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OPERATING EXPERIENCE SUMMARY

Office of Environment, Safety and Health

Summary 2002-06
March 25, 2002

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 2002-06

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EVENTS

1. CONCRETE PLUG FALLS THROUGH CEILING TILE

On March 7, 2002, at the Idaho National Engineering and Environmental Laboratory, construction workers were core drilling through the concrete floor of a third-floor office at the Specific Manufacturing Capability (SMC) facility when the concrete plug dropped through the hole and fell through a false ceiling into a second-floor office area. The plug landed about 8 feet from an office worker. There were no personnel injuries, and damage was limited to a single ceiling tile. (ORPS Report ID--BBWI-SMC-2002-0004)

Construction workers were drilling a 2¾-inch-diameter hole through the concrete floor in preparation for installing a communication circuit. The floor area being cut was above the false ceiling and slightly north of a wall between two office areas when the concrete plug dropped. The concrete plug was 2¾ inches in diameter by 3 inches in length and weighed about 1½ pounds (Figure 1). The concrete plug broke through the ceiling tile and came to rest on a filing cabinet (Figure 2).

Figure 1. The 2¾ x 3-inch concrete plug

The foreman for the project conducted a walkdown of the area before starting the drilling activity. He also walked down the project with a construction safety engineer and then with the building supervisor. However, none of these walkdowns identified the possibility that the plug could break through the false ceiling and fall into an occupied office. The job safety analysis included core drilling as a work activity, but it did not identify dropping the cut plug as one of the possible hazards. A construction worker stated that he was positioned below the cut with a bucket to capture water and debris from the cutting tool as well as the plug if it fell. However, the plug bounced off the rim of the bucket and fell through the ceiling tile. The office area south of the wall around the base of the ladder was posted as a construction area, but the office area north of the wall where the plug actually came to rest was not posted in any manner for the work in progress.

Figure 2. Damaged ceiling tile and filing cabinet where plug came to rest

SMC management, construction management, and DOE-ID were informed of the incident, and a formal critique of the event was held later the same day. A formal stop-work was issued that will remain in effect until the work order and job safety analysis can be rewritten and verified adequate for continuing the work.

A similar event occurred at the Advanced Test Reactor, when a large concrete plug fell into a room. On March 22, 1995, while core drilling through what was believed to be a 6-foot-thick concrete floor, the plug fell into a basement that had not been posted as an exclusion area. The drilling was to stop at a depth of 5½ feet before posting the area, which was 3 inches more conservative than industry practice. However, because of drawing inaccuracies, the floor was actually 5½ feet thick. There were no injuries or equipment damage as a result of this event, but there were no posted barriers to have prevented serious injury. The lesson learned from this event was that relying on the industry practice of drilling to within 3 inches of breakthrough before establishing a "construction

working overhead" restricted access area was not a conservative safety practice. (OES 2000-09 and OEWS 95-13; ORPS Report ID--LITC-ATR-1995-0011)

This event illustrates the importance of identifying all possible hazards associated with a job. The safety analysis for the core-drilling activity did not address the potential hazard from a falling object, such as the concrete plug. Effective methods for protecting workers from falling objects include installing physical barriers, using anchors or bracing, and maintaining distance by establishing an exclusion area. When work is being performed overhead, it is important that the exclusion area be posted as to the hazard and that the area is sufficiently adequate to ensure the safety of personnel who are not directly involved in the work activity.

KEYWORDS: *Concrete plug, drilling, falling object*

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

2. LIDS PROPELLED FROM PRESSURIZED WASTE DRUMS

On January 2, 2002, a worker was opening a 30-gallon waste drum in Building 9720-59 at the Oak Ridge Y-12 Site when the drum lid was suddenly propelled 4 to 5 feet into the air, missing the worker. On January 3, another worker was moving a 55-gallon waste drum in Building K-1065 at the East Tennessee Technology Park (ETTP) when the lid and retaining ring separated from the drum and struck him. Medical personnel examined the second worker and found no injury. Because of these two drum-related incidents, Bechtel Jacobs Company issued a safety pause directive on drum handling practices, initiated an investigation, and reported the two incidents together as a near-miss occurrence. The DOE Oak Ridge Operations Office also ordered a readiness evaluation of open-top drum handling operations by this contractor. (ORPS Report ORO--BJC-K25WASTMAN-2002-0001)

The drum in the Y-12 incident was 1 of about 30 low-level radioactive waste containers that the worker opened. He had safely removed the retaining rings and lids for the other containers before opening the 30-gallon drum. As he loosened the retaining ring, the pressure in the drum lid propelled the drum lid upwards and expelled three gloves from the drum. None of the containers had shown signs of over-pressurization, and each had been checked twice by "two-hand flex tests." In such a test, a worker presses both his hands on a drum lid and if it flexes downwards, he judges the drum's pressure to be safe. A later investigation would note that these tests are subjective. The worker who performed the tests was larger and stronger than some, and thus could flex the lids on drums with strong pressures when smaller workers might not have been able to. The undetected over-pressurization in the drum caused the lid to be propelled upward when the retaining ring was loosened.

