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

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

OE Summary 2002-15
July 29, 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.

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Operating Experience Summary 2002-15

TABLE OF CONTENTS

EVENTS

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EXTREMITY EXPOSURE EXCEEDS ANNUAL LIMIT OF 50 REM

On July 22, 2002, at the Lawrence Livermore National Laboratory, it was learned that a chemist had received a radiation dose to the hands that exceeded the annual limit (50 rem) specified in 10 CFR 835, *Occupational Radiation Protection*. The overexposure was discovered during monthly processing of dosimetry. The chemist had been working with a radioactive solution in a glovebox and was wearing finger-ring dosimetry. A reading of the dosimetry indicated an exposure of 54 rem to one hand and 120 rem to the other. The chemist's whole body exposure during the monitoring period was 63 mrem. A Type B investigation will be conducted and results from the investigation will be detailed in a future issue of the Operating Experience Summary. (ORPS Report OAK--LLNL-LLNL-2002-0019)

EVENTS

1. REGULATIONS VIOLATED IN TRANSPORTATION OF EXPLOSIVES

On October 22, 2001, at the Nevada Test Site, two contractor employees improperly transported two 20-pound boxes of explosives in violation of the Code of Federal Regulations Title 49 (Department of Transportation), Chapter 3, Federal Motor Carrier Safety Regulations. These violations included not being qualified to transport explosives, not being properly trained, not having proper shipping documents, and not properly transferring and securing the explosives. (ORPS Report NVOO-BN-NTS-2001-0016; final report issued February 12, 2002)

The employees, a project engineer and technical staffer, drove to an explosive material turnout area to escort a commercial motor carrier that transported the boxes of explosives. When they met the truck drivers, the project engineer learned that the cargo had changed carriers en route and that these truck drivers were not the ones who had been preprocessed by security to access the Nevada Test Site. In addition, the project engineer was concerned that the truck could not enter until after hours to unload the cargo because of a large media event occurring at the Site. In an attempt to prevent this delay, the two employees and the truck drivers left the explosive cargo at the turnout area, shown in Figure 1-1, and drove to the Site entrance where the technical staffer entered the commercial bill of lading and driver information into the Hazardous Materials Transportation Tracking System (HAZTRAK). When this was complete, they all returned to the explosives turnout area and transferred the explosives from the commercial carrier to a contractor company vehicle. The technical staffer then drove the explosives onto the Nevada Test Site and to an explosives magazine (bunker) (Figure 1-2) for storage.

Figure 1-1. The turnout area for vehicles carrying explosives

During a review of the HAZTRAK form, the transportation supervisor did not recognize the name of the project engineer, who was identified as the driver. The form contained no information on the driver's Commercial Driver License (CDL), which is required for transporters of hazardous materials. The project engineer was licensed to handle explosives, but did not possess a CDL to transport hazardous materials. Upon further investigation, the supervisor learned that the actual driver of the company vehicle was not

the project engineer but the technical staffer, who also did not have a CDL. In addition, the company vehicle was not a properly documented Commercial Motor Vehicle, as specified in the contractor's Company Directive Motor Carrier Operations and 10 CFR 49, Chapter 3, *Federal Motor Carrier Safety Regulations*.

Figure 1-2. An explosives bunker

An investigation revealed the two employees violated the Federal Motor Carrier Safety Regulations in several ways. They were not trained or qualified to transport explosives, the explosives were improperly transported with invalid shipping documents, and the cargo was not properly secured. Furthermore, when transferring the cargo from the commercial carrier to the company vehicle at the explosives turnout area, they failed to observe the minimum distance of 14 feet from the road required by 29 CFR 1910.109, *Explosives and Blasting Agents*.

A comprehensive root cause analysis identified the direct and root causes as personnel error (procedure not used or used incorrectly) because the employees violated both federal regulations (29 CFR 1910 and 49 CFR) and corporate directives (Motor Carrier Operations), and failed to correctly complete the HAZTRAK form. Contributing causes were a communication problem in the inadequate exchange of information regarding the transportation of explosives between the contractor employees and the commercial trucking company, a work organization/planning deficiency because the project work package failed to adequately address the transportation of the cargo onto the Site and its subsequent storage in the magazine, and the fact that the two employees did not understand that they should stop work when circumstances changed; instead, they chose to deviate from the scope of work by transporting the cargo to the magazine.

The contractor has undertaken a number of corrective actions as listed below.

