OPERATING EXPERIENCE SUMMARY

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OE Summary 2003-17

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The Office of Environment, Safety and Health (EH), Office of Analytical Studies, 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 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, 301-903-8008, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction.

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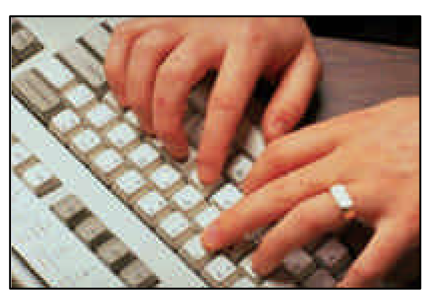

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EVENTS

1. UNDERRATED HOIST USED TO OPERATE HOT CELL DOOR

On March 13, 2003, at Oak Ridge National Laboratory (ORNL), a facility safety officer discovered that a crane hoist with a ¾-ton load capacity was being used to lift and lower a 1-ton hot-cell door. The hoist was the only mechanism holding the door open, and the door did not have mechanical blocks to prevent it from falling on personnel or equipment. Construction drawings specified a 1-ton load capacity for the hoist, but the wrong hoist had been installed. (ORPS Report ORO--ORNL-X10NUCLEAR-2003-0003; final report filed July 16, 2003)

During building construction in 1966, the ¾-ton hoist was mistakenly substituted for the specified 1-ton hoist. The hoist is not in an open area where it would be readily noticed by facility personnel, so no one discovered the error until the safety officer began an investigation to determine whether the hoist was routinely inspected. When a crane inspection crew removed a facility access panel, the safety officer saw the ¾-ton rating stamped on the hoist nameplate. The manufacturer confirmed the capacity of the installed hoist, and the crane crew weighed the door and confirmed it weighed 1 ton.

The safety officer investigated further and found that the hoist apparently had not been inspected in the last 10 years. The cell door had been identified as a "mechanical shield door," with a status of "standby," in an earlier preventive maintenance/inspection program. When the tracking system was updated in 1999, the standby items were dropped from the program. No one realized that neither the door nor the opening/closing mechanism was in the maintenance/inspection program.

The facility manager directed workers to lock out the circuit breaker that supplied power to the hoist to secure the hot cell door in the closed (down) position. Facility management also initiated an Unreviewed Safety Question Determination process. Analysts concluded that a USQ existed because of the increased probability of an accident previously evaluated in the safety basis. The postulated accident involved the door falling on a shipping cask containing radioactive materials. The analysis of the postulated accident was based on the 1-ton hoist capacity specified in the construction drawings.

Investigators identified the direct and root causes of the occurrence as personnel error. The construction drawings specified installation of a 1-ton capacity, Shepard Niles Crane, twin-hook hoist. When workers installed the hoist, they substituted the same manufacturer's ¾-ton capacity, twin-hook hoist, even though the rating was clearly visible on the nameplate. Another personnel error (inattention to detail) was a contributing cause of this incident. The cell door had been assigned "standby" status in the earlier tracking system, so engineers considered it to be a process component and did not transfer it to the new tracking system.

Corrective actions resulting from this incident included the following.

- Fabricate and install temporary bracing to hold the hot cell door open to allow shipping casks to pass through the door opening safely.
- Upgrade or replace the existing hoist to meet specifications and include a positive locking mechanism to secure the door open or closed.
- Add the hot cell door to the facility preventive maintenance/inspection program and perform an initial inspection when modifications have been completed.
- Conduct a review of facility/process equipment to ensure that all appropriate equipment is included in the appropriate preventive maintenance/inspection programs and the required activities are being performed.
- Prepare and distribute a lessons-learned document on this event emphasizing the importance of operational awareness and attention to detail.

A search of the ORPS database for similar events produced one event involving an over-loaded hoist and one involving a dropped hoist-operated door. On May 6, 2002, at the Rocky Flats Environmental Technology Site, a ½-ton hoist was used to lift a 55-gallon waste drum loaded with metal parts from a lathe being removed from a glovebox. After a successful lift, it was determined that the drum and its contents weighed 1,083 pounds. No injuries or equipment damage resulted from this incident. (ORPS Report RFO--KHLL-PUFAB-2002-0035)

On February 26, 2002, at the Idaho National Engineering and Environmental Laboratory Mixed Waste Storage Facility, a 1-ton vertical door operated by a hoist dropped approximately 15 feet when the hoist failed during post-modification testing. An over-extended wire rope separated from the hoist drum. Damage was visible on the lower portion of the dropped door. No injuries resulted from this incident. (ORPS Report ID--BBWI-WROC-2002-0001)

The hoist-installation error (non-conformance with construction specifications) at ORNL is significant because facility personnel relied solely on an under-rated hoist to lift and support a 1-ton door while personnel and casks containing radioactive material passed underneath. The incident was compounded by the fact that the hoist was not in a periodic inspection or preventive maintenance program for at least 10 years. Potential legacy equipment deficiencies need to be considered in configuration management programs by periodically investigating whether installed equipment is appropriate for its intended service. All structures, systems, components, and equipment expected to perform safety functions need to be included in periodic inspection, surveillance, and preventive maintenance programs.