Figure 1. Waste drum at ETTP

A 55-gallon waste drum (see Figure 1) was involved in the ETTP incident. A worker was moving the drum by tipping and rolling it, and was not trying to open it. While the worker was handling the drum by the retaining ring, the lid released and struck him in the chest and helmeted-respirator. A subsequent examination of the lid and ring found that both were dented on their edges. However, the examination could not determine whether the lid and ring were deformed before the incident, or if the top of the drum striking the floor caused the denting. If the former is true, then the ring could have been improperly seated, and the force applied by the worker grappling the ring could have pulled it off the drum. Whether the drum was over-pressurized and what contribution that would have made are not fully known.

The contractor's immediate actions were to suspend drum-opening operations pending investigation of the incidents. A DOE Lessons Learned Red Alert*, Uncontrolled Releases of Drum Lids*, R-2002-OR-BJCETTP-0201-3, was issued on February 4, 2002 to address these events. The following lessons learned statements are from the alert.

- Open-top drum lids and retaining rings need to be inspected for proper placement prior to moving drums.

- The use of hand-pressure flex tests to determine if a drum is pressurized may not be effective.

The contractor has since abandoned the hand-flex test for detecting pressurization, and now requires installation of a drum web (shown in Figure 2) before opening any open-top waste drums with the potential for pressurization. The web fits over the lid and top of the drum, and its ratchet band is tightened around the middle of the drum. This safely constrains the lid and retaining ring from being propelled by potential pressurization while the drum is being opened. Other lid-restraining devices have been successfully used at other DOE sites (for example, see Figure 2-1 in Operating Experience Weekly Summary 98-21).

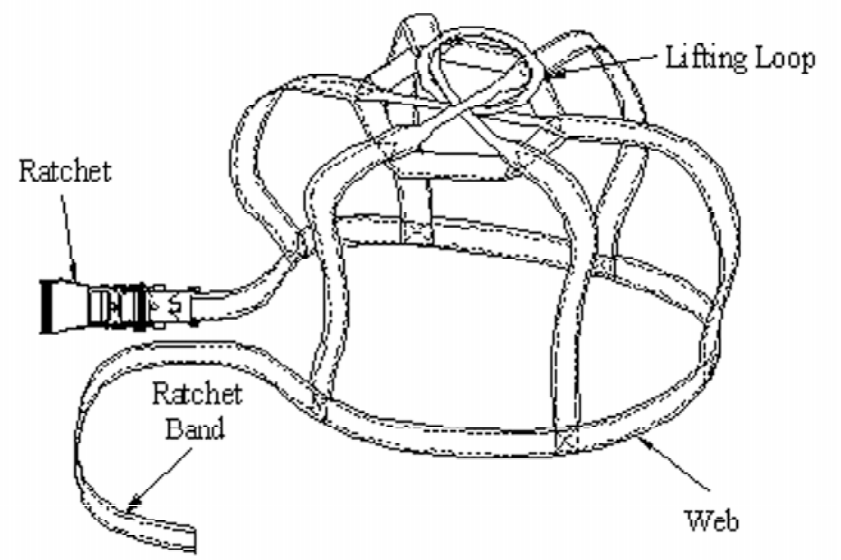

Figure 2. A drum web

Lid ejections from drum pressurization have occurred frequently across the DOE complex in the past (see Operating Experience Weekly Summaries 95-50, 96-42, 96-48, 98-21, and 99-34). Although such occurrences have decreased in recent years, the two recent incidents at Oak Ridge should remind those performing drum opening and handling operations that the hazard still persists.

