OPERATING EXPERIENCE SUMMARY

Inside This Issue

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With the full implementation of the redesigned Occurrence Reporting and Processing System (ORPS) on December 1, 2003, the Occurrence Reporting Binning and Tracking Tool (ORBITT) database has been discontinued. The ORPS database includes HQ Keywords that are equivalent to ORBITT bins to assist users in sorting through events to perform specific searches.

The old ORBITT bins have been crosswalked to the new HQ Keywords to provide data continuity.

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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.

EVENTS

1. INCORRECT EQUIPMENT SELECTION RESULTS IN PERSONNEL INJURY

On December 3, 2003, at the East Tennessee Technology Park, a worker was standing on a ladder removing piping when a section of pipe he was cutting sheared and knocked him to the floor. The worker broke his right wrist in three places and the radius in his forearm in two places. (ORPS Report ORO--BNFL-K31-2003-0002)

The worker and a co-worker were removing piping from a beam about 13 feet above the floor. They used an often-employed technique of cutting the pipe with a reciprocating saw until its weight bent it perpendicular to the floor, then making a final cut to drop the section to the floor.

One worker stood on the sixth step of a 10-foot ladder, about 5½ feet above the floor, to cut the pipe, while his co-worker held the ladder steady. Manlifts were available for the workers' use, but not in the immediate vicinity. The workers thought that this would be a quick job, completed in a few minutes, and believed using a nearby stepladder would be acceptable.

The worker on the ladder had cut $^{15}/_{16}$ inch through the $1^{5}/_{16}$-inch-diameter pipe when it began to hinge over. The worker held the saw in his right hand and used his left hand to control the pipe as it was bending to prevent it from striking the ladder or his co-worker on the ground. The vertical pipe section had bent approximately 90° when the remaining metal sheared.

The pipe broke so suddenly that its weight knocked the worker off the ladder. He fell to the floor, landing on his right wrist and elbow and hitting his head, but the ladder remained upright. He broke his wrist and radius when he attempted to break his fall. Fortunately, his powered air-purifying respirator protected his head from injury.

The contractor identified two lessons from this event. A manlift would have been a better choice of equipment to help the workers make this cut. If the worker who was injured had used a manlift, he could have put the saw down and used both hands to steady the pipe as it fell. There would also have been no need for a second worker to steady the ladder from below. Second, workers should review all the possible outcomes of their work methods to determine the worst-case scenario. If the worst case is considered before work takes place, steps can be taken to prevent it from happening.

The contractor undertook two corrective actions in response to this event. The use of all ladders at the site will be evaluated to determine if a ladder is appropriate for a task or if another type of equipment should be used. The worker who was injured has been briefing workgroups around the site to describe how his injuries occurred in an effort to emphasize the importance of using the appropriate equipment for the job, no matter how small.

A nearly identical accident occurred on April 14, 2003, at Los Alamos National Laboratory, when a subcontractor demolition worker fell from a stepladder and fractured the tibia and fibula of his right leg. The worker was standing midway up an 8-foot fiberglass stepladder, cutting a 6-inch-diameter metal pipe with a cutting torch. The 51-pound piece of pipe the worker was cutting fell, bounced off a piece of plywood, and struck the ladder, knocking it over. The worker's lower leg broke when it became entangled in the ladder. A contractor-led accident investigation similar in rigor to a Type B investigation followed. Corrective actions taken in response to this event include requiring that all elevated work be done from a manlift or scaffolding, and that pieces being cut from above be secured and safely lowered to ground level. (ORPS Report ALO-LA-LANL-HEMACHPRES-2003-0001)

Another event involving the incorrect selection of equipment occurred at the Rocky Flats Environmental Technology Site on October 7, 2003, when a construction worker helping to load demolition debris into a dump truck noticed a piece of rebar that extended beyond the side of the trailer. Instead of retrieving a tool specifically designed for reaching debris from the cab of the truck (Figure 1-1 shows a diagram), the worker attempted to climb the side of the trailer using a bungee cord. As the worker grabbed the top of the trailer box, he slipped and fell 4 or 5 feet to the ground, suffering a broken wrist, femur, and hip. (ORPS Report RFO--KHLL-FACOPS-2003-0005)

Figure 1-1. The tool used to retrieve debris

These events illustrate the importance of using the appropriate equipment for the job. If the appropriate equipment is not available or not serviceable, workers should consult their supervisors for assistance rather than using the wrong equipment.

