Office of Environment, Safety and Health • U.S. Department of Energy • Washington, DC 20585

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2002-10
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The 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.

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Operating Experience Summary 2002-10

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EVENTS

1. TRENCHING ACCIDENT RESULTS IN OCCUPATIONAL INJURY

This is a follow-up to the article published in Operating Experience Summary 2002-07, which provided preliminary information on the investigation of a leg injury at the Princeton Plasma Physics Laboratory (PPPL). On March 26, 2002, a subcontractor worker suffered two fractures to his right leg while working in a 5- to 6-foot deep trench. An internal accident review board was appointed to examine the circumstances leading to the accident, to determine root and contributing causes, and to recommend corrective actions. The complete report, documenting the results of the review, is available from PPPL upon request. (ORPS Report CH-PA-PPPL-PPPL-2002-0001)

The subcontractor was tasked with replacing the canal water service lines throughout the facility. Each new canal water line is located at a depth of 4 to 5 feet; trenches are dug to a depth of 5 to 6 feet and then backfilled with 6 to 12 inches of sand base for the new piping, as illustrated in Figure 1. At locations where utility lines cross the trench, workers must enter the trench to manually locate the lines and hand-dig around them

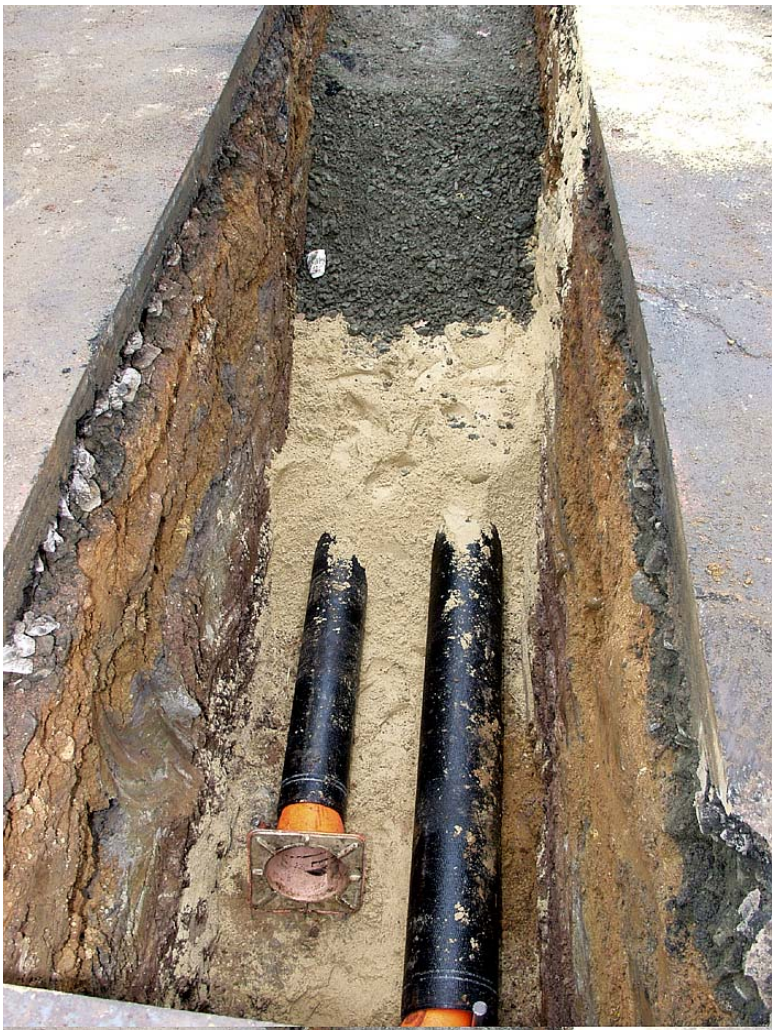

Figure 1. Western section of the trench with new pipes on sand backfill

On the morning of the accident, the worker, a foreman, entered the trench to determine a potential path for the new line around the existing utility lines. The trench had been excavated to the appropriate depth except at locations where utility lines were known or expected to cross the path of the trench. While he was in the trench, a mass of soil fell from the north face of the trench and struck him on his right leg above the ankle. The mass consisted of a mixture of compacted soil, clay, and rock, and struck the worker's leg with sufficient force to fracture both lower leg bones.

