OPERATING EXPERIENCE SUMMARY

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Operating Experience Summary 2003-04

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EVENTS

1. CARPENTER INJURED BY FLYING TABLE SAW GUARD

In October 2002, at the Lawrence Livermore National Laboratory, a contract carpenter was injured when a machine guard on a table saw became loose, was flung by the rotating saw blade, and struck him in the chest. The carpenter was wearing safety glasses and hearing protection. His injuries were minor and required only first aid. (SELLS Identifier LL-2002-LLNL-34)

The carpenter had just finished ripping a piece of lumber on the saw. As he was removing it from the table, the board inadvertently contacted the anti-kickback splitter fingers (guard), knocking the guard off its mounting and into the saw blade, which was turning at 6,000 rpm. Three teeth broke off the saw blade and struck the carpenter in the neck.

Figure 1-1. Anti-kickback guard not mounted

Figure 1-2. Anti-kickback guard installed

Figure 1-1 shows the anti-kickback guard off its mounting, and Figure 1-2 shows the guard in the correct position.

Investigators determined that the table saw had a slight vibration that could have loosened the wing nut securing the anti-kickback to the mounting channel. When the nut came loose, the guard slipped from the channel and hit the rotating saw blade. Investigators learned that workers in the carpenter shop had substituted wing nuts for regular nuts when securing the anti-kickback guard to the mounting channel. After the event, a through-pin (Figure 1-3) was installed on the mounting channel and a hole was drilled (Figure 1-4) into the pin's mounting bracket to ensure that the guard remains in place.

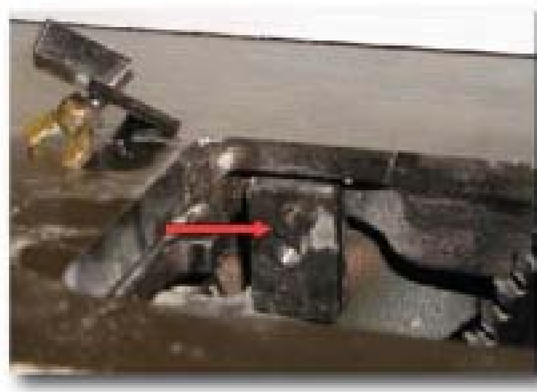

Figure 1-3. Mounting channel and through-pin (red arrow)

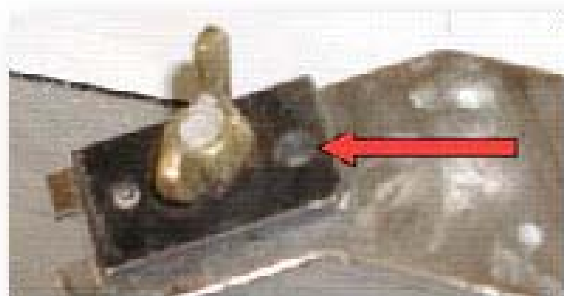

Figure 1-4. Wing nut and bracket showing hole for through-pin (red arrow)

Recommendations as a result of this event include the following.

- Install a through-pin near the kickback nut on all table saws to firmly secure the anti-kickback guard.
- Use regular nuts instead of wing nuts to secure the anti-kickback guard to the table saw. (A regular nut tightened using a wrench can be locked down with a higher torque than a wing nut using fingers.)
- Inspect the equipment before each use to ensure it is safe to operate.
- Check the anti-kickback guard to ensure it is not loose, cracked, or misaligned before turning on the table saw.
- Check saw blades for missing teeth that can cause vibration and replace damaged blades before using the saw.
- Shut down the table saw immediately and notify a supervisor if anything unusual is perceived.
- Schedule daily checklist inspections of all stationary shop equipment.
- Develop a routine maintenance schedule for all equipment to check for loose, worn, or misaligned parts.

Kickbacks occur when the blade catches the stock and throws it back toward the operator. Kickbacks can result if the blade height is not correct or if the blade is not maintained properly. Kickbacks are more likely to occur when ripping (cutting with the grain of the wood), rather than crosscutting (across the grain). Kickbacks also can occur if safeguards are not used or if poor-quality lumber is cut. Also, the cutting action of the blade may throw wood chips, splinters, and broken saw teeth.