GOOD PRACTICES FOR USING AND MAINTAINING HOISTS

- Ensure that all hoists in the facility are included in periodic inspection and preventive maintenance programs.
- If there is any concern that a load could exceed the hoist capacity, stop work and weigh the load.
- Track hoist qualification requirements to ensure that hoists are re-inspected before their qualification inspection intervals expire.
- Ensure that the design parameters for installed hoisting and rigging equipment are appropriate for the intended service conditions.
- Match the loads to be lifted with the appropriate facility hoists.
- Ensure that facility operations personnel involved in hoisting and rigging understand the ratings, limitations, and proper uses of the facility hoists.
- Ensure that facility operations personnel involved in hoisting and rigging are familiar with the content of DOE-STD-1090-2001, *Hoisting and Rigging.*

KEYWORDS: *hoisting and rigging, hoist rated capacity, over-loaded crane hoist, hot cell door, equipment installation, maintenance program, verification*

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

2. INCORRECTLY WIRED CIRCUITS RESULT IN AN ELECTRICAL SHOCK

On May 27, 2003, at the Oak Ridge Spallation Neutron Source construction project, an electrician connecting leads to a motor-operated valve received a mild shock when he brushed up against a neutral terminal in an electrical cabinet. The circuit the electrician was working on had a properly installed lockout/tagout (LOTO), but a zero energy check was not performed. Other circuits in the cabinet had been wired incorrectly, resulting in a 120-volt potential between the ungrounded neutral terminal and the ground terminal. The electrician was not injured. (ORPS Report ORO--ORNL-X10SNS-2003-0002; final report filed July 28, 2003)

The power supply for the panel (a three-phase, 480/120-240-volt transformer) was located in a building that was still under construction and had not undergone a final inspection and check-out. During an earlier evaluation, engineers concluded that the wires in the transformer should be larger gauge. Electricians rewired the transformer but did not correctly bond the neutral wire to ground, which allowed current to float between phases.

When an investigator tightened the neutral bonding screw after the incident to secure the ground connection, a circuit breaker tripped, indicating another wiring problem. Additional testing revealed that a 120-volt receptacle located inside a communication cabinet had a phase wire terminated on the ground terminal and the grounding wire terminated on a phase terminal.

Contractor quality assurance personnel did not discover the wiring errors in either the transformer or the receptacle. Investigators determined that the cabinet containing the incorrectly wired receptacle was not inspected after delivery to the inspection site, and the cabinet was put into service without ensuring that it met specifications.

Investigators determined that both the direct and root causes of this incident were personnel errors (inattention to detail). Electricians made errors when wiring both the transformer and the receptacle in the communication cabinet. Investigators also determined that zero-energy checks, while not required by procedure, were not performed as a "good practice" before connecting the motor-operated valve.

Investigators identified an equipment/material problem (defective component) as a contributing cause of the incident. The defective communication cabinet delivered to the construction project was put into service without an inspection to verify compliance with the purchase specifications. Investigators also identified a procedure problem (defective or inadequate procedure) as a contributing cause for this incident. The contractor's LOTO procedure conformed to OSHA standards and was followed correctly. However, the procedure did not require a zero-energy check on the relevant circuits and components before work began.

Corrective actions in response to this incident included the following.

- Revise the contractor's LOTO work instruction (procedure) to require zero-energy verification before work begins.
- Modify the contractor's acceptance criteria for equipment and components being put into service to ensure that quality assurance evaluations against the purchase specifications are performed.
- Develop an acceptance indicator (e.g., tag, document, or approval stamp) to be placed on equipment and components before they are provided to construction personnel for installation.

A search of the ORPS database revealed several other recent events in the DOE complex where undetected wiring errors resulted in electrical shocks. On May 27, 2003, at the Los Alamos National Laboratory, a machinist received a substantial electrical shock when he simultaneously contacted an energized welding cart and another piece of equipment. Improper wiring of a plug connecting the welding cart to its power supply (reversal of the ground lead and one of the power leads) resulted in 260 volts AC on the body of the welding cart. The machinist experienced numbness in his arm that lasted several days. (ORPS Report ALO-LA-LANL-NUCSAFGRDS-2003-0002)

On January 27, 2002, at the Argonne National Laboratory East, electricians discovered a 110-volt AC potential on a cabinet frame and on a piece of equipment in the cabinet that was plugged into an electrical receptacle that had been incorrectly wired, with the ground lead and one of the power leads reversed. (ORPS Report CH-AA-ANLE-ANLEPFS-2002-0001)

