel replacement.

At the Oak Ridge National Laboratory, an employee was using a 4-inch side grinder with an abrasive cutoff wheel when the outer rim of the cutoff wheel suddenly separated from the center, allowing the outer rim to fly off the grinder and across the room. The grinder had a safety guard for employee protection. No one was hit, as the employee was the only one in the room at the time. When he reported this incident to the project leader, he also mentioned that a similar event had occurred that week when another employee experienced the same type of failure.

The pieces of the cutoff wheel (Figures 1-3 and 1-4) were retrieved for inspection. Microscopic analysis of the wheel showed radial cracks, indicating that the wheel had been over-torqued during installation.

Figure 1-3. Separated parts of cutoff wheel

Operation of high-speed rotary equipment can be dangerous if the discs, wheels, and stones are not properly installed (torqued) or checked for potential flaws. The following event involving a grinding wheel failure at the Hanford Site in January 1999 illustrates the energy involved in these types of failures.

A pipefitter was using a handheld pneumatic grinder when the grinding wheel (6-inch-diameter cup stone) disintegrated (Figure 1-5).

The guard deflected the broken pieces away; however, the largest segment traveled approximately 15 feet and penetrated the side of a metal trash can (Figure 1-6), knocking the can about 15 feet. Fragments were dispersed over an area of approximately 400 square feet. There were no injuries. (ORPS Report RL--PHMC-FSS-1999-0006)

Figure 1-4 Metal center section

Figure 1-5. Pneumatic grinder and pieces of cup stone

Investigators determined that the pipefitter had performed a pre-use visual inspection of the cup stone and grinder and did not observe any chips, cracks, or other damage. They later determined that the stone was rated to 6,000 rpm, while the grinder was rated for 7,700 rpm.

Although relatively rare, the disintegration of a spinning grinding wheel is a highly energetic event that can propel pieces of the wheel at great speeds. Grinding wheels should not be subjected to speeds greater than the maximum operating speed of the wheel. The following references provide safety-related information on grinding and abrasive wheels.

Figure 1-6. Damaged trash can

- 29 CFR 1910.215, *Abrasive Wheel Machinery* (URL http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9839&p_text_version=FALSE)
- 29 CFR 1910.243, *Guarding of Portable Power Tools* (URL http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9850&p_text_version=FALSE)
- OSHA Directive STD 1-12.26A, *Abrasive Operation Using Cutoff Wheels and Masonry Saws* (URL http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1732)
- ANSI B7.1-1988, *American National Standard Safety Requirements for the Use, Care, and Protection of Abrasive Wheels*

Additional information is available from the Grinding Wheel Institute at http://www.nauticom.net/users/grind/gwi.html and the Abrasive Engineering Society at http://www.nauticom.net/www/grind.

These events illustrate the potential safety hazards associated with the operation of cutoff saws and grinders, which operate at high rotational speeds. Users of these tools need to ensure the abrasive wheels, blades, or stones are free of defects and correctly fastened to the tool using proper torque. Users also need to wear personal protective equipment and operate these tools in accordance with manufacturers' instructions and with guards in place.

KEYWORDS: *Near miss, cutoff wheel, abrasive wheel, missile, cutoff saw, grinder, industrial safety*

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

2. OSHA VIOLATION LEADS TO WORKER FALL AND INJURY

On August 20, 2002, at the Stanford Linear Accelerator Center (SLAC), a worker tripped, fell into a fixed ladder access opening in a utility shaft, and fractured and dislocated his shoulder. A co-worker helped the injured worker out of the opening and drove him to the SLAC Medical Department for evaluation. The injured worker was transported to the Stanford University Medical Center, where a metal plate was inserted in his shoulder. He was released from the hospital on August 23, 2002. (ORPS Report OAK--SU-SLAC-2002-0009, final report issued October 22, 2002)

The SLAC worker was walking around a landing that surrounded the ladder access opening using a broom to reach overhead and sweep cobwebs from the infrequently accessed shaft. The landing floor was level, and there were no objects on the floor that could have contributed to the fall. The worker stated that he tripped and fell toward the ladder access opening. His right shoulder struck the edge of the landing, where it entered the access opening, and his left foot caught on the rungs of the ladder. The worker fell approximately 4 feet, but did not fall completely through the opening.

Investigators determined that the direct cause of the accident was a design problem (inadequate work environment). The Occupational Safety and Health Administration (OSHA) requires a fixed ladder access opening to be guarded with standard railing on all exposed sides, except at the entrance to the opening. The passage through the railing must be provided with either a gate or an offset, and there must be no direct path into the opening. A gate would have prevented the worker's fall into the opening, but the entrance to this fixed ladder access opening was not equipped with a gate, nor was it offset.

