Operating Experience Summary

U.S. Department of Energy
Office of Health, Safety and Security
OE Summary 2009-05
May 29, 2009

Inside This Issue

Type B Accident Investigation—Electric Cart Passenger Injury

1

On February 25, 2009, at the Waste Isolation Pilot Plant (WIPP), a waste handling technician participating in a trailer-spotter activity suffered internal injuries when he was pinned between a trailer and the front seat of an electric cart. The technician was a passenger in the front seat of the cart when it went out of control and hit an unloaded trailer. He was transported to a local hospital, where he was diagnosed with a lacerated liver and bruises and abrasions on his torso. The worker was later air-lifted to a university hospital, where he was in intensive care for 6 days. The results of the Type B Accident Investigation into the accident are discussed below. (ORPS Report EM-CAFO--WTS-WIPP-2009-0003)

Four waste handling technicians were involved in the exchange of empty trailers in the parking lot. One of the technicians was driving the trailer jockey. Three other technicians, including two trainees, were in an electric cart (driver, front-seat and rear-seat passengers). As the cart approached the front of the trailer that was to be moved back to the waste handling area, the driver began applying the brakes. The driver stated that the cart was lurching and "acted like the accelerator was stuck," so he applied more pressure to the brake pedal, but the cart did not stop.

The driver tried to turn away from the trailer when he realized the cart would not stop, but there was not enough distance between the cart and trailer for the entire cart to avoid the trailer, and the front-seat passenger was pinned between the front seat of the electric cart and the light bar of the trailer. Figure 1-1 shows the position of the cart and trailer post-accident. Figure 1-2 shows the injured worker's shirt, with grease marks just below the front pocket, which resulted from the worker being pressed against the light bar.

The electric cart involved in the accident was a Taylor Dunn Model B0-210 36 Burden Master. This type of electric cart has been used onsite since the 1990s. One design feature of the electric cart is that the accelerator pedal extends off-center into the passenger's foot area. Workers told the Accident Investigation Board that they have placed a foot on the accelerator pedal while riding as passengers in these electric carts or that their passengers had, but they never formally informed management about the issue.

Figure 1-3 shows the proximity of the accelerator to the passenger side of the cart. The Board concluded that the location of the accelerator pedal was the leading cause of the

Figure 1-1. Electric cart and trailer post-accident
(showing angle of cart to trailer)

Figure 1-2. Grease mark from trailer on injured worker's shirt
(cut from worker post-accident)

Figure 1-3. Cart accelerator pedal

accident. As a result of this event, the manufacturer designed an accelerator pedal guard for these carts to protect against a future inadvertent engagement by a passenger.

An inspection of the cart involved in the accident indicated that the acceleration system was in good working condition and there was no indication that the accelerator had stuck open. However, during the inspection it was found that one of the brake pads was not attached to the backing, although it was held in contact with the braking system by the brake pad pins. The automatic seat brake switch was out of alignment and would not interrupt power. Also, the backup alarm was not functioning because a wire was not connected to the electrical terminal.

An inspection of all of the site electrical carts identified 12 carts with deficiencies. Daily operability checks are required by procedure, but it was not clear to all workers which failures of operability components should initiate an out-of-service action request for the cart. The Accident Investigation Board concluded that pre-operations and/or pre-use inspections of electric carts were not performed consistently.

Both site investigators and Accident Investigation Board members were able to reproduce the slipping/clicking sound and jerking of the electric cart described by the electric cart driver when they applied the brake and activated the accelerator at the same time. The Accident Investigation Board determined that this confirmed that depressing the accelerator could override the braking system of the cart.

The Board could not determine the exact reason for the brake override, but they found during testing that the drive chain was loose on the gear drive and could not be adjusted. The manufacturer stated that "brake performance is not changed by a misadjusted or worn out drive chain." However, the non-braking and slipping/clicking noises were corrected by replacing the brakes and drive chain.

The Board concluded that the combination of depressing the accelerator with the loose drive chain and worn brake linings resulted in an override of the braking system. Based on maintenance records, they also concluded that maintenance of the electric carts did not include the periodic drive chain adjustment or the manufacturer-required semi-annual and annual maintenance items. Instead of using the manufacturer's specific requirements, the site had used the same preventive maintenance procedure for all electric carts, regardless of manufacturer.

ANSI Standard B56.8-2006, *Safety Standards for Personnel and Burden Carriers*, states that operators should be qualified as to their visual, auditory, physical, and mental ability to safely operate the electric carts. However, these requirements apparently are not part of the qualification process at WIPP, and cart driver training consists of using a checklist and reviewing a handbook that discusses only preoperational inspections that are to be performed at the beginning of each shift. Moreover, the driver involved in the accident with the electric cart was not trained. The Board concluded that ANSI standards for operator qualifications were not incorporated into the WIPP vehicle safety program.

Interviews with electric cart drivers indicated that there are no instructions or requirements on how to approach the parked trailers, whether head-on or perpendicular to the trailer and that some drivers do not follow procedures (e.g., failing to sound the horn when backing). The Board concluded that worker training on electric cart use is not provided by the Training Department and is not part of the Waste Handling Technician Qualification Card.

Originally (starting in 2007), spotters were to be used for 2 months to avoid issues with tire damage on trailers caused by inadvertently moving them with the air brakes on. Because this was to be a short-term activity and was considered to be a low risk activity, no Job Hazard Analysis (JHA) was performed. Over time, however, use of a spotter became part of the accepted practice for moving the trailers.

