OPERATING EXPERIENCE SUMMARY

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Operating Experience Summary 2003-02

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EVENTS

1. APPLICATION OF RISK-BASED DECISION MAKING – REVIEW OF LOCOMOTIVE DERAILMENT EVENT

On July 22, 2002, at the Savannah River Site, a locomotive engine derailed while pushing an empty fuel cask car. The locomotive and the cask car remained upright, and there was no risk of rollover. The engineer shut down the locomotive engine and secured the area. There were no injuries or environmental releases as a result of this incident. However, the cask car could have been carrying radioactive nuclear fuel. In this case, the derailment could have had more serious consequences. (ORPS Report SR--WSRC-SUD-2002-0006; final report filed August 22, 2002)

Investigators found a broken switch point (Figure 1-1). However, they concluded that the direct cause of the derailment was indeterminate because of a combination of conditions they discovered, including a possible misalignment of the switch point, worn train wheels, and a cracked switch-point protector. Investigators attributed the root cause of this event to a less than adequate railroad inspection program. They also determined that the overall age and condition of the site rail system was a contributing cause. The Savannah River Site rail system is approximately 50 years old and continues to wear because a funding shortfall for rail system maintenance has existed for several years.

As a result of the investigation, rail inspectors checked all switch rail points using magnetic particle nondestructive evaluation. They declared 27 of 207 points as suspect and removed them from service. The following corrective actions will be implemented to prevent recurrence of this type of accident.

- Review the effectiveness of inspection programs for railcars and rail turnouts.
- Evaluate the effectiveness of training for personnel who perform rail car inspections and rail turnout inspections.
- Evaluate departmental instructions or procedures for railcar inspections and for rail turnout inspections.
- Evaluate the effectiveness of current rail lubrication preventive maintenance practices.
- DOE Savannah River will review the adequacy of current maintenance funding for the Savannah River Site rail system.

Figure 1-1. Broken Switch Point and Point Protector

The contractor's evaluation of the derailment accident did not identify a lesson learned, even though the evaluation determined that there are weaknesses in the rail system inspection and maintenance program because of funding shortfalls.

The facility infrastructure must be properly maintained to safely support the mission and operation of the facility. Because of the potential consequences of allowing the rail system to deteriorate, facility management needs to more closely follow the systematic risk-based decision-making process prescribed in DOE Guide 450.4, *Integrated Safety Management Guide;* DOE Regulation 10 CFR 830, *Nuclear Safety Management*; and Department of Energy Acquisition Regulation (DEAR) 48 CFR 970.5223-1, *Integration of Environment Safety and Health into Work Planning and Execution*.

These directives and regulations impose requirements on DOE contractors operating nuclear facilities and DOE personnel overseeing DOE contractor operations to control hazards and identify the resources needed to meet safety objectives, including maintenance program requirements.

At facilities in transition (changing missions), it makes good business sense to allow some infrastructure elements to run to failure when there is no adverse impact on environment, safety and health (ES&H). However, when there are adverse implications, such as those that could have resulted if a cask car loaded with nuclear fuel had derailed, facility managers should use their authorization basis documentation to manage and control risk. Risk-based decision making is inherent within this documentation as a systematic process that identifies and analyzes risk so that it can be managed through engineered or administrative controls. This process requires organizing information regarding the probability of one or more unwanted consequences occurring and supplying data in an orderly structure to better inform managers about how to make choices. The safety documentation should be a thorough and comprehensive assessment of risk that enables risk-based decision making.

Maintenance requirements for facility safety features (including infrastructure) are contained in DOE Order 433.1, *Nuclear Facility Maintenance Management Program* and DOE Order 430.1, *Life Cycle Asset Management*. For facilities in transition, all of the DOE safety management requirements can be tailored to meet the current mission and functions of a given facility at a particular stage in the facility life cycle pursuant to DOE Standard 1120-98, *Integration of Environment Safety, and Health Into Facility Disposition Activities*.

Because the railroad tracks are an element of the Savannah River Site infrastructure, a DOE Order 430.1 Condition Assessment Survey should have been performed to identify the deteriorating condition of the railroad tracks. Furthermore, because this was a case of deteriorating infrastructure that could adversely impact ES&H, the funding shortfall or unfunded maintenance activity should have been identified as an emerging ES&H issue in the Savannah River Site annual budget submittal. The railroad tracks should also have been inspected periodically in accordance with DOE Order 433.1 to determine whether degradation or technical obsolescence threatened performance and safety.

This event underscores the importance of maintaining a safe and functional infrastructure. Railway tracks and switches are dynamic systems that are subject to wear and deterioration, particularly one that is 50 years old. Continuous use without a solid inspection and maintenance program will result in track surface wear, gage and alignment problems, and deterioration of ties and switch points. The ultimate consequence of unaddressed rail system problems is a derailment of a locomotive and rail cars that could result in personnel injury, equipment damage, or an uncontrolled release of radioactivity.