Personnel error (inattention to detail) on the part of the injured worker was a contributing cause of this occurrence. The worker was looking up and sweeping away cobwebs overhead while walking. Had he been standing still while performing the task, or had he looked down before moving, it is unlikely that he would have tripped and fallen into the opening.

The root cause of the event was identified as a management problem. During construction of the utility shaft, management was not aware of the OSHA requirement to protect fixed ladder access openings with guardrails.

Several compensatory and corrective actions resulted from this event. Access to the utility shaft has been prohibited until guardrails and a self-closing ladder safety gate can be installed. Information on the utility shaft fall hazard was disseminated to workers, and use of the "two-person rule" will be required when workers access utility shafts. Management also directed that an inventory and evaluation of all fixed ladders in the facility be performed.

Section 1910.23(a)(2) of OSHA regulation 1910, *Occupational Safety and Health Standards,* subpart D, "Walking–Working Surfaces," standard 1910.23, "Guarding Floor and Wall Openings and Holes" states:

> Every ladderway floor opening or platform shall be guarded by a standard railing with standard toeboard on all exposed sides (except at entrance to opening), with the passage through the railing either provided with a swinging gate or so offset that a person cannot walk directly into the opening.

This OSHA regulation is reinforced by a second OSHA regulation in Part 1926, *Safety and Health Regulations for Construction,* subpart M, "Fall Protection," section 1926.502(b)(13), which states:

> When guardrail systems are used around holes which are used as points of access (such as ladderways), they shall be provided with a gate, or be so offset that a person cannot walk directly into the hole.

A search of the Occurrence Reporting and Processing System revealed five other events in the last 3 years where workers fell and sustained injuries. The injuries varied in severity from minor abrasions and contusions to fractures of ribs, shoulders, and ankles. One of the more serious accidents involving a fall happened at the Los Alamos National Laboratory Materials Science Complex on October 15, 2001, when a facility engineer fell through a false ceiling from a height of 12 feet and fractured both of his ankles. (ORPS Report ALO-LA-LANL-MATSCCMPLX-2001-0004) Another serious accident involving falls occurred on December 26, 2001, at the DOE North Las Vegas (Nevada) office, where two workers fell through a drywall ceiling while running computer cables and were injured. One worker sustained two broken ribs in this accident, and the other suffered a fractured and dislocated shoulder. (ORPS Report NVOO--BN-NLV-2001-0004)

These events highlight the need to protect workers from fall hazards associated with their day-to-day activities. Floor openings, such as fixed ladder access openings, need to be constructed and used in compliance with OSHA regulations that require a standard railing with toeboard on all exposed sides except at the entrance to the opening. The entrance shall either be provided with a swinging gate or be so offset that a person cannot walk directly into the opening. Working surfaces above false ceilings need to be designed and constructed to comply with OSHA requirements.

KEYWORDS: *OSHA regulations, fall protection, personnel injury*

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

3. NEAR MISS TO SEVERE INJURY WHEN BUS SLIPS OFF JACK STAND

On September 18, 2002, at the Nevada Operations Office North Las Vegas Complex, an apprentice mechanic lacerated his right forearm while quickly sliding out from under a bus when the bus slipped off a hydraulic jack. The apprentice and another mechanic had raised the bus about 1 foot from the ground to position it on jack stands when the hydraulic jack tipped over. The apprentice went to the site medical facility, where he needed five stitches to close the wound in his forearm. (ORPS Report NVOO--BN-NLV-2002-0004; update/final report filed October 31, 2002)

The mechanics were raising the rear of a hydrogen prototype bus, like the one in Figure 3-1, and placing it on jack stands. After chocking the wheels, they used bottle jacks on each side of the rear axle to raise the bus high enough to place a 20-ton hydraulic jack under the differential. With the bus resting on a pair of small jack stands, they raised the bus by the differential so that the weight of the bus was balanced on the hydraulic jack.

Figure 3-1. A hydrogen cell prototype bus

The mechanics then began to place a large jack stand under the driver's side of the bus. The mechanics were under the bus positioning the jack stand when the mechanic noticed that the hydraulic jack was beginning to tip, and he called out to the apprentice that the bus was coming down. The jack tipped to one side, causing the weight of the bus to drop suddenly onto the small jack stand on the passenger side of the bus. As the apprentice slid from under the bus, the weight of the bus landed on the small jack stand under the passenger side, causing it to break and drop the rear tire to the ground. The apprentice cut his right forearm on a jagged metal edge on the storage compartment as he moved out from under the bus.

The construction manager ordered a root cause analysis, which revealed a number of causal factors. The most obvious of these was the small jack stand breaking and dropping the bus to the ground on one side. Even more significantly, the work package failed to provide adequate information on the type of bus and environment in which the mechanics would be working, and no procedure existed for jacking up vehicles. Investigators were unable to conclusively determine the reason the hydraulic jack tipped.