KEYWORDS: *Lessons learned, ladder, injury*

ISM CORE FUNCTIONS: *Analyze the Hazards, Perform Work within Controls*

2. PERSONNEL ERROR CAUSES SIGNIFICANT INJURY

On October 20, 2003, at the Hanford Site ground-water protection project, a subcontractor well services worker installing a submersible well pump pinched his finger between a pipe nipple and the well casing (Figure 2-1), severing ½ inch from his right index finger. An ill-fitting seal assembly slipped into the well casing while the worker was trying to remove a discharge fitting from the pipe nipple. The well seal was not included in the pump installation package, and a substitute seal that was too small for the casing was used. (ORPS Report RL--PHMC-GPP-2003-0004; update/final report issued December 4, 2003)

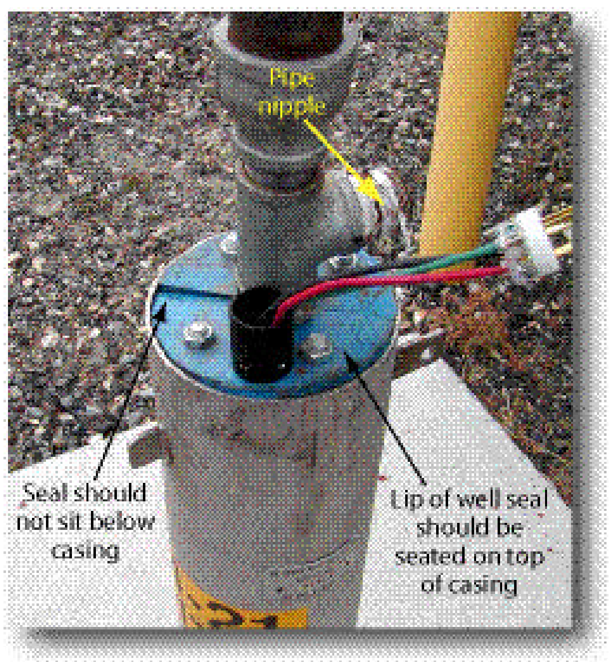

Figure 2-1. The well casing and seal assembly

The worker was highly-experienced and had performed similar installations in the past. He was wearing personal protective equipment, including leather work gloves, while using a pipe wrench to remove the discharge fitting from the pipe nipple. He had one hand on the wrench; the other was on the bottom of the fitting holding the wrench in place (Figure 2-2). When the worker exerted force on the wrench, the seal slipped down inside the casing. The end of his right index finger was severed within the glove. The worker was treated and reported to work the next day.

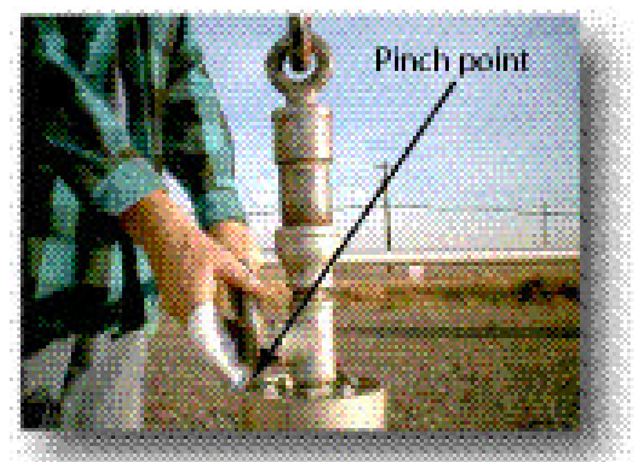

Figure 2-2. Re-enactment of the event

The well services manager stopped work, and the subcontractor conducted an assessment to determine the causes of the accident. Well services personnel inspected other wells onsite to verify that they were fitted with the correct seal. The assessment team determined that the use of a makeshift well seal for the stainless steel pipe casing caused this event. Contributing factors are briefly highlighted below.

The well seal normally contained in the installation package was missing. Instead of returning the package for replacement or notifying management, the workers used a substitute seal.

- The Well Services Procedures Manual does not require installers to inspect well seals for proper fit into the well casing.

- Because the well services organization has an excellent safety record of more than 15 years without an accident, managers and supervisors were more lax in their oversight than they normally would be.

- The well services workers, who are highly experienced, had become complacent about the installation because they had done similar installations in the past. The worker who was injured felt the seal assembly drop into the casing, but did not verify that it was fully set before proceeding.

The corrective actions that were taken are listed below.

- The manager met with all well services workers instructing them not to install any well pump systems without first verifying that the installation packages contain the appropriate components. Any deviation from the work procedure or changing conditions must be communicated to the manager.

- The procedure manual was revised to require workers to test the well seal that will be used to support the well pump assembly.