Construction projects are particularly vulnerable to electrical hazards because purchased electrical equipment may be improperly put into service before it has undergone acceptance testing, as was the case in this event. Electricians wiring electrical receptacles and other components need to pay attention to detail to avoid wiring errors that energize the ground terminal and create a hazardous condition. Zero-energy checks need to be performed before starting work as a matter of

GOOD PRACTICES FOR ENHANCED ELECTRICAL SAFETY

- Always perform a zero-energy check on the circuit to be worked, as well as on other nearby circuits and terminals.
- Upon completion of wiring work, check for proper voltages, phasing, and grounding.
- Use lockout/tagout processes 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 independent verification that the lockout/tagout has been performed correctly.
- Ensure that lockout/tagout procedures or work instructions include a zero-energy check to confirm the effectiveness of the lockout/tagout installation.
- Ensure that purchased electrical components and equipment receive acceptance testing before they are put into service.
- Do not work on energized circuits without special approvals and job-specific controls.
- 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 and equipment.

good practice, independent of whether they are specified in a procedure.

KEYWORDS: *lockout/tagout, electrical shock, wiring error, floating current, transformer re-wiring, receptacle wiring error, energized ground terminal*

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

3. DEGRADED BUNGS ON WASTE DRUMS ALLOW WATER INTRUSION AND SPREAD OF CONTAMINATION

On May 30, 2003, at the East Tennessee Technology Park, an operator accidentally spread contamination while moving waste drums. The operator was segregating drums that had rainwater in them from drums that were empty and had tipped the drums to remove the rainwater that had collected on top around the bungs. Degraded plastic bungs on the drums had allowed rainwater to enter the drums and become contaminated. (ORPS Report ORO--BJC-K25WAST-MAN-2003-0006; final report filed July 17, 2003)

Old waste drums (Figure 3-1) at the Toxic Substances Control Act Incinerator were being staged for shipment to a disposal facility. While segregating the drums, the operator noticed a suspicious green material around the bung of one of the drums. Because his work glove had gotten wet while handling the drums, the operator checked it with a survey meter and saw an elevated response. Radiological control personnel were contacted and they performed surveys for contamination. Survey results are shown in Table 3-1.

Figure 3-1. Weathered waste drums for disposal

Table 3-1. Radiological survey results (dpm/100 cm²)

Drum (highest of seven)	707,815 beta-gamma, 6,161 alpha
Pavement around drums	13,255 beta-gamma, 555 alpha
Forklift used to move drums	10,684 beta-gamma, 406 alpha
Operator's glove	162 alpha

All affected drums were covered to prevent further spread of contamination and were moved to a posted contamination area.

The drums originally contained uranyl nitrate or a tributyl phosphate (TBP) uranium mixture, depending on the type of drum. The uranyl nitrate drums are of a newer design that has a blow-molded liner inside the drum with a shoulder/collar that fits up and around the drum liner bung hole. The TBP drums, on the other hand, have a liner that is not affixed to the drum and use a plastic seal to anchor the liner bung hole to the drum top.

Investigators determined the direct cause of this event was the degradation of the plastic seal (Figure 3-2) on the TBP drums, which allowed rainwater accumulating on the top of the drum to flow into the space between the liner and the drum where it became contaminated. The root cause was legacy contamination located between the liner and the drum that occurred years earlier during process operations while removing the contents from the TBP drums. The operator then spread the contaminated rainwater when he tipped the drums to remove the water from the top of the drums. A contributing cause was the storage of the waste drums outdoors where they were exposed to the weather. Corrective actions included the following.

Figure 3-2. Degraded bung on waste drum

- Empty drums with plastic bungs currently stored outdoors that previously contained radioactive material will be covered with suitable material to protect them from the weather or moved into a covered storage area.

- Issued a Lessons Learned that summarizes the incident. (SELLS Identifier: L-2003-OR-BJCETTP-0802)

RECOMMENDATIONS

- Inspect waste drums equipped with plastic bungs for signs of degradation and leakage.
- Take appropriate actions to protect drums with degraded bungs from exposure to the weather (e.g., cover the drums or move them into covered storage areas).
- Consider the possibility that rainwater on top of drums or inside drums could be contaminated.
- If possible, try and minimize the length of time drums are stored or staged outdoors.

Accumulation of water on the top of drums marked as having contained radioactive or hazardous materials should be considered as potentially contaminated until proven otherwise. Drums that have been exposed to the weather may be subject to water intrusion, increasing the potential for spread of contamination and adding to the waste disposal stream. Waste drum handlers need to notify appropriate personnel when drums that are presumed to be empty appear to contain excessive amounts of residual material.