Information on machine safety and guarding can be found in 29 CFR 1910, subpart O, *Machinery and Machine Guarding*. OSHA regulations can be accessed at http://www.osha.gov. Safety information specific to table saws can be found in 1910.213, *Woodworking Machinery Requirements*, which can also be accessed at the OSHA website http://www.osha.gov/SLTC/etools/machineguarding/saws/tablesaws.html.

This event illustrates the importance of ensuring that all machine guards are correctly installed and in proper working condition. In addition, substitution of hardware used for mounting machine guards should be evaluated to ensure safety is not compromised during equipment operation. As a general rule, any equipment modification should be evaluated for safety impact, particularly those that directly affect installed safety features.

KEYWORDS: *Injury, table saw, anti-kickback, machine guard, power tool*

ISM CORE FUNCTIONS: *Perform Work within Controls, Provide Feedback and Continuous Improvement*

2. OCCUPATIONAL EXPOSURE DUE TO INADEQUATE JOB PLANNING

On November 13, 2002, at the Savannah River Site, a radiological control inspector received a 226-millirem (mrem) radiological exposure while surveying a water sample drawn from a storage can containing failed test reactor fuel. Facility personnel were sampling the cans of failed fuel to support characterization of the material inside the cans before transferring the contents to another storage location. The failed fuel had been stored underwater in 14-foot-tall storage cans at the Savannah River receiving basin for over 30 years. (ORPS Report SR--WSRC-RBOF-2002-0004; final report filed January 28, 2003)

On September 25, 2002, personnel used the probe of a survey instrument to determine the location of the fuel within the cans. The highest reading from eight of the cans was 70 rad per hour (R/hr); the reading from the ninth can exceeded the maximum reading on the surveying instrument (199.9 R/hr). Using those results, they performed a job hazards analysis for sampling the water in the cans. Operators would be inserting a centrifugal pump connected to a tube into the storage cans to draw 250-ml samples. An assumption in the job hazards analysis was that the high readings from the cans came from the fuel and that the water itself had a low activity level.

Work resumed one week later. In accordance with the job hazard analysis, one of the operators surveyed the centrifugal pump while the sample was being drawn. A direct probe of the sample bottle measured 3,000,000 dpm beta/gamma and a 5 mrem/hr whole-body dose rate. Work was suspended so the cans could be moved into another area to facilitate removing their lids.

On November 13, 2002, sampling resumed. A pre-job briefing was held, but the need to survey the pump and discharge hose while drawing the sample was not mentioned. One of the radiological control inspectors assigned to the job had not been present during the previous sampling activities, and he was unaware of the survey requirement.

The sample that was withdrawn from the fourth can was placed on a cart (located away from personnel) to perform the survey. The initial dose rate measured of 34 R/hr on contact and 2 R/hr whole-body dose at 30 cm. The radiological control inspector reported the high rate to the first-line manager, who told him to discard the sample. The radiological control inspector poured the sample into the basin, discarded the bottle in a radiological waste bag, and exited the area, taking the filter papers from the air monitors and a sample of the basin water.

External dosimetry personnel read the thermoluminescent dosimeters from the four operators in the activity area, as well as that of the radiological control inspector. The operators' exposures were less than 50 mrem, but the radiological control inspector's exposure measured 226 mrem. This exposure is attributed to the radiological control inspector's proximity to a hot sample.

The root cause analysis identified three causal factors.

1. Discussion in the pre-job briefing failed to clearly identify the radiological control inspector's role in the sampling process; specifically, the requirement to survey the pump and discharge line was not mentioned.

2. The radiological control inspector failed to survey the pump and discharge line during sampling. Although he was not specifically told to perform this task in the pre-job briefing, the job-specific radiological work permit required continuous coverage. A skill-of-the-craft understanding of a radiological control inspector's job should have led the inspector to survey the hands-on work, irrespective of whether or not he was directed to do so.

3. The radiological control inspector should have posted the area as a High Radiation Area with the appropriate additional controls when he found the unexpected high dose rates and should have communicated that the sample was to be isolated from personnel. Instead, the first-line manager simply instructed him to discard the sample.