KEYWORDS: *Open-top drum, drum lid, near miss, pressurized*

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

3. WORKERS NAUSEATED BY VAPORS FROM CHEMICAL SPILL

On January 2, 2002, at the Rocky Flats Environmental Technology Site, two workers became nauseated when exposed to 1,1,1-trichloroethane that had spilled out of a filter housing. The workers were surveying and bagging chemicals in preparation for transfer. Both workers were taken to an off-site medical facility and were released the same day without work restrictions. On the following day, the occupational medical clinic placed one worker on restricted duty. The chemical 1,1,1-trichloroethane (methylchloroform) is most commonly used as a solvent, which evaporates quickly into a vapor. If inhaled in high concentrations it can cause dizziness, lightheadedness, and loss of coordination, although the

symptoms generally subside quickly after fresh air is introduced. (ORPS Report RFO--KHLL-NONPUOPS2-2002-0001; final report filed February 14, 2002)

Approximately two months before this occurrence, workers were handling and packaging low-level waste when they discovered a filter housing containing some liquid with a mildew smell. The filter was to be removed and bagged for further disposal. The workers notified environmental compliance specialists, who indicated that the liquid would have to be sampled in the future and characterized. However, this action was not accomplished before this incident.

The workers, an industrial hygiene (IH) technician, and radiological control technicians (RCTs) began removing non low-level waste. One worker cut away plastic bags from the filter housing and laid it on its side. He noticed it was leaking from taped quick-disconnect ends, and righted it. After dry-wiping the unit, he transferred it to another worker with instructions to keep it upright because it contained liquids. At that point, one worker smelled a solvent odor and another worker smelled an odor that he associated with carbon tetrachloride or trichloroethane. The IH technician set the bag on the worktable and performed a planned beryllium smear sampling of the housing, which was not upright in the bag. Because the odor was very strong, one worker insisted that the technician stop work. Shortly thereafter, the IH technician felt lightheaded and asked one worker how he felt, and the worker replied that he also felt lightheaded. When the IH technician went down on his knees, the worker contacted the foreman, who directed the IH technician to exit the area. After exiting the area, the worker left the building to get some fresh air. He vomited, and returned inside to the men's bathroom and continued vomiting. The foreman and a certified industrial hygienist double-bagged the filter housing and placed it into a hood in another room.

When the workers noticed the unknown free liquids in the filter unit, they failed to stop work, notify supervision, and exit the area. There was sufficient information by knowledgeable personnel at this point to stop the work activity, leave the area, and evaluate the proper steps for proceeding. Because 1,1,1-trichloroethane is heavier than water, the mildew smell may have been from foul water atop the solvent. In this case, a specific hazards analysis should have been prepared.

The direct and root causes of the incident were determined to be deficiency in the work planning, scoping, and control. Work was performed outside the approved work package scope. The only tasks specified in the work package were to move and smear the inventoried waste items for radiological and beryllium contamination. Packaging the waste was not addressed.

Several similar occurrences have been identified in the ORPS database. On April 4, 2001, at the Lawrence Livermore National Laboratory, there was an unanticipated release of rhenium hexafluoride gas from a cylinder, which produced hydrogen fluoride when the gas reacted with moisture in the air. A mechanical engineering technician enlisted the aid of a pipe shop worker in loosening the valve cover of the gas cylinder, although the hazards of removing the valve cover were not addressed in the work package. No one was injured; however, the potential existed for a number of workers to be exposed to hydrogen fluoride gas. (ORPS Report OAK--LLNL-LLNL-2001-0012)

Another occurrence, which was reported in OE Summary 2001-09 (November 5, 2001), occurred at the Rocky Flats Environmental Technology Site, in which a chemist vented 1,3-butadiene gas into the ventilation system of Building 776/777, resulting in a controlled evacuation of the building. Asbestos workers in the building had reported chemical odors and one of them felt nauseous, initiating a call for the Building Emergency Support Team. Following their response, a team member also became nauseated, requiring him and four asbestos workers to be evaluated by Occupational Medicine personnel. The chemist was assigned to clean out a laboratory within the building, but was not authorized to dispose of any gases. (ORPS Report RFO--KHLL-SOLIDWST-2001-0060)

This event illustrates that during property removal activities, personnel need to recognize that residual hazardous materials may still exist in the facility. These materials should be characterized, and appropriate work packages must be developed for their removal. Personnel must also understand that if circumstances are identified that are outside normal operations or if work is not addressed in the

referenced package, they should stop work and then seek assistance instead of acting on assumption. When understanding of how to handle a given situation is uncertain, personnel must ask for assistance.