KEYWORDS: *Rainwater, drum, plastic bung, degradation, contamination*

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

4. *LABORATORY TECHNICIAN CUTS INTO PRESSURIZED UF_6 CYLINDER FOUND IN SALVAGE YARD*

On August 12, 2003, Lawrence Livermore National Laboratory (LLNL) issued a lessons-learned report on an event where a laboratory technician cut into a cylinder pressurized with uranium hexafluoride (UF_6), resulting in a release. The cylinder, which was believed to be empty, had been removed from salvage. The technician provided bioassay samples to verify no uptake of uranium had occurred. (SELLS Identifier: LL-2003-LLNL-19; not reported in ORPS)

The technician went to the LLNL salvage yard in search of cylinders for a project. He found two stainless steel sample cylinders that were equipped with integral valves (Figure 4-1). The technician opened and closed the valves and concluded the cylinders were empty when nothing came out. He took the cylinders back to his laboratory to work on them.

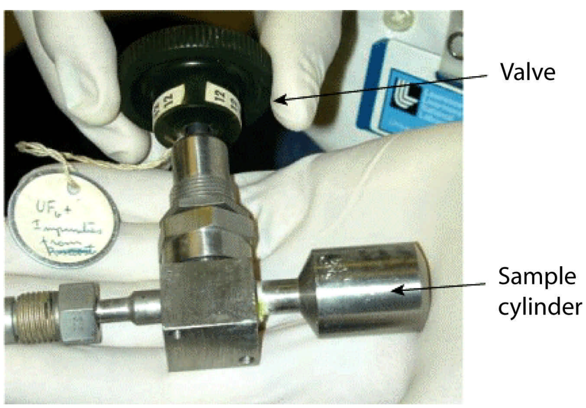

Figure 4-1. Sample cylinder and valve with attached UF_6 tag

The technician locked one of the cylinders in a vise and started cutting the tubing with a hacksaw between the cylinder and the valve. When the wall of the tubing was breached, he saw a wisp of smoke. Upon closer examination, the technician noticed a small round "UF_6" tag (dated 1976) attached to the valve and a yellowish-green substance clogging the end of the tubing. He took the cylinder into an adjacent room and surveyed it with a beta-gamma meter, which detected radioactivity on the open end of the valve. The technician placed the cylinder in a hood and contacted a health and safety technician for assistance. The hacksaw, vise, work area, and the technician's face and hands were surveyed, and no contamination was detected.

The cylinder had been used to take a small sample (less than 10 cc) of UF_6, and may have remained in a lab for years after the sample was taken. The valve may either have been opened or leaked, exposing the UF_6 to air. Water vapor in the air reacted with the UF_6 to produce uranyl fluoride (UO_2F_2) and hydrofluoric acid (HF). The yellowish-green UO_2F_2 clogged the valve orifice, effectively sealing in the remaining UF_6. Thus when the technician opened the valve, no UF_6 escaped. When he breached the tubing, the remaining UF_6 reacted with air to produce the wisp of HF "smoke."

RECOMMENDATIONS

- Ensure that every item placed in a recycle hopper is not hazardous. Individuals sending items to salvage are responsible to ensure items are non-hazardous.
- Do not put trash or non-recyclable items into recycle hoppers.
- Do not assume that items found at salvage are non-hazardous. Examine them for evidence of previous applications. Contact safety personnel or supervision before breaching unknown systems.
- Perform a careful, comprehensive cleanup of all hazardous materials and equipment when shutting down an experimental facility or laboratory. The potential exists for leaving unrecognized hazards during project closeouts.
- Be vigilant when cleaning up unfamiliar areas. Proper planning and oversight by knowledgeable program, facility, and safety personnel is essential.
- Properly mark all items containing hazardous materials to minimize the risk of improper handling in the future.

Similar events have been reported to ORPS over the years. The following two events provide examples of hazards that may exist if disposal procedures are not followed.

- At the Los Alamos National Laboratory, the leader of an environment, safety and health team discovered an 8-foot section of asbestos insulated pipe in a recycle bin. The asbestos was encapsulated and undamaged, but not secondarily wrapped in plastic. Evidence pointed to unauthorized dumping of scrap in the recycle bins. (ORPS Report ALO-LA-LANL-HEMACHPRES-1998-0010)

- At the Stanford Linear Accelerator Center, campus employees discovered a container of corrosive liquid in a paper recycling bin. The container did not leak. (ORPS Report OAK--SU-SLAC-1991-0024)

These events underscore the importance of proper disposal and segregation of recyclable items from non-recyclables. Trash and non-recyclable items can mistakenly be thrown into recycle hoppers and bins. The cylinder in this event could appear to be a valve, and someone may have thrown it into a recycle hopper without realizing that it had the integral gas sample cylinder. Personnel who remove items from salvage for reuse need to be cautious and alert for items that may be hazardous.

KEYWORDS: *Cylinder, pressurized, release, uranium hexafluoride, exposure, potential injury, salvage*

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