The PPPL Emergency Services Unit was summoned to the accident scene, finished installing timber shoring, and entered the trench to rescue the worker. The worker was extricated within 20 minutes and transported to the Princeton Medical Center for treatment. The worker underwent surgery that evening and was released from the medical facility on March 28.

After completing its investigation, the review board found that the root cause of the accident was the failure to identify the hazard posed by the condition of the trench wall. A contributing factor was failure to properly define roles and responsibilities for inspecting and overseeing the task. Neither the

subcontractor nor project management assigned a competent person to perform soil assessments as required in 29 CFR 1926, *Safety and Health Regulations for Construction*, sections 651 and 652.

The review board recommended that the Maintenance and Operations Division take the following actions before resuming work.

- Re-assess the roles and responsibilities of project management and oversight.
- Assign a competent person, as described in 29 CFR 1926.652, with the documented training and experience to anticipate and recognize conditions that can lead to soil collapse.
- Project management must ensure strict adherence to the requirements in 29 CFR 1926.652 relative to excavations; in particular, protective systems such as sloping, benching, or shoring must be used in trenches greater than 5 feet deep.
- Perform soil inspections on a daily basis and after a change in conditions has been observed. The Occupational Safety and Health Administration (OSHA) provides an inspection checklist that can be used as a guide. A record of these inspections should be maintained.
- Site management should ensure that future procurement processes for subcontractor work stipulate compliance with OSHA requirements.
- Sites may consider developing qualifications criteria for personnel who can support excavation activities in the role of competent person.

KEYWORDS: *Accident investigation, injury, trenching, soil collapse*

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

2. TEMPORARY ELECTRICAL POWER LINE SEVERED BY TRACKHOE

On April 29, 2002 at the Oak Ridge National Laboratory, an operator for a construction subcontractor was using a trackhoe to dig a trench to bury electrical conduit when the bucket of a trackhoe severed a temporary electrical power line. The power cable was a direct-buried (i.e., there was no conduit surrounding it) 240-volt line that was energized at the time of the incident. The work was immediately stopped, and power to the temporary power line was isolated. The excavation was part of ongoing construction at the Spallation Neutron Source (SNS) Project. There were no injuries to workers or significant impacts on other construction activities. (ORPS Report ORO--ORNL-X10SNS-2002-0003)

The temporary line, which was located at a depth of approximately 1 foot, was shown on the main site utility map, had been located, and the surface marked with spray paint. However, the locating device was imprecise, and the line was not directly beneath the painted location marks. Investigators determined that the line should have been de-energized and controlled under a lockout/tagout while excavating by hand to precisely locate the line before mechanical excavation was allowed to proceed.

As with most construction projects, temporary power lines are provided either by stringing them overhead or burying them in the ground. However, buried utilities present an obvious challenge in that their location has to be recorded or marked for future removal and to help prevent them from being damaged during continuing construction work. There were two other near-miss electrical intrusion events on this project caused by construction subcontractors performing excavation. Neither of these events involved injuries.

- On February 12, 2002, an operator using a trackhoe to slope the sides of an excavation struck a temporary 120/240-volt underground power line. The work had been authorized without identifying the location of utilities and without obtaining an excavation/penetration permit. (ORPS Report ORO--ORNL-X10SNS-2002-0001)

- On September 21, 2001, a laborer was digging holes for fence posts when the auger struck a 120/240-volt underground line. The subcontractor did not understand the excavation/penetration

permit process, and the buried utility lines were identified on a map instead of being marked on the ground. (ORPS Report ORO--ORNL-X10SNS-2001-0001)

Following an investigation of the April 29 event, the contactor will incorporate the following requirements into the existing excavation permitting process for the construction site. These requirements are also good practices that should be part of every excavation/penetration safety program to reduce the risk of electrical intrusions.

- All energized utilities will be locked out/tagged out before digging in the vicinity.
- Hand-excavation will positively locate the utility before machine excavation within 3 feet of the utility.
- All new temporary electrical lines will be run in conduit.
- Temporary lines will be backfilled with at least 2 feet of white sand above the utility line.
- A tape ribbon will be placed on top of the sand before it is covered with soil.

This event illustrates that the precise location of a concealed utility cannot always be determined, even through drawings or subsurface surveys, thus underscoring the importance of hand digging and de-energizing the power source. In addition, appropriate personal protective equipment should be used when working in close proximity to electrical utilities because an accidental intrusion can result in electrical shocks, severe burns, or electrocution.

