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

OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2002-11
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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 2002-11

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EVENTS

1. STOWING HOOK FAILURE CAUSES NEAR MISS

On January 22, 2002 at the Nevada Test Site, a contractor worker was securing a cable on a rolloff box truck (Figure 1) when the stowing (retaining) hook failed and the cable recoiled past the worker, striking the front windshield of the truck cab. The recoil from the cable cracked the top left corner of the windshield. The worker was not hit, but was standing just below the arc of the recoiling cable. (ORPS Report NVOO--BN-NTS-2002-0003; final report filed May 2, 2002)

Figure 1. Truck unloading a rolloff box

The worker, a Fleet and Equipment teamster working for the Solid Waste Operations Department, picked up a full box and took it to an onsite landfill. After dropping the box at the landfill, he hooked the cable eye to one of two stowing hooks. He then used the hydraulic system to apply tension to the cable to remove any slack. He watched the cable and the back of the vehicle, where the cable eye was hooked, to make sure that the cable did not drop off the hook. Just as the cable started to straighten out and he was about to release the controls, he heard a pop. The hook failed and fell straight to the ground while the cable recoiled behind him in an arc, hitting and cracking the windshield (Figure 2).

The worker picked up the cable from the ground and hooked it to the other stowing hook on the back of the truck. After attaching the cable eye to the other side of the truck, he took out the slack using the hydraulic system just as before, this time without incident.

Figure 2. The cracked windshield

There are two stowing hooks on this truck; one on each side. The hook that failed was added to the truck by the contractor in September 2001 as a retaining or stowing hook for the cable end, not a load-bearing hook. The hook on the driver's side came with the truck as original equipment, and when used, requires the cable to be routed around the load-bearing roller on the back of the truck. The configuration of the additional stowing hook allows the cable to bypass the roller, placing the load on the hook.

The direct and root causes of this occurrence were defective design because consideration was not given to relocating the stowing hook, which allowed it to become load-bearing, although it was neither intended nor designed to bear tension loads.

The stowing hook showed a stress intensifier crack that caused it to fail. The contractor Fleet and Equipment organization has adopted a policy that requires equipment engineering to research proposed modifications and make recommendations to management as to the feasibility of the modifications. Modifications to the design of any equipment, system, or sub-system will not be authorized until equipment engineering has reviewed the proposal and issued detailed instructions.

This incident illustrates the hazards associated with modifying manufacturer-designed equipment without performing an appropriate engineering analysis. The event also illustrates the need to administratively control equipment modifications and to involve the original equipment manufacturer in the design review process to ensure safe equipment operation.

KEYWORDS: *Break, cable, hook, inadequate design, equipment modification*

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

2. TRITIUM CONTAMINATION FROM UNKNOWN SOURCE DURING D&D

On March 4, 2002, in the Tritium Systems Test Assembly at the Los Alamos National Laboratory, reportable quantities of tritium (beta) contamination were discovered in several uncontrolled offices, a hallway, and on the shoes of four personnel. The office with the highest level of contamination had 200,000 disintegrations per minute (dpm)/100 cm^2. The hallway had tritium contamination at 60,000 dpm/100 cm^2. The shoes of one individual were contaminated to 200,000 dpm/100 cm^2. Contamination occurred when workers were dismantling two gloveboxes as part of decontamination and decommissioning (D&D) activities. The results of both routine and immediate bioassays did not indicate a measurable internal dose to any workers. (ORPS Report ALO-LA-LANL-TRITFACILS-2002-0002; final report filed May 13, 2002)

Pre-work surveys indicated that the two gloveboxes being dismantled would contain minimal tritium contamination. The radiological work permit did not require personal protective equipment or physical controls to contain tritium contamination, other than the lab coat and gloves that are used in routine operations. The D&D work involved removal of equipment and windows from gloveboxes and opening of process piping. Radiation surveys of the work area performed at the end of each workday indicated no unusual levels of tritium contamination.

On the day of the occurrence, two workers had walked through the area preparing for future activities. Unknowingly, their shoes became contaminated while in the area, and they spread contamination to the offices and the hallway in the building. During normal daily swipes that morning, a radiological control technician (RCT) detected tritium contamination levels of 80,000 dpm/100 cm^2 at the entry points for the controlled area. The RCT then took additional smear surveys of the radiological buffer areas and found contamination levels up to 12 million dpm/100 cm^2. This contamination was found in an area where the process piping in a glovebox was being removed. The controlled area was then closed, posted, and locked. Additional smear surveys indicated tritium contamination in the office areas of the building and on the shoes of the workers. A surface radioactive value of greater than 10,000 dpm/100 cm^2 for tritium is defined as contaminated in Appendix D to 10 CFR 835, *Occupational Radiation Protection*. All areas where tritium contamination was discovered were posted with contamination levels and entry requirements. Contaminated shoes were either bagged or decontaminated.