Proper application of risk-based decision making and the DOE safety management system becomes increasingly important because of the aging infrastructure across the DOE complex and the challenges imposed by decreasing budgets and changing missions.

KEYWORDS: *Near miss, train, locomotive, derailment, inspection, maintenance, risk-based decision making, infrastructure*

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

2. INATTENTION TO DETAIL RESULTS IN INADEQUATE RESPIRATORY PROTECTION

Two recent occurrences at the Rocky Flats Environmental Technology Site involved personnel working in a beryllium area without adequate respiratory protection. The workers were wearing full-face respirators, but failed to install filter cartridges. Neither of the workers in these events suffered a reportable beryllium exposure. (ORPS Reports RFO--KHLL-NONPUOPS1-2002-0005; final report filed December 2, 2002, and RFO--KHLL-NONPUOPS1-2002-0009; final report filed January 9, 2003)

The first event was discovered on October 15, 2002. A subcontractor worker had been working in a beryllium-regulated area for approximately 2½ hours when a radiological control technician noticed that a worker's full-face respirator did not have filter cartridges installed. The worker had been delayed in a safety meeting that caused him to rush to obtain and clean the respirator without checking to see that it had filters and was working properly, as was his responsibility. Over the 2½-hours that the worker was in the beryllium area unprotected, he came in contact with at least 10 people, including supervisory personnel, and no one noticed the missing filter cartridges. The worker was paired with a co-worker using the buddy system, and the co-worker also failed to notice the missing cartridges. The worker immediately left the area after the radiological control technician informed him of the missing cartridges. An analysis of the smears of his respirator indicated less than detectable levels of beryllium and radiological contamination.

The contractor conducted a safety pause briefing on October 16 covering the buddy system, the radiological control technician's role, safe-to-work checks of respirators, and proper donning procedures for personal protective equipment. The contractor also installed additional mirrors to help workers donning protective equipment, posted a notice near the radiological boundary, and moved the new respirator cartridges closer to the respirator storage bins. Industrial hygienists and radiological control technicians have been mandated to verify that the proper protective equipment is worn before entering a contamination area. After the second event, the contractor directed that workers are not to remove and disassemble respirators before donning them. The respirators will now be cleaned and assembled for use at the respirator laundry and inspection center. Contractor and subcontractor personnel attended a briefing on the importance of verifying that equipment is properly assembled before use.

The second event was reported on November 25, 2002. A subcontractor worker was spotted wearing a respirator without cartridges, even though co-workers asserted that they had seen cartridges in his respirator earlier in the day. Investigators concluded that the worker either neglected to install the cartridges or attached them incorrectly. Lapel and surface samples indicated less than detectable readings for beryllium.

Another recent event involving respiratory protection occurred on January 8, 2003, at the Fernald Environmental Management Project. A low-pressure air supply hose became disconnected from a worker's supplied-air respirator while he was cutting and draining a nitric acid line in an airborne radioactivity area. Although the potential for an exposure to nitrogen dioxide or radioactivity existed, the worker exhibited no sign of exposure and declined medical evaluation. (ORPS Report OH-FN-FFI-FEMP-2003-0001)

Two workers, attended by their foreman and a safety representative, were cutting a nitric acid line to drain the acid into a plastic bucket. As the acid drained into the bucket, the workers heard a hissing noise in the area, and realized that the supplied-air hose had disconnected from the facepiece of one worker's respirator. The foreman quickly connected the supply hose slip-nut to the facepiece connection and restored breathing air to the worker. The safety representative determined that there was no nitrogen dioxide concentration in the room.

An evaluation of the event indicated that the facepiece separated from the speaker diaphragm. Investigators postulated that the worker held the adapter assembly, shown here in Figure 2-1, too close to the speaker diaphragm during assembly, which prevented him from properly connecting the two pieces. Corrective actions are still under development at this time.

These events illustrate the importance of using care when assembling and donning personal pro-