The Office of Environment, Safety and Health analyzed 63 electrical intrusion events reported in ORPS from January 2000 through December 2001 because of an increase in the frequency of these events across the DOE complex. These events included accidental contact with underground utilities during excavation or penetration of embedded or concealed utilities within structures such as walls, floors, and ceilings. Problems included inaccurate as-built drawings, procedure non-compliance (e.g., not hand digging as required), blind penetrations, lack of zero-energy checks, and inadequate component marking during electrical conduit demolition. The results of this analysis will be summarized in a future report. A lessons-learned report (HQ-EH-2002-01) on this topic can be accessed from the Society for Effective Lessons Learned Sharing (SELLS) website at http://tis.eh.doe.gov/ll/listdb.html.

KEYWORDS: *Electrical safety, excavation, penetration, energized, construction, buried*

ISM CORE FUNCTION: *Perform Work within Controls*

3. INCORRECTLY WIRED CONNECTOR RESULTS IN ELECTRICAL SHOCK

On January 15, 2002, at the Lawrence Livermore National Laboratory, a contractor worker received an electrical shock while plugging a supply cord into a temporary power distribution (spider) box. The worker had plugged the supply cord into a short pigtail connected to a 208-volt power panel on the wall. An immediate review showed that the ground and the hot conductors were switched in the cord connector at the end of the pigtail. The worker was transported offsite for evaluation by emergency room physicians. He was released and returned to work the next day. (ORPS Report OAK--LLNL-LLNL-2002-0002; final report issued March 20, 2002)

The root cause of this near miss was management's failure to ensure that workers were properly trained in the Occupational Safety and Health Administration (OSHA)-required Assured Grounding Program and the lack of a procedure for verifying proper wiring before returning equipment to service. Prior to this incident, two experienced nightshift electricians shortened the length of approximately 75-100 individual pigtails. After shortening the pigtails, the electricians failed to visually inspect the pigtails or perform an Assured Grounding inspection using a voltage/continuity test instrument. Instead, the electricians passed an A/C Sensor Wand over the external insulation of the pigtail, which only verifies that the cable was energized but does not check for correct wiring.

The direct cause of this incident was incorrect wiring of the pigtail leads, which resulted in the neutral lead of the box being connected to the hot bus and the ground lead of the box to the neutral bus, causing one set of the spider box 120-volt rated breakers to be exposed to 208 volts. The electricians were unaware that an Assured Grounding inspection was required.

Some of the corrective actions implemented as a result of this event are listed below.

- Re-test the other pigtails that had been shortened to verify that they were properly wired
- Issue the OSHA-required Assured Grounding Program to all supervisors and foremen
- Retrain all OSHA-required Assured Grounding Competent Persons in proper testing procedures
- Retrain all electricians in the proper procedure of verifying wiring prior to returning equipment to service.

Assured equipment grounding conductor programs cover all cord sets and receptacles that are not part of the permanent wiring of a building or structure and equipment connected by cord or plug. Program requirements are stated in 29 CFR 1926.404, *Wiring Design and Protection,* section (b)(1)(iii). In addition, the Occupational Safety and Health Administration (OSHA) requires two tests. The first is a continuity test to ensure that the equipment grounding conductor is electrically continuous. It must be performed on all cord sets, receptacles, and on cord- and plug-connected equipment that is required to be grounded. The second test is to ensure that the equipment grounding conductor is connected to the proper terminal. These tests are required before first use, following repairs or suspected damage, and at three-month intervals.

This incident illustrates that workers must be properly trained to perform work safely and follow established procedures. The electricians must perform a visual inspection and have a procedure for performing an assured grounding inspection.