The contractor will require future radiological work permits that involve glovebox work or other work with a significant potential for spreading contamination to incorporate enhanced practices and controls. These controls could include removable shoe covers, floor coverings as appropriate and roped-off areas. Post-job surveys will be conducted before returning the area to a radiological buffer area status. The contractor recognizes that a change in the mode of operation (i.e., from operational to D&D) requires enhanced radiation control measures.

This event illustrates that sources of tritium contamination during D&D activities are difficult to identify during pre-job surveys, and therefore precautions should be taken to anticipate that the work area will become contaminated. The source of contamination in this occurrence was never determined. A similar event was described in OE Summary 2001-08, in which an unexpected source of tritium from cut process piping during D&D operations at Mound contaminated an area and a worker who was not wearing personal protective equipment. DOE-HDBK-1129-99, *Tritium Handling and Safe Storage,* provides additional guidance for D&D activities involving tritium, and can be found at http://tis.eh.doe.gov/techstds/standard/hdbk1129/hdbk1129.pdf.

KEYWORDS: *Tritium, D&D, radiological work*

ISM CORE FUNCTION: *Develop and Implement Hazard Controls*

3. COMBUSTIBLE LIQUIDS NOT PROPERLY STORED

On March 5, 2002, at the Rocky Flats Environmental Technology Site, facility personnel found approximately 14 containers of combustible liquids that were not stored in flammable liquid storage cabinets as required. Spark-, heat-, and flame-producing activities were curtailed in affected areas until the combustibles were removed from the facility. Facility management identified this occurrence as a programmatic deficiency because the applicable program requirements for controlling flammable/combustible liquids were not met. (ORPS Report RFO--KHLL-371OPS-2002-0014)

Facility personnel began the process of identifying improperly stored combustibles after a DOE facility representative found a 10-gallon drum of flammable liquids stored next to radioactive waste during his walkthrough on February 28, 2002. On March 11, 2002, Nuclear Safety Operations personnel concluded that the storage of drums containing combustible liquids did not comply with the administrative control requirements of the facility Technical Safety Requirements, which require combustible/flammable liquids to be stored in approved containers that are kept in flammable liquid storage cabinets. Contrary to this requirement, several containers including 55-gallon drums were discovered to be stored in other storage drums including transuranic and residue waste drums. Polyethylene bottles and cans of oil were stored outside flammable liquid storage cabinets in a manner that was not compliant with the requirements of the site Fire Protection Program Manual.

The analyses of the fire scenarios credit the control of combustible materials with limiting the size of potential fires and location of fires relative to stored radiological material. The failure to fully implement the controls degraded barriers designed to prevent or mitigate an accident involving combustible materials. On March 14, facility management upgraded the occurrence to Unusual because of the specific population of combustible liquids outside of flammable liquid storage cabinets. One 55-gallon drum containing three 4-liter bottles of unused oil was stored in the Central Storage Vault. A positive unreviewed safety question was declared as a result of this condition. All identified combustibles were removed from the facility. Operations in the affected areas have been suspended, and a recovery plan is under development. A fire protection engineer will approve any collection or storage of combustible materials.

Figure 1. Combustible/flammable liquid storage cabinets

Flammable and combustible liquids are defined as such based on their flashpoint, which is the minimum temperature at which a liquid gives off a vapor to form an ignitable mixture with air. Flammable liquids have a flashpoint below 100° F (37.8° C), and combustible liquids have a flashpoint equal to or greater than 100° F. Figure 1 illustrates typical combustible/flammable liquid storage cabinets.

The following standards and regulations provide requirements on fire protection and safe storage of flammable and combustible liquids.

- National Fire Protection Association (NFPA) Code 30, *Flammable and Combustible Liquids*, section 5-4, "Liquid Handling, Transfer, and Use," provides information on ignition sources, storage requirements, and spillage.

- 29 CFR 1910, *Occupational Safety and Health Administration,* subpart L, "Fire Protection," and 29 CFR 1926, *Safety and Health Regulations for Construction*, subpart F, "Fire Protection and Prevention," provide statutory requirements on fire safety that apply to DOE programs and facilities.

- 29 CFR 1910.106, *Flammable and Combustible Liquids*, provides requirements for storage of these types of hazardous materials.