- Line managers and safety personnel will periodically inspect work sites to review work practices and document these inspections.

Complacency and familiarity have led to other injuries and mistakes. On September 4, 2003, at Brookhaven National Laboratory, a lathe operator with 20 years of experience set up a piece of $^3/_8$-inch brass tubing that extended 13 inches past the head stock at low speed. He made an adjustment and inadvertently switched the lathe to high speed, causing the extended portion of the tubing to bend. When he realized what had happened, the operator immediately switched the lathe to the off position. The whirling tubing then cut the operator's hand. Investigation revealed that the lathe operator took shortcuts because of his long familiarity with this type of operation. (ORPS Report CH-BH-BNL-NSLS-2003-0002)

At the Hanford Site, complacency caused two separate incidents where maintenance workers, long familiar with the facility, locked and tagged out and performed safe-to-work checks on the right equipment but worked on the wrong component. In the first incident, on August 19, 2003, workers performed preventive maintenance on the wrong hoist. (ORPS Report RL--PHMC-FFTF-2003-0008) In the second event, on October 29, 2003, workers locked and tagged out the right cooling tower fan and performed the work on the wrong fan. Fortunately, the fan was interlocked with a spray pump that was off, preventing the fan from starting. The workers noticed their mistake when the fan continued to trip after they had finished the work. The corrective action taken on both of these events was to require that both workers and supervisors physically verify by touch the actual component being worked on. Their verifications must match the work package, and they must sign attesting to their verification. (ORPS Report RL--PHMC-FFTF-2003-0009)

In the Hanford events, the workers performed the work control portion of the task as expected. However, their focus on making sure that the process was correct and followed to the letter distracted them from the actual task.

These events illustrate the potential for serious injury from seemingly innocuous errors stemming from familiarity with the task at hand. Facility managers should ensure that personnel do not develop an over-familiar, complacent attitude, even when performing routine tasks. A few moments taken to verify configuration can make the difference between successful work completion and injury or damaged equipment.

KEYWORDS: *Well seal, pinch point, injury, procurement, complacency*

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

3. *TWO ELECTRICAL SHOCK EVENTS OCCUR AT THE SAME SITE WITHIN THREE DAYS*

Two workers at the Y-12 site received mild electrical shocks in separate incidents that occurred within a 3-day period in September 2003. On September 12, an electrician performing a voltage check on a lamp socket accidentally touched a meter lead and received an electrical shock. On September 15, a worker performing a site investigation received an electrical shock when an exposed outdoor cable struck an adjacent metal guardrail. Both workers received medical attention, but neither was injured. (ORPS Reports ORO--BWXT-Y12CM-2003-0003; final report filed October 27, 2003, and ORO--BWXT-Y12SITE-2003-0037; final report filed November 4, 2003)

GOOD PRACTICES FOR AVOIDING ELECTRICAL SHOCKS

- Work on energized circuits should be performed only after obtaining special approvals and developing job-specific safety controls.
- Use lockout/tagout processes where practicable if there is a possibility that work may be performed in proximity to energized electrical conductors.
- Ensure that lockout/tagout procedures or work instructions include a zero-energy check to confirm the effective-ness of the lockout/tagout installation.
- Always use electrical-rated personal protective equipment (e.g., insulated gloves and boots, ground-fault circuit interrupters, double-insulated tools, and rubber mats) when working on electrical circuits or equipment.
- Stop work if an unanticipated electrical hazard or condition is encountered and seek appropriate assistance.

In the September 12 incident, the electrician was trying to determine why a 250-watt, multi-vapor light fixture was not working. He removed the lamp from the fixture, inspected it, and concluded that the lamp itself (not the socket or the wiring) had failed. As he looked down to read a voltmeter he was using to verify voltage at the socket, his hardhat began to slide off his head. He believes that, as he reached up to catch his hat, he touched the meter lead with the ring finger of his left hand and received an electrical shock.

Investigators identified two causal factors for this incident, both of which were violations of the site Electrical Safety Instruction document. The voltmeter leads had clips rather than probes, and one clip held a piece of wire to use as a probe. In addition, the electrician was not wearing any personnel protective equipment (PPE), such as electrical-rated gloves, although he was aware of the electrical safety requirement. Apparently the electrician chose not to obtain the proper meter leads and PPE before working on the lamp.

In the September 15 occurrence, the worker was using an electronic device to locate underground utilities. He picked up an exposed cable that exited from a conduit in a concrete base for a traffic light that had been removed about 10 years ago. The cable extended out of sight into tall grass, but the worker did not realize it extended only a few yards into the grass. As he was attaching an electronic device to the cable to trace its location underground, the cable pulled loose from the grass and touched the guardrail, resulting in the electrical shock.