- Commercial carriers will no longer transfer cargo to the contractor when making deliveries.
- Contractor employees working with explosives have been briefed on the need for proper training and credentials, and the need to follow the work package and to stop work whenever the parameters of the work package have been exceeded.
- The Company Directive Motor Carrier Operations is being revised to clearly identify limitations on the transportation of explosives and other hazardous material.
- Employees working with explosives have been directed to fully comply with the requirements in Motor Carrier Operations and DOE M 440.1-1, Explosives Safety Manual, and 49 CFR with respect to appropriate vehicles, CDL certification, hazardous materials training, and shipping documentation.
- Work packages will include training and qualification requirements and will address work areas that are outside of the facility boundary.
- Existing procedures and work packages governing transportation and storage of hazardous materials are being evaluated to ensure that they are clear and complete.

Nevada Test Site management identified the following lessons learned. Employees need to understand and comply with the scope of activities specified in the work package, including invoking stop-work authority when conditions change. When developing work packages, work planners should review hazards and the controls that have been put in place to prevent or mitigate accidents involving those hazards. Managers and employees must ensure that training and licensing requirements are fully understood and followed.

KEYWORDS: *Explosives, transportation, CDL, hazardous material*

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

2. WORKER FALLS FROM ROOF AND SUSTAINS SERIOUS INJURIES

On April 29, 2002, at the Sandia National Laboratory/California, a subcontractor worker fell approximately 12 feet from the roof of a building and sustained injuries to both ankles and lacerations to his left hand. The worker was installing metal trim panels on a vinyl-coated metal roof on the west side of the building. He was not wearing fall protection at the time of the accident. Emergency medical personnel responded to the scene and transported the injured worker to a hospital. All elevated work at the construction site was suspended and a site accident investigation was initiated. (ORPS Report ALO-KO-SNL-CAFAC-2002-0002; final report filed June 18, 2002)

The worker reached the work area using a boom lift. There was a light rain at the time, causing the roof, which had an approximately 40-degree pitch, to be very slippery. The worker was unable to perform the assigned task from the lift basket, so he opened the gate on the lift basket and exited the confines of the basket. He slid down the side of the roof, and upon reaching the edge, fell feet first onto a concrete surface (see Figure 2-1). The worker did not put on the required fall-arrest equipment when he entered and operated the boom lift. The work area was at an elevation that required mandatory fall protection, according to OSHA regulations and the subcontractor's Safety and Health Plan.

The subcontractor supervisor was not at the work site at the time of the accident, and the injured worker was working alone. Although there was a co-worker and two workers from a different subcontractor at the construction site, they were out of sight of the roof work and did not witness the accident.

The causal analysis for this occurrence cited personnel error as the root cause because the worker failed to use mandatory fall protection. The direct cause of the accident was also personnel error in that the worker decided to step out of the lift basket onto the wet sloping roof, resulting in his fall to the ground. On previous occasions, this work had been postponed until roof conditions were dry. The fact that the work proceeded under rainy conditions suggests that the subcontractor's enforcement of the project Safety and Health Plan was less than adequate. Thus, a contributing cause was inadequate administrative controls.

Corrective actions included reviewing the process for managing construction safety on subcontractor-directed projects and updating the ad-

Figure 2-1. Building 960 construction site

ministrative procedure entitled *Construction Safety for Contracted Construction* to incorporate the results of these reviews.

In the past year, there have been a number of incidents across the DOE complex involving the failure to use fall protection. The following are two examples reported in the Operating Experience Summary.

- On January 8, 2002, at the Hanford Site, a worker using a man-lift to inspect the integrity of roof guardrails and ladders at a deactivated building violated the subcontractor fall protection plan during windy conditions by tying off to a non-approved guardrail and using a nearby crane hook to return to the ground. There were no injuries as a result of this violation. (ORPS Report RL--BHI-DND-2002-0001; OE Summary 2002-05)

- On November 5, 2001, at the Portsmouth Gaseous Diffusion Plant, a safety inspector observed two subcontractors performing overhead activities from an elevation of about 12 feet without fall protection. No one was injured in this event. (ORPS Report ORO--BJC-PORTENVRES-2001-0017; OE Summary 2002-02)

The incident at Sandia/California illustrates the importance of performing work in accordance with the requirements of the safety and health plan. In this case, the hazards and controls (fall protection) were identified when the work was planned, but the plan was not followed. Furthermore, a check should be made for any new hazards when the work begins; in this event, the light rain posed a hazard that should have been considered. This event also points out the need for timely and effective emergency response actions. Initial actions taken by the subcontractor personnel following the accident were less than adequate. They were not aware of the proper accident response protocols, including emergency telephone numbers.