KEYWORDS: *Chemical, odor, trichloroethane, spill*

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

4. WORK PERFORMED ON ENERGIZED 480-VOLT CIRCUIT

On February 19, 2002, at the Pantex Plant, a construction inspector discovered that a subcontractor had removed and terminated 480-volt lines while they were still energized. The subcontractor was performing demolition work in the Building 12-64 Penthouses that involved removing existing heating, ventilation, and air conditioning (HVAC) control panels that contained 480-volt solenoid valves. When the subcontractor was unable to locate the power cutoff, he performed the work with the wires still energized. There were no injuries to personnel or damage to equipment as a result of this event. (ORPS Report ALO-AO-BWXP-PANTEX-2002-0010)

On December 18, 2001, a work package was issued to the subcontractor for demolition work that involved the removal of existing HVAC control panels containing 480-volt solenoid valves. The work package specified the lockout/tagout procedures to be followed. The subcontractor was unable to locate the source of power to de-energize the 480-volt power supply, and decided instead to perform the work with the wires still energized. After performing the work, the subcontractor removed the wires to the nearest junction box, cut and terminated the wires with tape and termination caps, and abandoned the energized wires.

An immediate stand-down was called, and a subcontractor employee was removed from this job. The subcontractor was issued a verbal directive to complete the removal of the remaining HVAC control panels and other circuits by following the lockout/tagout procedures as specified in the work package and job specifications. In removing these panels, the subcontractor is required to verify that the panels and circuits are de-energized before disconnecting and removing them. In addition, the subcontractor must locate and mark the locations where wires were removed and left energized and abandoned.

Preliminary corrective actions to be taken include the following.

- Issue a lessons learned notice to appropriate management and staff on worker responsibility and on electrical “hot” work and lockout/tagout requests.
- Review the flow-down distribution of the Subcontract Work Permit process.
- Review the flow-down distribution of the Construction Change Authorization document.

A search of the ORPS database found a similar incident involving failure to lockout/tagout 480-volt power. On October 24, 2000, a subcontractor at Savannah River failed to adequately isolate and de-energize a 480-volt system that was being repaired. (ORPS Report SR-WSRC-LTA-2000-0022) The root cause of this incident was a work organization/planning deficiency because the instructions to the subcontractors were inadequate.

At this time, the final ORPS report for the event at Pantex is still pending. However, this event underscores the importance of carefully following the instructions specified in the work package. If circumstances prevent compliance with the instructions and requirements of the work package, such as not being able to locate the source of electrical power, then the work should be stopped pending a resolution of the problems. This event highlights the fact that individual contractors and subcontractors

must also be responsible for cultivating a safe work attitude. Performing work on energized electrical lines carries the potential for serious injury.

KEYWORDS: *Lockout/tagout, 480-volt, energized*

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

5. FIELD REPAIR CAUSES DRILL RIG ACCIDENT WITH INJURY

On August 8, 2001, at the Pantex Plant, a contractor drill rig operator was injured when a discharge swivel fell from its supporting chains and struck him with a glancing blow to the head. He was pushed off a work platform onto a pile of sand approximately one foot below and suffered a broken right wrist and an additional injury on his left wrist. The drill rig operator was preparing to place a new piece of well casing onto the drill stem when the discharge swivel released and fell because of an inadequate field repair to the swivel assembly. Pantex emergency personnel responded to the scene immediately following the incident and assisted the injured drill rig operator. (ORPS Report ALO-AO-BWXP-PANTEX-2001-0082; final report filed January 2, 2002)

The drill rig operator had placed a backout wrench on the tool slot of the drill stem. The drill stem disengaged, and suddenly the discharge swivel, which was located approximately 25 feet above the ground, unexpectedly released from its supporting chains and fell. The drill rig operator suffered injuries to his wrists because of the placement of his hands on the wrench. Pantex Fire Department paramedics performed immediate treatment and transported him to a local hospital. The Plant Shift Superintendent suspended all drilling operations on site and an Accident Investigation team was initiated.

The direct and root causes of this event were determined to be an equipment/material problem (defective or failed part). The equipment was defective because a field repair to correct a crack in the lifting fixture had altered the original manufactured part. This modified configuration allowed the chain to slip from the lifting fixture, which eventually led to the injury. Personnel error (inattention to detail) was identified as a contributing cause because the modification to the lifting fixture did not match the original manufactured configuration.