Facility managers distributed an internal lessons learned document to radiological control and spent fuel program personnel to emphasize the importance of being technically inquisitive during job planning. Using this lesson learned, facility personnel are working to identify other radioactive liquid-handling activities to verify that the controls in place are adequate. The spent fuel job hazard analysis will be revised to require risk assessments and to place emphasis on improving hazard controls and technical inquisitiveness.

This event illustrates the importance of personnel having a clear understanding of the tasks they are to perform during a work evolution. Comprehensive pre-job briefings are important for successful performance of radiological work activities. At a minimum, these briefings should include the following:

- *Scope of work to be performed*
- *Radiological conditions of the workplace*
- *Special radiological control requirements*
- *Contamination or radiation levels that could void the radiological work permit (e.g., in this event, the suspension guide was 50 mrem/hr)*
- *Radiological hold points*

In the event of confusion or uncertainty, workers should ensure that they understand which activities they are responsible for performing.

Management should not rely on skill-of-the-craft presumptions.

KEYWORDS: *Radiological control inspector, failed fuel, cans, sampling, radiological exposure*

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

3. COMMUNICATION CABLE SEVERED DURING EXCAVATION

On January 8, 2003, at the Brookhaven National Laboratory (BNL), a backhoe severed a communication cable, disrupting the site fire alarm communication circuit for a nearby building, as well as a number of site pagers and telephone lines. No injuries resulted from this incident. (ORPS Report CH-BH-BNL-PE-2003-0001)

The communication cable was accidentally unearthed while workers were removing a deactivated underground fuel oil tank. A worker noticed the cable when the backhoe severed it, and instructed the backhoe operator to stop work. The fire alarm communication circuit was restored to service about 3 hours after the cable was severed. Approximately 30 percent of the pagers on the BNL site paging system and 6 individual telephone lines were also out of service following this event. Workers re-spliced the cable and restored all communications within 24 hours.

Site personnel had marked the location of the 150-pair, low-voltage communication cable in August 2002 in anticipation of removing the deactivated underground fuel tank. However, a delay in the delivery of a replacement tank delayed removal of the old tank past the scheduled start date (September 2002). In November, shortly after the replacement tank had been installed and fuel oil had been transferred from the old tank, the BNL project coordinator authorized the subcontractor to remove the deactivated tank. The project coordinator provided the work package to the subcontractor, including a digging permit, and participated in the final walk-down of the work area.

Several site excavation procedure requirements were violated both before and during this incident. The BNL project coordinator had not adequately reviewed the digging permit for validity, and did not notice that it had exceeded the 30-day time frame for re-evaluation. He also failed to adequately inspect the work area for utility markings. The site excavation procedure requires that these markings be re-evaluated every 30 days after the initial marking.

During the investigation, subcontractor personnel stated that they did not see any utility markings in the immediate excavation area. However, some paint from the August utility marking process was later found on the wall of a nearby building and in the roadway. Investigators also learned that no one supplied the subcontractor with a utility map of the area that showed the marked utility locations, even though this is required by the site excavation procedure.

Investigators determined that the direct cause of this incident was a personnel error (procedure not used or used incorrectly). The site excavation procedure requires re-evaluating the digging permit 30 days after it is issued and re-evaluating utility markings every 30 days after the initial marking. The project coordinator also must provide a utility map of the work area. None of these requirements was met. In addition, workers should have questioned both the digging permit status and the absence of utility markings before they began to excavate the area.

Investigators determined that a management problem (inadequate administrative control) was the root cause of the occurrence. The digging permit indicated that utility markings had been made in the field, but these markings were not adequately controlled or verified. The project coordinator did not request a re-evaluation of the digging permit in light of the long time lapse following its issuance, as required. Because the project coordinator did not notice that the digging permit was more than 30 days old and utility markings were not visible, he and the subcontractor did not review the details of the work package before work began.

Corrective actions resulting from this event included the following.

- Revise the site excavation procedure to require that the project manager and the subcontractor supervisor sign the work package attesting that they jointly reviewed the digging permit and marked-up utility drawings before work began.