- 29 CFR 1926.152, *Flammable and Combustible Liquids*, provides requirements for container storage in cabinets, inside rooms, and in warehouses; including spill containment, drainage, and design criteria for fire protection systems.

Although the contractor has not completed the causal analysis and formal lessons learned, this event underscores the importance of safely storing flammable and combustible materials in approved locations and within proper confinement. Confinement of flammable and combustible liquids is important because any liquid that is released from a container could spread fire to other areas if it ignites, or the vapors from these liquids could spread and reach an ignition source. This event also highlights the importance of ensuring that combustible loading limits are not violated and that flammable materials are properly stored and kept separate from radioactive materials or material at risk.

KEYWORDS: *Combustible, flammable, liquid, storage, fire protection*

ISM CORE FUNCTION: *Perform Work within Controls*

4. POOR MAINTENANCE OF CRANE HEADACHE BALL CAUSES NEAR MISS

On March 5, 2002, at the Oak Ridge National Laboratory Spallation Neutron Source (SNS) construction site, a crane was removing a wooden form from a concrete wall panel when the crane's lifting (headache) ball separated from the load line. The 8,800-pound form was raised only about 3 inches when failure occurred and dropped safely back onto the wall. However, the 500-pound headache ball fell 20 feet, a 1,250-pound spreader bar fell several feet, and the load line whipped backwards. In accordance with SNS hoisting procedures, no one was under the load as it was lifted. There were no injuries or damage to other equipment; however, the consequences from the dropped crane parts and load could have been greater. The contractor reported this as a near-miss occurrence. (ORPS Report ORO--ORNL-X10SNS-2002-0002)

Crane operators use hooks at the bottom of headache balls to grab loads that they raise and lower with lifting cables (load lines) attached to the top of the balls. The headache ball in this occurrence was a Miller Model XII of two-piece construction. It had internal bearings designed to allow the ball and the load to swivel relative to the load line. A spreader bar attached the wooden form to the ball.

Investigators determined that internal bearings seized because of lack of lubrication, which prevented the ball and the load from swiveling. This apparently created significant rotational torque on the ball's upper threaded connection that attached to the load line. Despite a setscrew, the threads turned and disengaged, causing the ball and the load to fall. Figures 1 and 2 show the ball and disconnected threads after the incident.

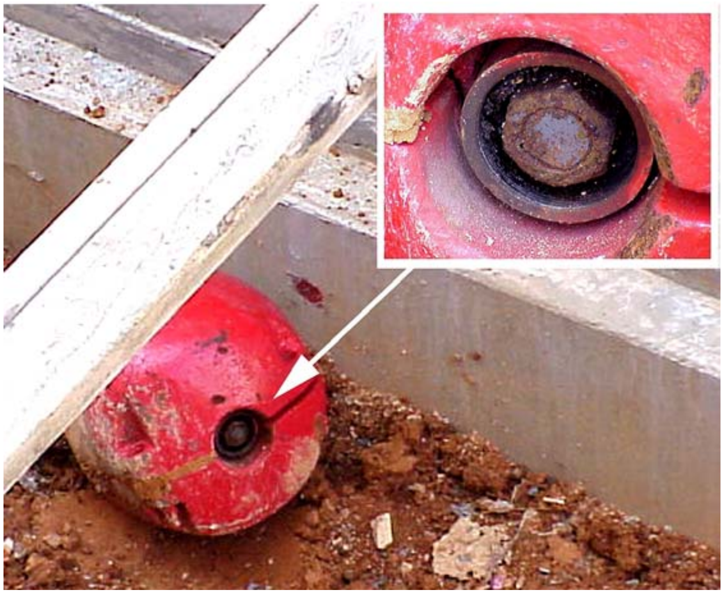

Figure 1. Fallen headache ball and connection threads (insert)

The crane supplier's investigation report blamed the poor design of the headache ball for the failure, noting that there are no external grease fittings for the bearings and that the ball had to be completely disassembled for lubrication. However, the manufacturer of the headache ball stressed that despite this maintenance inconvenience, the ball should have been inspected and lubricated routinely – varying between a daily and a two-week basis, depending on use. The crane supplier and crane operators were not aware of those maintenance requirements. The manufacturer and the SNS contractor concluded that the real cause of the failure was inadequate inspection and maintenance of the ball, not its design. The contractor implemented the following corrective actions.

- A third-party crane inspection firm re-certified all SNS cranes provided by the crane supplier.
- A third-party crane inspection firm assessed the crane supplier's certification process.
- The crane supplier, site construction manager, and the construction subcontractor personnel were re-trained to current crane manufacturer and industry requirements.
- The construction manager will complete a self-assessment of the crane inspection and lubrication process and will evaluate all lifting equipment certification processes.