KEYWORDS: *Fall, fall protection, lift, injury*

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

3. NEAR MISS – 2,800-POUND LOAD DROPS FROM CRANE

On June 12, 2002, at the Idaho National Engineering and Environmental Laboratory, a stainless steel table weighing 2,800 pounds was dropped from a height of about 11 feet. The load was rigged by a two-way bridle with two nylon straps choked around the table. The table's sharp edges cut the straps, causing them to separate and allowing the table to drop. No one was injured. The table was substantially damaged; superficial damage occurred to the floor and to adjacent equipment. (ORPS Report ID--BNFL-AMWTF-2002-0005)

A journeyman rigger with 16 years of experience rigged the table, assisted by an apprentice with 1 year of experience. No supervisor was present to oversee the lift. The table was being lifted in a horizontal orientation and was about 11 feet above the floor when the first strap separated. The load twisted and shifted to a vertical orientation. This shift positioned the lower end of the table about 4 feet from the floor when the second strap separated. There were two millwrights in the room at the time; one was controlling the tagline and the other was spotting. The millwrights were standing approximately 15 feet on either side of where the load was being lowered.

The apparent causes of this incident include: (1) the riggers' failure to comply with the contractor's crane, hoisting, and rigging operations procedures that require the use of softeners between lifting straps and sharp edges of a load and (2) insufficient involvement of contractor management in the planning and execution of this lift.

The waste treatment facility general manager ordered construction activities to cease until the contractor could demonstrate with certainty that work could continue safely. The contractor immediately suspended all power rigging (crane) activities and issued a moratorium on the use of nylon or Kevlar® straps except for certain loads. All lifts of loads that could cause a strap to deteriorate or fail will be made using wire rope. In addition, because the journeyman was found to be insufficiently qualified, he was

replaced by his immediate supervisor. Contractor management has committed to being more involved in task planning and execution.

A similar event occurred at the Brookhaven National Laboratory on August 29, 2001, when one end of an 11,000-pound collider magnet fell approximately 4½ feet to a concrete floor when one of two lifting slings failed by cutting. No one was injured, and the damage to the magnet was not severe. Investigators determined that riggers used material that did not provide adequate chafing protection, which allowed a sharp corner of the magnet support casting to cut through the sling. (ORPS Report CH-BH-BNL-BNL-2001-0023; OE Summary 2001-09)

The Idaho event illustrates the importance of management involvement in job planning and ensuring that the work is performed in accordance with regulations and procedures. In addition, management must ensure that workers are adequately trained and qualified to perform the task. Both of these events underscore the importance of checking the load for sharp edges and potential chafing points that can damage rigging, resulting in a dropped load.

Guidance on protecting slings from damage caused by sharp edges can be found in DOE-STD-1090-2001, *Hoisting and Rigging (*URL http://tis.eh.doe.gov/techstds/standard/std1090_c/toc2001.htm). Chapter 11, *Wire Ropes and Slings*, of the Standard mentions using anti-chafing materials, such as corner saddles, burlap padding, wood blocks, and leather pads. The Occupational Safety and Health Administration (OSHA) Office of Training and Education publication, *Sling Safety*, and OSHA Standard 29 CFR 1910.184, *Slings*, state that slings must be protected from sharp bends and cutting edges, as well as from unsafe lifting procedures such as overloading. OSHA regulations and standards can be accessed at http://www.osha.gov/comp-links.html.

KEYWORDS: *Crane, dropped load, hoisting and rigging, sling*

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

4. *ELECTRICIAN INJURED BY ELECTRICAL ARC FLASH*

On July 15, 2002, at the Hanford Site, a subcontractor electrician received minor flash burns to his left forearm and the left side of his neck when an electrical arc occurred while he was replacing a circuit breaker in a distribution panel. The panel was energized to 480 volts with no lockout/tagout or energized work permit controls in place. A preliminary investigation indicated that the electrician was installing the breaker in the closed, or on, position. Although the electrician's injuries were minor, they could have been more serious and event fatal if he had received an electrical shock. (ORPS Report RP--CHG-TANKFARM-2002-0075)

The accident occurred when the journeyman electrician was replacing a 20-amp breaker with a 60-amp breaker in the distribution panel. Figure 4-1 shows the replacement breaker that was to be installed. The electrician intended to minimize downtime to the facility by mounting the replacement breaker without de-energizing the panel. He then planned to isolate the panel with a lockout/tagout before attaching the breaker to the bus bar and load side connectors.