- Provide a copy of the site excavation procedure to an excavation subject matter expert for a detailed review and suggested improvements.

- Prepare a lessons learned document on this event and provide it to all engineering and construction staff.

This event highlights the fact that project managers are responsible for ensuring compliance with all requirements and procedures applicable to the work to be conducted, even if the work will be performed by subcontractors. It is important that project managers review all requirements with subcontractor supervisory personnel to ensure comprehensive understanding of the work to be performed and to ascertain that work site conditions are compatible with work planning assumptions. Time lapses between completion of the work authorization process and start of work need to be recognized and acted on with regard to permit re-evaluations and changes in work site conditions.

KEYWORDS: *Excavation, backhoe, severed cable, digging permit, work package, utility intrusions*

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

4. WORKER INJURED IN FALL FROM STACKED WASTE CONTAINERS

On January 9, 2003, at the Nevada Test Site, an ironworker foreman fractured both bones in his lower right leg when he stepped down from the bottom tier of stacked waste containers. A nearby fire chief assisted the foreman at the scene of the accident, and paramedics transported him to an offsite hospital for treatment. (ORPS Report NVOO-BN-NTS-2003-0001) Figure 4-1 shows a representative configuration of the boxes at the Radioactive Waste Management Complex (RWMC).

Figure 4-1. Waste boxes at the RWMC

The procedure at the RWMC permitted the waste handling crew to stack low-level waste containers and drums up to four tiers high in a stair-step arrangement across the floor of the disposal cell, with a minimum of 4 feet of clearance between the top of the highest tier and the natural grade. Containers and drums were stacked four tiers high, and each tier was between 2 and 4 feet in height. To accurately place the fourth tier of containers, a forklift and spotter were required. When assisting a forklift operator, a spotter normally used a ladder to climb up onto waste containers.

The foreman was spotting for a forklift operator at the time of the event. Because of staged containers positioned near the access point, he was unable to use a ladder to climb up onto the waste containers. As the foreman stepped down from the bottom tier of waste containers, he lost his footing and fell between stacks of containers with his right leg at an angle. The impact broke both bones in his lower right leg. Another ironworker in the area stopped work and contacted emergency responders. The injured foreman's leg was surgically repaired that day.

Facility management conducted a safety stand-down to discuss the accident. Initial corrective actions developed in response to this event include reducing the maximum height of the stacked containers from 16 feet to about 6 feet to eliminate the need for climbing on packages. Facility managers are also considering relocating low-level waste containers to another area and stacking them only one tier high.

The Office of Environment, Safety and Health has noticed a growing trend in significant injuries resulting from low-level falls (i.e., less than 10 feet). According to the Journal of the American College of Surgeons, low-level falls can result in high-level trauma. Studies have shown that 37 percent of all patients who experienced low-level falls had significant injuries. Trauma from these types of events can produce significant skeletal and intracranial injuries. Patients who experience low-level falls and are over 55 years old have a high likelihood for significant injuries.

Recent examples of low-level falls that resulted in an injury include the following.

- Employee fell from ladder – extent of injuries is unknown. (ORPS Report OAK--SU-SLAC-2003-0001)
- Employee fell from ladder – suffered head injury and injuries to right elbow and forearm. (ORPS Report ORO--BWXT-Y12SITE-2003-0002)
- Worker fell on ice – sustained ligament damage to knee. (ORPS Report ORO--BWXT-Y12NUCLEAR-2003-0003)
- Worker fell into ladder opening – lacerated leg and bruised hip. (ORPS Report CH-AA-ANLE-ANLEPFS-2003-0005)
- Worker fell down stairway – suffered fractured leg and torn ligaments. (ORPS Report NVOO--LLNV-LLNV-2003-0001)

Operating Experience Summary 2002-19 reported a serious injury accident that occurred at Savannah River on April 2, 2002, when a carpenter fell from shoring at a height of about 4 feet and struck his head on an adjacent concrete wall, fracturing his skull. (ORPS Report SR--WSRC-CMD-2002-0002)

These events illustrate the importance of analyzing all potential hazards when developing procedures and clearly delineating safe work practices in those procedures. Personnel should never be permitted to engage in unsafe work practices because of poorly configured work areas. More importantly, workers should be aware that falls from relatively low heights have the potential to result in significant injury.