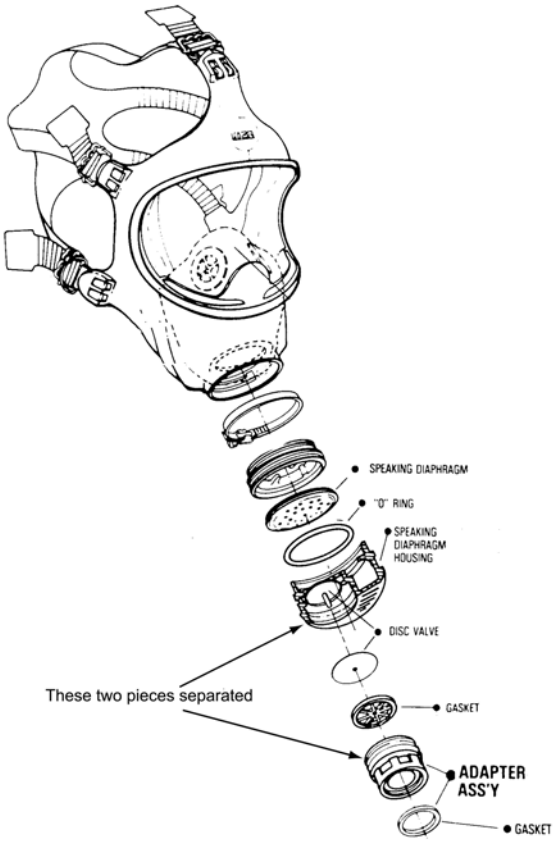

Figure 2-1. Respirator speaking diaphragm and adapter assembly

tective equipment. Inattention can result in workers receiving inadequate protection. Workers need to remain aware of the hazards and protect themselves accordingly. Workers should also remain observant of others in the area and ensure that everyone is properly protected.

KEYWORDS: *Respirator, supplied air, radioactivity area, beryllium, filter cartridge, personal protective equipment*

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

3. NEAR MISS: TRUCK PULLS DOWN ELECTRICAL LINES

On November 12, 2002, at the Oak Ridge Y-12 Site, a concrete truck exiting a construction site snagged four overhead lines, pulling them down and breaking three wooden utility poles. Three of the lines were electrical conductors, with a maximum voltage of 440 volts, but none of them was energized. No injuries resulted from this occurrence, but because of the potential for serious injury it was categorized as a near miss. (ORPS Report ORO--BWXT-Y12CM-2002-0002; final report filed December 30, 2002)

The truck driver had just completed a delivery and was exiting the area through a recently reopened access road when the receiving hopper of the truck snagged the overhead wiring. This truck measured 11 feet, 9 inches at its highest point. Two other concrete trucks had entered and exited the area without incident a few weeks before this occurrence. The highest points on these trucks measured 11 feet, 11 inches and 12 feet, 5 inches. Inspection of the three poles broken during the event revealed no degradation of the pole composition.

Site transportation compliance department practices require surveying an access that is not normally subject to commercial truck traffic and flagging overhead lines to indicate that they may present a hazard. Additionally, there was a severe tornado within 20 miles of the site a few days before this event. This significant weather event should have prompted a re-evaluation of the work site hazards. Investigators estimated that a displacement of as little as 1 inch at the base of the nearest utility pole could generate as much as 1 foot of additional cable sag over the access road.

When the overhead lines were installed in 1993 or 1994, the access road was barricaded and closed to traffic. The road was re-opened in June 2002 to allow workers easier access between parking lots with their private vehicles. An evaluation of the access road at that time identified no concerns about the elevation of the overhead lines.

The 2002 National Electrical Safety Code requires that wires, conductors, and cables over roads, streets, and other areas subject to truck traffic be at least 15.5 feet above the ground. If the access road was intended to be open to restricted traffic only (i.e., vehicles under 8 feet high), cables as low as 9.5 feet above the ground would have been in compliance with the Code.

The work planning process conducted for the construction site included a hazards analysis checklist, site characterization, definition of worker requirements, and appropriate walkdowns. The ingress/egress point for heavy equipment, located

approximately 250 feet from the work site, was not included in the construction planning process.

Investigators determined that the direct cause of this occurrence was a management problem (policy not adequately defined, disseminated, or enforced). The hazard analysis checklist performed for this work addressed the hazards at the worksite, but did not include overhead hazards at the ingress/egress points for heavy equipment.

Investigators determined that a contributing cause of this incident was external phenomena, weather, or ambient conditions. The amount of sag of the overhead lines over the access road before the high winds that occurred a few days before this event is not known, but a small displacement of a utility pole from the near-tornadic winds could have increased the overhead line sag substantially.

Corrective actions identified to help prevent recurrence of events involving snagged overhead lines included the following.

- The automated job hazards analysis system will be revised to consider overhead obstructions at work site ingress/egress points.
- The automated job hazards analysis system will be revised to include a re-check of site hazards following a severe weather event.
- Any changes to the automated job hazards analysis system will be formally disseminated to all appropriate site personnel by the system administrator.
- A formal lessons-learned document for this event will be generated and disseminated to all appropriate site personnel.