Investigators determined that leaving the exposed cable in an energized state following demolition of the traffic light was the principal causal factor for this occurrence. The abandoned cable was a potential safety hazard for many years and could have resulted in an electrical shock at any time. They determined that another causal factor was that the worker moved the cable before he verified that it was de-energized. The device he was attaching was designed to be used for locating buried pipes and cables, not for determining the absence of voltage, and an electrician should have performed a zero-energy check before the worker touched the cable.

Corrective actions developed in response to these electric shock events included the following.

- Conduct briefings with all electrical crews to confirm that electricians are provided with appropriate equipment, including proper meters and leads.

- Retrain the electricians to reinforce the message that compliance with personal protective equipment requirements is mandatory, not optional.

- Provide information to appropriate engineering personnel (including subcontractors) on the potential hazards of abandoned cables and the need to have qualified electricians check them for the presence of voltage before they are touched.

- Establish a method for evaluating and communicating information on hazards identified by engineering surveys and walkdowns.
- Emphasize the importance of leaving partially completed or uncompleted projects/tasks in a safe, secure, and de-energized state (.e.g., issue a safety bulletin on this topic).

A search of the ORPS database for similar events revealed that 14 electrical shock events have been reported during the first 11 months of 2003. The following two events were the most serious.

On May 27, 2003, at the Los Alamos National Laboratory, a machinist received an electric shock from a mobile welding cart that contained an incorrectly wired welding receptacle. When the machinist simultaneously contacted the energized cart and another piece of equipment, he became part of the path to ground and received a substantial shock that resulted in numbness to his arm that lasted several days. (ORPS Report ALO-LA-LANL-NUCSAFGRDS-2003-0002; OES 2003-16)

On April 25, 2003, at the Pacific Northwest National Laboratory, an experienced researcher performing a routine electroplating operation received a substantial electrical shock. The researcher removed a protective guard from the electroplating equipment, reached under a vacuum chamber to confirm cooling water flow, and touched a cooling water connection to a cathode that was operating at 500 volts DC and 0.5 amperes. His hands and arms were immediately "thrown off" the equipment, and he had to pace the floor for several minutes to "shake off" the effects of the shock. (ORPS Report RL-PNNL-PNNLBOPER-2003-0007; OES 2003-10)

The National Fire Protection Association Standard 70, *National Electrical Code®,* provides safety standards for electrical circuits and systems. A copy of the latest (2002) edition of the code can be obtained by calling NFPA at 1-800-344-3555 or from the NFPA website at http://www.nfpa.org/codes.

These events underscore the need to pay attention to detail and follow established practices and procedures when working with electrical circuits or equipment. A lapse in attention by a worker can cause a serious injury. Electrical instrumentation needs to be appropriate for the task, not custom-rigged because one chooses not to obtain the proper instrument. Similarly, schedule constraints or inconvenience are not valid reasons for performing electrical work without proper personal protective equipment. A zero-energy check should always be performed before working with an electrical cable of unknown status, independent of whether it is called for in a procedure.

KEYWORDS: *Electrical shock, personal protective equipment, electrical hazards, zero-energy check, legacy hazards*

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

4. WASTE STACK TOPPLES ONTO FORKLIFT

On July 17, 2003, at the Idaho National Environmental and Engineering Laboratory (INEEL) Radiological Waste Management Complex (RWMC) Subsurface Disposal Area (SDA), a forklift operator was attempting to place a 5½-ton pallet of low level waste (LLW) on top of a stack of packaged fuel racks when an adjacent stack of containers collapsed, toppled into the fuel racks, and hit the forklift. The front window of the forklift was shattered, and the outer Herculite™ wrapping on one of the packages of fuel racks split open at an end seam. The forklift operator, a spotter, and five other workers escaped uninjured. There was no release or spread of radioactive contamination following this near-miss event. (ORPS Report ID—BBWI-RWMC-2003-0005)

The LLW disposal pit is 30 feet deep, with containers stacked 24 feet high. The forklift operator was going to place the non-standard, 5½-ton package (a milling machine part on a pallet) on top of a stack of empty fuel racks located in front of a stack of LLW containers. As he positioned the pallet to place it on top of the fuel racks, the adjacent stack of containers collapsed. Figure 4-1 shows the position of the forklift immediately before the accident. Figure 4-2 is a photograph of the scene after the accident. To view a computer animation of this event, [click here](#).