Figure 4-1. Replacement 60-amp breaker

The electrician removed the 20-amp breaker from the distribution panel, then removed its mounting screws and placed them into the 60-amp breaker. He slid the 60-amp breaker into place with the intent of attaching the mounting

screws but without connecting to the bus bar or load side. As he attempted to screw in the lower mounting screw, his screwdriver made contact between the breaker C phase line-side lug and the mounting plate, which was grounded. The resulting arc flash caused him to jump back as he was burned. The arc continued down the bus bar and through the adjoining breakers, causing physical damage to the equipment. The main breaker tripped, causing a loss of power to the entire complex. Figure 4-2 shows some of the arc flash damage to the panel internals.

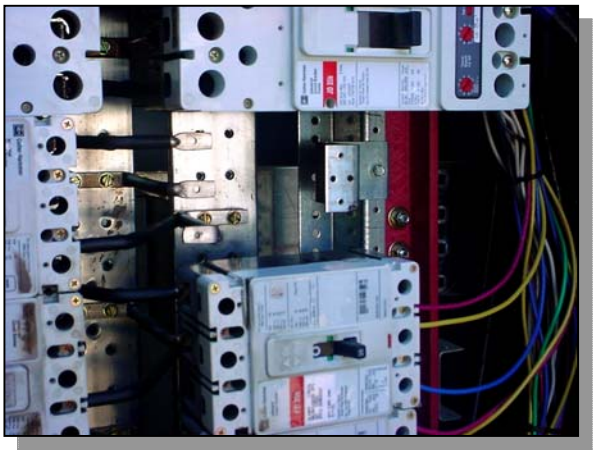

Figure 4-2. Arc-blast damage to panel

An apprentice electrician drove the injured worker to the immediate care medical facility in Richland, and subsequently to the Hanford Environmental Health Foundation. The injury was diagnosed as minor flash burns to the forearm and neck. Approximately 4 hours after the accident, the electrician was released and returned to work.

Listed below are the major issues that were identified in the course of the preliminary investigation.

- **Plan of the Day**
  The replacement of the 20-amp breaker with the 60-amp breaker was not included in the plan of the day. Although the need to perform the replacement had been discussed informally, the specific work activity was never planned, and thus the associated hazards were not identified or controlled.

- **Job Safety Analysis**
  The job safety analysis clearly states that if work is to be done on a source of electrical energy greater than 50 volts, it must be performed either under a formal lockout/tagout process or under an energized work permit.

- **Lockout/Tagout Program**
  The subcontractor's lockout/tagout program closely follows that of the Hanford Site lockout/tagout program. Both the management and operating contractor personnel and subcontractor personnel expected that this distribution panel would have a formal lockout/tagout installed prior to performing the breaker replacement.

- **Personal Protective Equipment (PPE)**
  The injured electrician was wearing standard leather gloves, a hard hat, and tinted safety glasses. The screwdriver he used had a rubber handle, but was not insulated or voltage-rated for the job. Figure 4-3 shows burn marks on the shaft of the screwdriver. Proper PPE for this work would include a hard hat, a face shield, voltage-rated gloves, voltage-rated insulated tools, and a rubber mat for the worker to stand on.

- **Work Control**
  No work package or other procedural document existed for this task. Instead, the Job Safety Analysis and relevant drawings were used to control the work. In addition, facility management did not formally release this task, and the facility owner was not aware that this work was being done.

Figure 4-3. Damaged screwdriver

Site personnel have not completed a formal causal analysis or developed corrective actions on this incident. When completed, causal factors are expected to include working on an energized electrical distribution panel, installing the replacement breaker in the closed (or on) position,

and working without work controls or proper PPE.

A search of the ORPS database revealed a similar event, also at Hanford, on January 11, 1997, when an electrician received minor flash burns while re-connected an energized, 480-volt power lead to a motor control center main breaker. Investigators determined that the drawings used to establish the isolation boundaries did not reflect the current system configuration and the electrician failed to perform a zero-energy check. (ORPS Report RL--PHMC-S&W-1997-0001)

The July 2002 Hanford event highlights the need to ensure that basic safety practices and procedures; e.g., lockout/tagout, PPE, and work controls are followed at all times by all contractors and subcontractors. This event describes how personnel safety can be endangered by ignoring multiple levels of safety controls. All the conditions were in place to produce a serious injury, and the electrician was very fortunate to escape with only minor flash burns.