An additional contributing cause of this event was determined to be an equipment or material problem (defective or failed part). The chains used to lift the discharge swivel showed significant plastic deformation (a condition in which the shape or size of an item is permanently changed due to a sustained stress exceeding the yield strength of the material). It is not clear how the chains became deformed. Damage to the chains was evident, as was the need for replacement chains of sufficient strength to meet the guidelines established by the American Society of Mechanical Engineers (ASME).

Corrective actions included replacing both fixtures with ones that exceeded the manufacturer's original specifications and replacing the chains for lifting the discharge swivel with ones that meet ASME specifications. The manufacturer certified in writing as to the acceptability of the repair. Programmatic corrective actions taken include (1) requiring independent inspectors to review their inspection reports with the project manager to ensure that the project manager is familiar with the design and operation of the rig, (2) requiring the subcontractor to notify the project manager and construction safety personnel when field repairs are made during a project, and (3) requiring a determination to see if the rig needs to be re-inspected or if certification of the specific repair meets the manufacturer's specifications.

This event underscores the importance of ensuring that equipment modifications or repairs meet or exceed the original manufacturer's specifications. In addition, project management and personnel need to be thoroughly familiar with the equipment involved in the job – both before work commences and as it progresses. If modifications or repairs are necessary during the course of the job, the project manager

must determine if there is a potential for a change in the configuration of the equipment that could compromise personnel safety.

***KEYWORDS**: Drill rig, repair, injury, defective part*

***ISM CORE FUNCTION:** Perform Work Within Controls*

6. SUBCONTRACTOR WORK PERFORMED WITHOUT PROPER AUTHORIZATION

On February 19, 2002, at the Test Reactor Area (TRA) of the Idaho National Engineering and Environmental Laboratory, a subcontractor worker removed a section of pipe from an abandoned warm waste drain line and noticed resin beads in the pipe and some water spillage. He stopped work and called for a radiological control technician (RCT). During the course of the resulting investigation, it was discovered that the work had been performed without proper work authorization or the presence of an RCT. Although this event resulted in no personnel or environmental contamination, performing work without required radiological coverage could have spread contamination. (ORPS Report ID--BBWI-TRA-2002-0002)

The worker removed a section of pipe from an abandoned warm waste 4-inch drain line at the Advanced Reactivity Measurements Facility without proper work control documents, under the wrong radiation work permit, and without full-time RCT coverage. The RCT who responded to the scene directed the workers out of the area and performed a hand and foot and partial whole-body survey. He then escorted the workers through a personal contamination monitor, where no contamination was detected.

The RCT dressed appropriately and entered the area where the pipe had been cut, took a large area swipe of the inside of the pipe, and performed a direct survey of the inside of the pipe. All readings measured less than 1,000 disintegrations per minute (dpm). The RCT then performed a direct survey on soil gathered from where the water had spilled, and this survey also read less than 1,000 dpm. The dose rate at the area where the pipe was removed measured 0.8 millirem/hour because of the close proximity to another 4-inch warm waste drain line. The RCT then notified the lead RCT at the Materials Test Reactor and stopped the work in progress. The Projects and Integration Manager directed the subcontractor to place the remaining 4-inch pipe in a safe operating condition. The subcontractor capped the two cut ends of the pipe. The cap on the east end could not be secured properly, and management was notified.

The Project Manager held a fact-finding critique that led to the following actions.

- Management issued a Night Order to operations personnel at the Advanced Test Reactor, informing them of the improperly secured cap on the east end of the 4-inch pipe.
- Radiological control personnel set up a catch basin under the improperly secured cap.
- TRA and Construction management issued stop-work orders.
- TRA and Construction management will conduct a formal lessons learned evaluation and establish a path forward before resuming work.

The probable direct cause of this incident is that the subcontractor failed to obtain proper work authorization before starting work. Contributing causes included the following.

- Multiple radiological work permits existed for various tasks being performed on different sections of the warm waste system. The workers were signed in on one radiological work permit, but it was not the correct one. The workers were unaware that other permits existed.

- Construction management personnel were not present at the pre-job brief for this work. Further, the subcontractor job supervisor had not seen the contract and was unaware of the special conditions it contained that specified the requirements for this task, such as the necessary radiological controls.

This occurrence illustrates the importance of carefully examining work control documents before starting work. Appropriate management personnel should also attend the pre-job briefing to ensure that the appropriate work controls are in place, that the workers have the necessary equipment and resources to perform the work, and that the workers know which radiological work permit is required.

KEYWORDS: *Contamination, pre-job briefing, radiological controls, radiological work permit*

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