This near-miss occurrence demonstrates that hoisting equipment should undergo routine inspection and maintenance. Site personnel should not rely solely on the equipment supplier's certification and inspection processes.

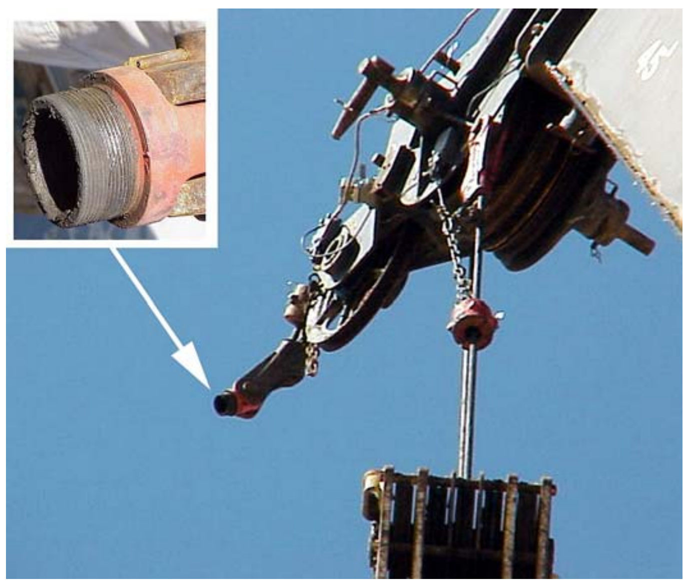

Figure 2. Threaded connecting pin at end of load line

KEYWORDS: *Hoisting and rigging, headache ball, near miss*

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

5. HUMAN ERROR RESULTS IN INADVERTENT LIQUID TRANSFER

On April 18, 2002, at the Savannah River Site, the facility manager reported an unintended siphoning of more than 500 gallons of process liquid from one tank to another as a result of two mispositioned valves. A control room operator misread a transfer procedure and directed field personnel to position the valves incorrectly. The control room operator's actions represented a single-point human error. There was no release of liquid to the environment, and no injuries to personnel resulted from the occurrence. (ORPS Report SR--WSRC-HTANKW-2002-0009)

The first of three planned liquid transfers from the Defense Waste Processing Facility to the Tank Farm was initiated in accordance with an approved procedure. Upon completion of the first transfer, operators noticed an unexpected increase in a tank level at the Tank Farm, which indicated that a siphoning event was likely occurring. Operators took action in accordance with approved procedures to terminate the siphoning event and to place the facility in a safe configuration.

Because of the difficulty in reading procedures at the work location while wearing personal protective equipment, as well as attempting to minimize the quantity of radioactive waste generated by work crews, the contractor had instituted a "reader-worker" method for directing work activities at selected locations. The work crew receives instructions and step-by-step procedure implementation directions by radio from the control room. The work crew does not have a copy of the procedure; instead, the instructions are given by a control room operator who is reading from the approved procedure. A worker at the work location repeats back the instruction and then performs the assigned tasks. In this instance the control room operator misread the procedure and instructed the workers to open instead of close a valve and to close instead of open a second valve. The workers at the job location followed the instructions verbatim, as if they were reading the procedure themselves.

In another recent event at the Savannah River Site, a control room operator incorrectly directed a work crew to execute a conditional step in a backflush procedure that resulted in waste being siphoned up a supply line to a transfer jet, creating a radiation condition that caused area radiation monitors to alarm. A less-than-adequate pre-job briefing was determined to be a causal factor. (ORPS Report SR--WSRC-HTANKW-2002-0002)

These events illustrate that a new process (i.e., the reader-worker method) implemented to improve upon traditional procedural controls or checkpoints can be vulnerable to errors, even if the new process improves on a previous version. In both of these events, the control room operator represented a single-point vulnerability. The fact that field personnel follow these instructions verbatim could result in their misunderstanding the full scope of their activities, making them less likely to question instructions and relay potential problems to the control room. The contractor has found that pre-job briefings for reader-worker activities are less rigorous than those requiring field personnel to perform work by following written procedures directly. Additionally, the control room operator may be tuned in to hearing what he expects to hear during the repeat-back process from field personnel, thereby making it difficult to detect his own or the work crew's error. The contractor is performing a detailed human performance analysis of the reader-worker method to discover ways to improve the process.

KEYWORDS: *Human Performance, work processes, radiological work, reader-worker*

ISM CORE FUNCTION: *Develop and Implement Hazard Controls*