The work package did not describe the bus that would be involved: a hydrogen prototype bus that is heavier than conventional fuel bus models and has an uneven lateral weight distribution. The bus' total weight was 30,000 pounds, two-thirds of which was in the rear. The mechanics had never worked with this type of bus before, and were unprepared for the task. They proceeded to perform the task as they had done in the past with conventional buses.

The work package did not specify a safe location for working on this type of bus. The bus was sitting on an asphalt surface, with a slight slope toward the front, and was locked. The mechanics had no way to move it onto a concrete pad, which would have provided greater stability.

The mechanics were relying on skill-of-the-craft to perform this work because there was no procedure on safely jacking heavy vehicles. They did not use cribbing to more evenly distribute the bus' weight, and the hydraulic jack was not equipped with a saddle or cup to prevent slipping. A procedure on jacking up vehicles would have significantly reduced the likelihood of this accident.

Following the critique, the construction manager began developing a procedure on jacking and cribbing mobile equipment. Training will

be provided to mechanical personnel when the procedure is complete. In addition, the construction group will develop a system for identifying work requests involving different mobile equipment.

This event illustrates the importance of adequately planning and communicating work. Procedures should cover all types of equipment that will be utilized. Work packages should clearly describe the equipment that will be used and the surrounding environment. Workers should be aware of potential hazards and unknown configurations before they begin work. Job hazard analyses should identify all situations that could pose a hazard to workers.

KEYWORDS: *Jack, heavy equipment, injury, inadequate procedure*

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

4. WORKER INJURED WHILE SIZE-REDUCING METAL COMPONENTS

On October 21, 2002, at the Rocky Flats Environmental Technology Site, a worker was size-reducing metal components with a reciprocating saw when it kicked back and cut him in the lower throat. The worker's supervisor transported him to the occupational medical facility, where he received five stitches in the Adam's apple area of his throat and was cleared to return to work. This occurrence was categorized as a near miss to a serious injury. (ORPS Report RFO--KHLL-NONPUOPS1-2002-0006)

The worker was cutting a square fan housing into pieces at the time of the accident. The housing, approximately 8 feet on each side, consisted of sheet metal panels supported by C-channel structural members. Workers were using a "buddy" system with two-person teams performing cutting work. One worker started the cut and, after cutting approximately 18 inches, turned the saw over to the second worker, who grasped the saw incorrectly and started cutting. Because he was holding the saw incorrectly, the worker pulled it toward himself as he cut. When the saw blade started to cut into the C-channel support it kicked back and cut the worker in the throat.

The injured worker was not immediately aware of his injury. A co-worker noticed that the worker's clothing was cut in the throat area and escorted him to the step-off pad. A radiological control technician surveyed the worker for radiological contamination before he was transported to the occupational medicine office for treatment.

The injured worker was wearing the required personal protective equipment for performing work in a beryllium controlled area (Tyvek® coveralls, gloves, respirator, etc.). He had more than 12 years of experience as a carpenter, and his current job classification is machinist. He had extensive experience using a reciprocating saw on soft wood, but little experience using it for cutting metal components. Following the accident, all reciprocating saw operations in the facility were curtailed until an investigation could be completed and corrective actions implemented to prevent recurrence.

Both the direct and root cause of this occurrence were personnel error (inattention to detail). The injured worker did not remain attentive to the safety aspects of the task and did not remain focused on performing the task safely. He had attended several recent training sessions where the safe use of the reciprocating saw was discussed, but still used the tool incorrectly. He stated during the fact-finding meeting that he was holding the saw incorrectly and could have kept it pointed away from his body or repositioned himself to complete the cut in a safe manner.

Corrective actions taken as a result of this occurrence included the following.

1. Conduct hands-on training in the work area for all facility personnel to address safe methods of cutting the different materials and configurations to be encountered in the size-reduction tasks.
2. Conduct training for all facility personnel on the emergency response expectations and actions to be taken following injuries or similar emergencies.

3. Conduct briefings for all facility personnel on hand tool safety and the potential consequences of injuries or other accidents in radiological and/or beryllium-contaminated areas.
4. Revise all facility Job Hazards Analyses to address the safe use of reciprocating saws.
5. Prepare and distribute a site-wide Lessons Learned document that discusses the accident and addresses the safe use of cutting tools.