KEYWORDS: *Fall, injury, waste containers, stacking, tiers*

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

5. INTENTIONAL VIOLATION OF WORK CONTROLS

On January 15, 2003, at the Idaho Specific Manufacturing Capability facility, a lead engineer for an equipment testing project intentionally violated work controls when he used a length of aluminum conduit as a fabricated tool to remove a stuck part from equipment being tested. While handling the conduit, it came dangerously close to an exposed electrical terminal. The engineer did not perform a hazards analysis or install a lockout/tagout on the power source supplying the terminal. (ORPS Report ID--BBWI-SMC-2003-0001)

While the engineer was trying to free the part, co-workers noticed that one end of the aluminum tool was within a few inches of the exposed, 100-volt electrical terminal being used to monitor the equipment during testing. (The exposed terminal was barricaded and appropriately posted.) Although his co-workers warned him of the potentially hazardous situation, no one exercised stop-work authority, and the engineer continued his attempt to free the stuck part. The construction supervisor at the scene contacted a supervisor at the next level of authority to intervene. That supervisor promptly reported to the scene and directed the engineer to leave the job site. Workers then locked and tagged out the terminal and removed the stuck part.

The work controls violation was considered to be an isolated event. During a pre-job briefing the following day, supervisors discussed the safety implications of work control violations with personnel who had observed the event. Before allowing testing to resume, facility managers walked down the job site and determined that it was safe to continue the equipment testing project.

Investigators identified the direct cause of this incident as the lead engineer's intentional disregard of established controls for the safe performance of work. The reason for the engineer's willful violation of requirements is not known, although schedule constraints may have been a factor, as the test program had experienced several delays. The engineer was removed from the project, pending further investigation.

Corrective actions in response to this incident will include a site-wide program to re-emphasize the need for workers to overcome any reluctance to invoke their stop work authority when unsafe practices or conditions are observed. This program will involve localized job-site training sessions, as well as increased emphasis on discussing each individual's stop-work authority during regularly scheduled safety meetings.

A search of the ORPS database for other instances of intentional violation of requirements revealed several other occurrences in the past few years. In September 1999, at the Hanford Site, a night shift operator falsely recorded equipment status data on the operator round log sheet on two successive nights. The operator recorded satisfactory instrument air pressure and tank water level (for shielding a cobalt source) on the round sheet, but did not actually enter the facility to obtain the readings. (ORPS report RL--PNNL-PNNLBOPER-1999-0029)

On January 24, 2001, at Los Alamos National Laboratory, a pipefitter performing preventive maintenance on a deluge fire suppression system decided to use a "short cut" based on his experience with a similar system, and deliberately departed from the maintenance procedure. As a result, the deluge system in a building was activated and approximately 1,000 gallons of water were released. Because an automatic alarm was sent to the local fire department, fire trucks were sent to the facility. (ORPS report ALO-LA-LANL-HEMACHPRES-2001-0002)

On July 31, 2002, at the Hanford Site, an operator conducting rounds was observed walking under a barrier in a radiological buffer area while going from a facility storage basin to an adjacent radiologically clean area. Exiting the buffer area without the required radiological survey was an intentional violation of radiological control procedures. (ORPS Report RL--PHMC-SNF-2002-0048)

These events highlight the need for all workers to observe established safety controls and to be willing and able to exercise stop-work authority when they observe unsafe work practices. In the January 15, 2003 incident, several workers observed the lead project engineer performing work in an unsafe manner (i.e., handling a piece of aluminum conduit near a live, exposed electrical terminal), but no one took immediate action to stop the work. All of the employees involved were aware of their responsibility to work safely and of their authority to issue a stop-work order, but none exercised that authority. Even in cases where interpersonal relationships exist (e.g., friendship, junior-to-senior worker status, previous negative experience, or worker-to-manager relationship), a safety culture needs to be established where all workers are comfortable invoking their stop-work authority whenever unsafe conditions are observed.

KEYWORDS: *Unsafe work practices, electrical safety, willful violation of requirements, lockout/tagout*

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