KEYWORDS: *Electrical, incorrect wiring, grounding.*

ISM CORE FUNCTIONS: *Define the Scope of Work, Implement Hazard Controls, Perform Work within Controls*

4. INADEQUATE RIGGING RESULTS IN DROPPED 400-POUND LOAD

On April 18, 2002, at the Hanford Site Remedial Action Project, a 400-pound fiberglass hut was dropped while being moved. The hut, which is used for exiting out of high-radiation areas, was being relocated for upcoming work by the subcontractor. Hoisting and rigging work was immediately suspended until follow-up actions are completed. There were no injuries to personnel as a result of this event. (ORPS Report RL-BHI-REMACT-2002-0007)

Figure 1. The hut

The hut, measuring 7 feet wide by 10 feet high (Figure 1), was suspended from an excavator bucket using a doubled ⅜-inch nylon rope (Figure 2), which was strung through a ½-inch nylon rope attached to the hut by stringing it through two holes at the top. Both ropes had been installed before the hut was delivered to this project. The excavator raised the hut approximately 10 feet in the air to maneuver it over a concrete bunker. While the excavator was turning a

corner on an access road, the hut began to swing. The ½-inch nylon rope failed, presumably frayed by the swinging motion of the hut, and the hut fell to the ground. No workers were closer than 20 feet to the hut at the time of this incident.

The contractor conducted a critique of the incident and identified the following preliminary corrective actions:

- A safety stand-down will take place with contractor and subcontractor management to address the conditions affecting the incident and to emphasize procedure compliance by all personnel and safety expectations, including stop-work authority.

- All operators will receive refresher training on the subcontractor's hoisting and rigging procedures, desk instructions, and operator responsibilities.

- The contractor will provide information to other organizations at Hanford on the incident and on potential problems with similar loop rigging arrangements.

Figure 2. The excavator bucket

This event underscores the importance of comprehensive pre-job preparation and adequate supervision while work is being performed. Two of the riggers on this job did not attend the pre-job briefing, and the excavator operator was left to supervise himself. The requirements specified in the Hanford Site Hoisting and Rigging Manual were not followed. Everyone involved in this lift failed to follow basic hoisting and rigging principles. These include failing to complete a hoisting and rigging checklist, not verifying that the excavator was authorized by the manufacturer for the load being lifted, and using two looped ropes that did not qualify as a rigging sling. Also, the riggers and a radiological control technician recognized the hazards involved with the task, but failed to stop the work as required by the Health and Safety Plan.

KEYWORDS: *Hoisting and rigging, lifting, dropped load*

ISM CORE FUNCTION: *Develop and Implement Hazard Controls*

5. VIOLATION OF RADIOLOGICAL POSTINGS

On April 17, 2002, at the Hanford Plutonium Finishing Plant, two radiological control technicians and a laborer entered a room of a building in violation of Airborne Radioactivity Area (ARA) postings. They did not notice the posting, and entered without wearing appropriate personal protective equipment that included respiratory protection. The three individuals had entered the posted area to repair a door, which was not planned ARA work. When they realized their mistake, they immediately exited to a safe location and were surveyed for potential radiological exposure. Surveys for radiological uptake were negative. (ORPS Report RL--PHMC-PFP-2002-0016)

To perform aerosol testing of high-efficiency particulate filters, the room was placed on ARA status as a precautionary measure. All access doors to the airspace were properly posted, and the filter testing commenced. When the door repair crew entered the filter work area, they and the person in charge of

filter testing immediately recognized that the potential for exposure to airborne radioactivity existed. The door repair crew rapidly exited the airspace by reverse route and phoned for assistance. The filter testing crew then placed their work in a safe configuration and stopped.

The door repair crew failed to notice the posting on the door as they walked up a stairwell to the door. Once the door was opened, the posting was no longer visible to others who were entering. Although the workers did not willfully violate the radiological posting, this occurrence emphasizes the importance of checking for postings before entering rooms and areas and obeying them. Personnel attentiveness is essential because entry requirements may change depending on radiological conditions within the area or room, requiring postings to be revised to communicate these changed conditions.

On May 4, 2001, in another room of the same building, personnel violated radiological postings when they unknowingly entered a posted ARA. The room had been placed in ARA status for routine work and was then cleared for downposting the next day following radiological surveys. However, before the posting was changed, a team of workers propped the door to the room open without noticing the ARA posting on the door. Over a two-hour period, 12 people entered the room without noticing the posting. An operator, who was leaving the room following a routine surveillance, closed the propped-open door and saw the posting. He contacted radiological control and was informed that the room had been downposted. (ORPS Report RL--PHMC-PFP-2001-0023)

Requirements for posting and control of radiological areas can be found in 10 CFR 835, *Occupational Radiation Protection*. Subpart G, *Posting and Labeling;* § 835.601(b) states: "Signs required by this subpart shall be clearly and conspicuously posted and may include radiological protection instructions."