A search of the Occurrence Reporting and Processing System identified two other instances where workers injured themselves while using (or misusing) tools or equipment. On November 1, 1999, at the Monticello Remedial Action Program site in Monticello, Utah, a worker received a severe head injury when he was struck by an iron bar that he was using to pry open the stuck doors of a belly dump truck delivering a load of stone. The doors suddenly opened and the iron bar slipped, striking the worker in the head. This occurrence was the subject of a DOE Type B accident investigation. (ORPS Report ALO--MCTC-GJPOTAR-1999-0004) On March 14, 2000, at the Los Alamos National Laboratory, a worker was size-reducing aluminum bar stock inside a glovebox. The blade of the cutting tool accidentally cut through the glovebox glove and caused a small cut on the worker's right thumb. The wound was found to be contaminated with 3,000 disintegrations per minute of alpha contamination (Pu-239). (ORPS Report ALO-LA-LANL-TA55-2000-0008)

These events demonstrate the need for workers to stay focused on the safe performance of the job at hand at all times while working with tools, especially power tools. A momentary distraction or lack of attention to detail can result in a serious injury to the worker or to others. An individual using a power saw should never position himself such that the saw is moving toward any part of his body. If a worker needs to apply a lot of force to the saw while cutting, the blade may be dull and in need of sharpening or replacement. The hazard here is that when the dull blade finally cuts through the material, the worker may not be prepared for the sudden movement of the saw caused by his applied force, resulting in an injury Facility managers and work supervisors should regularly address the need to give attention to detail in training sessions, briefings, and regularly scheduled safety meetings.

KEYWORDS: *Reciprocating saw, injury, size reduction, metal cutting*

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

5. METAL SPROCKET FALLS FROM ROLL-UP DOOR, RESULTING IN NEAR MISS

On November 18, 2002, at the Pantex Plant, a 5-pound chain sprocket for a roll-up door fell to the floor and landed approximately 1 foot from a security police officer (SPO). The position of the SPO to the sprocket at the time of the incident is shown in Figure 5-1. The SPO was attempting to operate the door at the time of the incident, and was not injured. Maintenance personnel locked and tagged out the roll-up door. (ORPS Report ALO-AO-BWXP-PANTEX-2002-0059)

Figure 5-1. Position of SPO to sprocket on floor

Investigators determined that the 6-inch-diameter sprocket (Figure 5-2) mounted on the door drum came off the shaft. A collar that locks the drum shaft in place slipped, allowing the drum to move and causing the sprocket to become misaligned. The misalignment caused the drive chain to put side pressure on the sprocket, allowing it to walk off the shaft and fall to the floor.

Figure 5-2. Sprocket on floor near the door

The sprocket hit the floor with enough force to damage some of the teeth (Figure 5-3) and the concrete floor.

Figure 5-3. Sprocket and damaged teeth from impact

Inspection and maintenance procedures for roll-up doors at Pantex are generally based on manufacturers' recommendations, and most roll-up doors have an established annual preventive maintenance schedule. However, preventive maintenance was not established for roll-up doors at this facility. Personnel from the Pantex Infrastructure Division are inspecting all roll-up doors to ensure they operate safely. After the visual inspections are complete, facility managers will be requested to identify all roll-up doors in their facility to ensure the doors are inspected and entered into the preventive maintenance system.

A search of the Occurrence Reporting and Processing System for similar events identified 12 other roll-up door failures that resulted in falling doors and parts. The following are examples.

- On May 13, 2002, at the Idaho National Engineering and Environmental Laboratory, a half-pound locking collar in the operating mechanism of a roll-up door fell 25 feet to the floor, landing 3 feet from a facility operator. (ORPS Report ID--BBWI-TAN-2002-0001; OE Summary 2002-12)

- On September 13, 2000, at the Portsmouth Gaseous Diffusion Plant, a sprocket fell from the operating mechanism of an overhead door and struck the floor beside an operator who had just pressed the button to open the door. Investigators determined that the sprocket bolts had failed from end-of-life and corrosion. (ORPS Report ORO--BJC-PORTENVRES-2000-0013)

These events resulted from aging components and a lack of preventive maintenance. Corrective actions included repairing door mechanisms and scheduling annual preventive maintenance. Although these events resulted in near misses to injury, a 1994 event at the Oak Ridge Y-12 Site shows that injuries can occur if maintenance is not performed on these doors. A material clerk was injured when she was hit in the chest by a 9¾-inch sprocket gear that fell from a roll-up door because of a loose setscrew that allowed the sprocket to slide off the motor shaft. (ORPS Report ORO--MMES-Y12SITE-1994-0045)

These events underscore the importance of including roll-up and overhead doors in the facility infrastructure preventive maintenance and inspection programs. Years of operation without maintenance can result in increased wear and deterioration of parts in the operating mechanisms, creating potential safety hazards. Falling parts and doors have the potential for causing serious injury.

KEYWORDS: *Near miss, overhead door, roll-up door, preventive maintenance, inspections, falling parts*

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