KEYWORDS: *Electrical safety, electrical arc, flash burns, circuit breaker, subcontractor*

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

5. UNDERGROUND BUCKET LOADER OVERTURNS

On July 18, 2002, at the Waste Isolation Pilot Plant (WIPP), an operator was preparing to dump a load of salt from a load-haul-dump (LHD) bucket loader when the loader overturned on its right side onto a salt pile. No one was injured, and no damage occurred to the loader. (ORPS Report ALO--WWID-WIPP-2002-0002)

The operator was assigned the task of moving loose excavated salt from mining operations from the north end of the work area to the south end to create additional storage room. Salt had been piled to the left and right sides of the 27-foot-wide drift, and the bases of the two piles met in the middle.

The operator filled the bucket with salt and drove the LHD between the two piles to reach the dumping ar ea. The LHD was positioned on the two piles at an angle, with the left wheels sitting higher than the right wheels. As he raised the bucket to dump the load, the center of gravity shifted, and the LHD turned onto its right side and landed at a 45-degree angle on the salt pile at the right side of the drift (Figure 5-1).

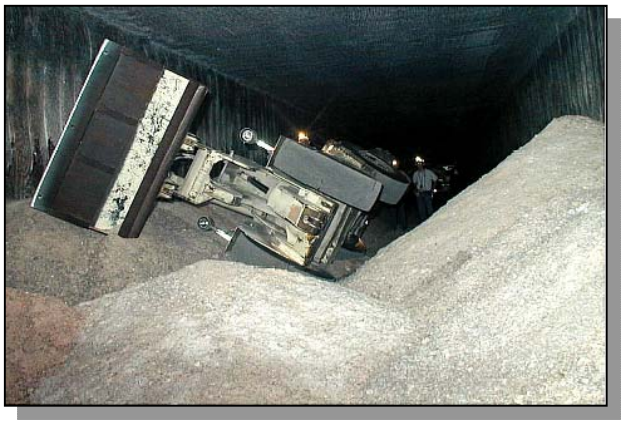

Figure 5-1. The overturned LHD

The direct cause of this event was a personnel error. The operator, qualified to operate an LHD since August 2001, drove onto uneven, loose salt and raised the bucket, shifting the center of gravity. Although the operator has years of experience working in industrial and mining environments, he had not operated this type of equipment in a confined, unstable environment.

A contributing cause is inadequate training content. The LHD Equipment Operator Program Guide that accompanies the qualification card includes a section entitled *Equipment Safety*. The section fails to address operating an LHD on an unstable surface or machine stability when a loaded bucket is elevated. The manufacturer's operator manual states only that, while moving, operators should "Keep the bucket as low as possible."

In addition, the supervisor failed to identify the potentially hazardous environment during the pre-shift work review, and so did not review the scope of work or provide detailed work instructions to the operator.

Facility management has recommended a number of corrective actions. These include conducting a safety stand-down with all personnel working underground and other personnel using heavy equipment. The qualification guide for LHD and other underground equipment will be reviewed and revised to discuss all potential hazards that could arise during operation. This event will be reviewed with managers and supervisors overseeing underground operations to reinforce the need to review the work site before operations begin so that all potential hazards can be identified, and to communicate those hazards to the workers. In addition, the site plans to develop and maintain hazard analyses for each piece of equipment to assist operators in knowing beforehand the types of hazards they could encounter.

On December 4, 2000 at the Nevada Test Site, an LHD tipped over on its side when its left rear tire moved too close to the edge of a hole and slid into it. The operator attempted to steer it out of the hole by turning the front end to the left. The center of gravity shifted enough to allow the LHD to slowly tip over onto its left side. The operator received an abrasion on his arm. (ORPS Report NVOO--LANV-U1A-2000-0005) In addition, a search of the Occurrence Reporting and Processing System identified many occurrences in which heavy equipment vehicles overturned or tipped because the operator was attempting to maneuver on an uneven surface.

These events illustrate the importance of evaluating a work site for all potential hazards before work begins. Pre-job briefings should communicate those hazards and give specific guidance on how to perform the work safely. In addition, when planning for tasks involving the use of heavy equipment, managers should ensure that operators are experienced in handling the equipment under the prevailing conditions.

KEYWORDS: *Bucket loader, mining, LHD, near miss*

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