Figure 4-1. Position of forklift before the accident

Figure 4-2. Accident scene following stack collapse

Immediately after the waste stacks toppled, a radiological control technician, who was monitoring the lift, directed all of the workers to the disposal pit exit to be monitored for contamination. No contamination was detected on any of the workers. A team of radiological control technicians surveyed the area for signs of a radioactive release and found none. SDA workers and managers conducted a critique and devised an immediate recovery plan to stabilize the waste containers and reduce the risk of a radioactive release. The recovery plan included the following actions.

- Retract the forklift boom and lower the pallet of waste.
- Remove all vehicles from the SDA except the forklift.
- Drain the fuel from the forklift to reduce fire risk.
- Repair the split Herculite™ wrapping.

Inspections at the accident scene revealed that the stack that collapsed into the fuel racks comprised five standard containers topped by a 9,000-pound packaged milling machine part resting on a pallet. A container in the middle of the stack apparently collapsed under the weight of the containers on top of it (see Figure 4-3).

Inspectors determined that the container on top of the collapsed box was smaller than the other containers, which may have caused uneven, excessive loading on the collapsed box. A recovery plan to stabilize the collapsed waste containers and prevent the release or spread of contamination was completed on July 29, 2003.

On August 1, 2003, the RWMC project director commissioned an Operations Review Team to assess SDA operations. They questioned SDA personnel, reviewed pertinent documents and

Figure 4-3. Container that collapsed

records, toured the SDA, and interviewed subject matter experts. The team determined that the following deficiencies contributed to the collapse of the waste stack.

- The stacking of containers in the bulk pit section was not conducted in accordance with a pre-engineered design to ensure stack stability.
- The stacking procedures did not adequately address waste stack stability or include plans, methods, or limits for maintaining stable waste stacks.
- Personnel involved in waste stacking activities were not trained on the proper use of procedures or provided with detailed instructions for waste pit activities during their pre-job briefings.
- The Job Safety Analyses for SDA procedures did not delineate the potential hazards associated with an unstable waste stack.
- There were no barriers or signs to restrict personnel entry or vehicle access into or near the bulk waste pit and adjacent areas.
- No lessons learned or corrective actions were implemented following a similar event in June 2002, and the Job Safety Analyses was not revised.
- There is no evidence that workers and supervisors received training or briefings on recent changes to procedures, and it does not appear they are aware of current management expectations for operating the SDA.
- The SDA Safety Analysis Report (SAR) requires the facility to consider the weight and size of containers when stacking waste, but this requirement was not reinforced in the SDA bulk pit procedures.
- The SAR requires non-containerized, nonstandard LLW to be pre-rigged before lifting and stacking. The pallet of LLW being lifted at the time of the accident was not pre-rigged. If it had been pre-rigged, workers would have used a crane for the lift and been at less risk of injury when the waste stack toppled.

A DOE Idaho Operations Office Oversight Report (QSD-2003-67) cited INEEL for failures to (1) follow OSHA material handling standards for ensure stacked materials are stable against sliding or collapse; (2) identify the unsafe stacking conditions in the self-assessment program; and (3) implement lessons learned and corrective actions following the June 2002 stacking event.

In response to the DOE findings and the Operations Review Team determinations, INEEL developed and initiated 15 corrective actions, including the following seven key action items.

1. Revise the hazard analyses for LLW disposal pit operations.
2. Prepare stacking plans and guidelines for placing non-standard boxes and items in the bulk pits of the SDA.
3. Perform an engineering analysis of the current stability of the SDA disposal pit stacks; of pit boundary cargo boxes as load supports; and of slope, soil stability, and hazards associated with disposal pit perimeters.
4. Periodically assess SDA operations including pre-job briefings for waste placement processes; personnel compliance with operating procedures; and procedure applicability to specific work activities.
5. Revise procedures to include RWMC evaluations of container load support capabilities and placement methodology.
6. Require RWMC Lifting and Handling Engineer review and approval of all proposed stacking configurations.
7. Revise the training requirements for SDA operators, supervisors, and foremen to include initial instruction on SDA operating procedures and continuing training on procedure changes.

This event illustrates the importance of engineering evaluations, procedure utilization, operator training, and management oversight when moving and stacking materials. It also indicates the need for rigorous self-assessment, corrective action, and lessons learned programs. The collapse of stacked LLW containers and boxes can cause personal injury, equipment damage, and the release of radioactive materials into the environment.

KEYWORDS: *waste, stacking, lifting, material handling, and collapse*

ISM CORE FUNCTIONS: *Analyze The Hazards; Develop And Implement Hazard Controls; Perform Work Within Controls; Provide Feedback And Continuous Improvement*