A search of the ORPS database identified several other events in recent years where a truck snagged and pulled down overhead electrical or communication lines. Two of these events are described below. On January 9, 2002, at the Fernald Environmental Management Project, an energized overhead 480-volt electrical line was severed when it was snagged by the raised bed of a dump truck that was pulling out of an exit gate. No personnel injuries resulted from this occurrence. (ORPS Report OH-FN-FFI-FEMP-2002-0002)

On August 4, 2000, at the Hanford Site, an empty truck used for hauling waste containers snagged a telephone line while moving with the tilt frame extended. Forces transmitted through the telephone line pulled down a nearby utility pole holding a 50-kilovolt transformer and three 13.8-kilovolt electrical lines, severing the electrical lines as well as the telephone line. No safety class systems were affected by the subsequent power outage, and no injuries resulted from this event. (ORPS Report RL--BHI-REMACT-2000-0007)

These events highlight the need to perform a comprehensive evaluation of the hazards associated with a work task, including those that may appear at a location other than the work site. The scope of the hazards analysis and other work planning tasks should not be limited to the immediate work site. Ingress and egress points not normally used for commercial traffic should be included as appropriate in the hazards analysis, including any overhead hazards. Work sites should be checked for degraded safety conditions following significant weather events such as high winds, heavy rains, or other natural phenomena.

KEYWORDS: *Near Miss, overhead lines, snagged electrical lines, broken utility poles, work planning, natural phenomena hazards*

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

4. TWO CRANES COLLIDE AT CONSTRUCTION SITE

On November 26, 2002, at the Hanford Waste Treatment Plant construction site, a crawler crane operator did not respond to a radioed request from his spotter to stop the crane, and it collided with a counterweight on the mast of a tower crane. No significant equipment damage or personnel injury resulted from this event. (ORPS Report RP--BNRP-RPPWTP-2002-0012)

The crane operator intended to pick up a bundle of steel reinforcing rods located directly beneath the tower crane counterweight, which was approximately 100 feet above the ground. He moved the crane in reverse while a spotter, communicating by radio, observed the distance between the boom

and the counterweight. As the distance decreased between the cranes, the spotter told the operator to stop because he was going to walk to a better vantage point to judge the changing relative positions of the two cranes and was temporarily ceasing communication. The operator apparently did not receive the instruction from the spotter. He continued moving the crane as the spotter turned his back and began walking, and did not stop until the top of the crane boom hit the counterweight.

Following this incident, all work was stopped, and the crawler crane boom was lowered to the ground. All work with other large crawler cranes in the vicinity of any tower crane was also halted pending the results of the initial investigation of the event. Both cranes were thoroughly inspected, and no major damage was apparent.

Crane operators must meet stringent training and certification requirements before being allowed to work on this project. The crawler crane operator involved in this incident had met all the certification requirements and was knowledgeable in the standard practices used in operating cranes.

Investigators determined that both the direct and the root cause of this event were human error on the part of the crane operator. Despite his training and certification, the crane operator violated a fundamental standard practice: when he lost communication with the spotter, he did not stop moving. Standard practice for crane operators is to stop whatever is moving (i.e., the load, the boom, or the crane) when communication with the flagman/spotter is lost.

Investigators and construction managers identified the following compensatory and corrective actions.

- Crane coordinators will be used immediately to support the construction project. (Use of coordinators was originally scheduled to begin when the three project tower cranes became operational.)

- Movement of large crawler cranes in building construction areas has been curtailed. These cranes may be moved only when approved by a crane coordinator.

- All superintendents, general foremen, operators, and flagmen/spotters must familiarize themselves with the tower-crane swing coordinator procedure.
- A training class on standard site hand signals and voice commands will be developed, and all crane operators and flagmen/spotters will be trained.

- A meeting will be held with all site crane operators and flagmen/spotters to discuss this event.

A search of the Occurrence Reporting and Processing System database revealed several other events involving large crawler cranes, including another event at the Hanford Waste Treatment Plant construction project. On July 1, 2002, the main boom of a large crawler crane was damaged while the operator was repositioning the boom. A "popping" sound alerted the operator to a problem, and he immediately stopped the crane and lowered the boom to inspect it. He found damage in the heel section of the main boom and damage above and below the mechanical boom stops. The damage was caused by a defective or failed luffing boom limit switch that did not disengage the hoist before the boom reached the mechanical boom stops. The crane operator was also implicated in the causal sequence for this event because he operated an incorrect control lever, which may have initiated a sequence of events that caused the limit switch to fail.

These events underscore the importance of effective communication and the need to avoid human errors that could lead to hazardous conditions. In the November 2002 event, the crane operator continued moving the crane after he lost communication with his spotter. The workers were fortunate that no major damage or serious injury resulted from the subsequent collision of the crawler crane with the tower crane. In the July 2002 event, the operator apparently manipulated the incorrect control lever, leading to the failure of an electrical component and crane damage. A broader lesson learned from this event is the need to consider more formal communication protocols (e.g., a "repeat-back" requirement) when personnel safety depends on accurate communication between workers.

KEYWORDS: *Crawler crane, tower crane, spotter, communication, crane operator*

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