These events underscore the importance of verifying postings and area or room status before entry and adhering to all specified radiological requirements. Radiological postings are used to alert personnel of the presence of radiation and radioactive material and to aid them in minimizing exposures and preventing the spread of contamination. Personnel are responsible for obeying posted, written, and oral radiological control instructions and procedures. Also, when doors with radiological postings are propped open, others entering the area may not think to check the other side of the door for postings, placing them at risk of radiological exposure or contamination. Personnel should be cautioned about propping open doors that can obscure postings. If a situation requires propping open a door, then someone should be stationed at the door to control access or the posting should be relocated to ensure it remains visible.

KEYWORDS: *Radiation protection, radiological postings, airborne radiation*

ISM CORE FUNCTION: *Perform Work within Controls*

6. DOE CITES WESTINGHOUSE SAVANNAH RIVER COMPANY FOR NUCLEAR SAFETY VIOLATIONS

On March 19, 2002, DOE issued a Preliminary Notice of Violation (PNOV) against Westinghouse Savannah River Company (WSRC), management and operating contractor at the Savannah River Site. During the period December 11-13, 2001, the Office of Price-Anderson Enforcement (OE) conducted an on-site investigation into the facts and circumstances surrounding 10 events that were reported in the Noncompliance Tracking System (NTS) and the Occurrence Reporting and Processing System (ORPS) during 2001. These events included work control deficiencies that resulted in violations of facility safety basis requirements, and As Low as Reasonably Achievable (ALARA) deficiencies in the radiological control program that contributed to unplanned worker uptakes and the spread of contamination. Based on this investigation, DOE concluded that violations of the Quality Assurance (10 CFR 830.120) and Occupational Radiation Protection (10 CFR 835) Rules had occurred.

Section I of the PNOV describes multiple breakdowns in work processes related to maintaining the status and control of safety equipment and instruments in nuclear facilities. These deficiencies resulted in

violations of Technical Safety Requirements. The OE review found similarities in several of these events that occurred at separate facilities. The similarities included inadequate documentation of safety-significant equipment status, inadequate log keeping and shift turnover, and inadequate testing before placing safety-significant equipment back into operation following maintenance.

Section II of the PNOV describes several instances where modifications were performed incorrectly on safety-significant or safety-class equipment. In these instances, the equipment was returned to service following the modification, but was later found to be incapable of performing its designed safety function. Associated work process deficiencies included inadequate knowledge of the equipment configuration before performing the modification, inadequate design and design reviews, and inadequate post-modification testing.

Section III of the PNOV describes several events that resulted in the unplanned spread of contamination. One of the events also involved the unplanned uptake of radioactive material by several workers. Although the resulting worker exposures were below the regulatory limit, they are of concern and highlight deficiencies in radiological work planning and control. Other common deficiencies noted in the radiological events included failure to adhere to procedures and failure to implement effective ALARA controls.

In accordance with the General Statement of Enforcement Policy specified in 10 CFR Part 820 Appendix A, the violations cited in the PNOV were classified as Severity Level III violations, and no civil penalty was assessed. In determining the severity level of these violations, DOE considered the actual and potential safety significance of these violations as significant enough to have warranted a Severity Level II. However, consideration was given for WSRC self-identification and reporting of the work process deficiencies, and for the event-specific corrective actions related to all of the deficiencies. Based upon this consideration, the violations were classified at the lower Severity Level III. DOE classifies violations as either a Severity Level I (most significant, with actual or potential significant consequences to workers or the public), II (significant, could impact worker or public safety), or III (greater than minor significance and important to avoid a more significant condition).

This PNOV illustrates the importance of timely self-identification, reporting, and correction of noncompliances in potentially mitigating or eliminating civil penalties that might otherwise be associated with violations of DOE's nuclear safety rules.

The Price-Anderson Amendments Act of 1988 requires the Energy Department to undertake regulatory enforcement actions against contractors for violations of its nuclear safety requirements. The program is implemented by the Office of Price-Anderson Enforcement. This enforcement action was taken with the support and participation of the Department's Savannah River Operations Office. Additional details can be found on the Internet at http://tis.eh.doe.gov/enforce.

KEYWORDS: *Enforcement, Price-Anderson Amendments Act, work processes*

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