The Board concluded that spotter activities were not completely analyzed for hazards associated with the task. The JHA for underground carts does identify the potential for a "caught between" hazard and outlines safety procedures, including inspection of the carts, but there is no similar caution for above-ground carts. The Board concluded that because a JHA was not performed for the surface electric carts, appropriate controls were not implemented.

The Accident Investigation Board concluded that the overarching and systemic root cause for this accident was that management determined that use of the electric carts above ground was a low risk task. They also determined that the following were root causes for this accident.

- The location of the electric cart acceleration pedal allowed a front seat passenger to engage the accelerator.
- Maintenance of electric carts did not meet the manufacturer's recommendations.
- Because electric cart activity was determined to be low-risk and short-term, a JHA was not performed, controls were not implemented, and there was a lack of oversight.

Contributing causes included: training was neither formal nor complete; identified problems with accelerator pedal activation were not communicated to management; and a formal inspection of the electric carts was not required.

The Judgments of Need identified by the Accident Investigation Board included the following.

- Install the manufacturer's approved retrofit for the electric cart accelerator to prevent inadvertent engagement by the passenger and implement the manufacturer's recommendations for maintenance and servicing of the electric carts.
- Enhance the job hazard process to analyze task-level activities based on a formal risk-based approach and evaluate the continued need for spotter activities.
- Establish a formal training and qualification process for electric cart operators that meets manufacturer and ANSI requirements.
- Improve the Vehicle Safety Program to establish onsite requirements for cart inspection and the resulting procedures.

This accident illustrates the need for workers to communicate all safety issues that they identify to supervisors in a timely manner. Many of the workers who drove or rode in the site electric carts had noticed that a passenger could inadvertently push on the accelerator pedal because of its location, but no one reported the potential problem. It is essential to develop JHAs for tasks, even if they appear to be low risk, to ensure that the necessary controls are in place to ensure safety. Inspections and maintenance should always be performed in accordance with manufacturer requirements and recommendations, and appropriate training should be developed to ensure that workers are properly prepared to perform assigned tasks.

At sites where the Taylor Dunn Model B0-210 36 Burden Master electric carts are used, the manufacturer's approved retrofit (i.e., guard) for the accelerator should be installed to prevent inadvertent engagement of the accelerator by a passenger. In addition, other cart designs should be inspected to determine the applicability of an engineered safety feature (i.e., guard) to protect against similar events.

KEYWORDS: Electric cart, injury, Type B, accelerator, brake, inspection, maintenance, accelerator guard

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

Clear Communication—An Important Element of Worker Safety 2

Less than adequate communication can result in injuries and near misses that could have been avoided if all required information about potential hazards, work activities, and hazard controls had been communicated properly to workers before they performed a task or between workers engaged in a task, as shown by the following events reported to the ORPS database.

On February 9, 2009, at Idaho National Laboratory, a contractor laborer was struck by the bucket of a backhoe when the boom was being moved. The backhoe operator was working with the laborer and another worker ("rod man"). He had the bucket positioned right of center and his attention was focused on the rod man who was working on the right side of the boom. The laborer was raking an area on the left side of the boom and was looking in the opposite direction from the boom. When the bucket work was finished, the operator began to move the bucket to a center position to stow it and inadvertently struck the laborer on the shoulder and hip, knocking him off his feet. Fortunately, the laborer was not injured. (ORPS Report EM-ID--CWI-IWTU-2009-0001; final report issued April 8, 2009)

Investigators learned that the backhoe operator and the laborer attended separate pre-job briefings. At the laborer's briefing, his supervisor said that being struck by equipment was a worst-case scenario, but he did not discuss how to avoid being struck by nearby equipment. The pre-job briefing attended by the backhoe operator did not focus on hazard controls. Investigators determined that the Job Safety Analysis (JSA) did not specifically identify hazards associated with working within the swing radius of the backhoe and that hazards specific to the work were not covered in enough detail to ensure safe work practices in either the JSA or pre-job briefings.

In addition to inadequate communication of hazards in the JSA and in the pre-job briefings, the workers did not communicate adequately while performing the task and there was a lack of coordination between communication and backhoe movements. There was limited work space to perform the job because of overhead structural steel and walls, and work began less than 30 minutes before the end of the shift.

The laborer was working between the front wall and the backhoe boom and bucket, facing away from the backhoe, and was focused on finishing his work before the end of his shift. His ability to process visual cues was limited because of the area in which he was working and his attention to the task. In addition, the backhoe operator was focused on shutting down operations and on the rod man, whom he could see. With the short amount of time left in the shift, the lack of an effective pre-job briefing coupled with inadequate communication and work methods led to an inaccurate perception of the risks associated with the task.

Corrective actions for this near-miss event included the following.

- Revise the JSA to include additional provisions for maintaining eye contact, as well as precautions about the swing radius of equipment, the dangers of blind spots and of turning your back on equipment, and the dangers associated with moving machinery without knowing where other workers are located.
- Brief heavy equipment operators on the importance of ensuring that all workers are in a safe location before moving or repositioning equipment and require them to stop all movement if spotter contact is lost.

Another event in which communication was less than adequate resulted in an injury at the Strategic Petroleum Reserve, West Hackberry Site, on November 6, 2008. A subcontractor work crew was uncoupling a casing joint when a fiberglass joint broke and fell to the floor, hitting a crew member (i.e., roustabout), who sustained multiple factures to his left femur. (ORPS Report FE--SPRO-SPR-WH-2008-0001; final report issued February 4, 2009)

After several joints had been pulled, the rig supervisor took over operating the rig and assigned the designated rig operator various rigging tasks on the ground. After lunch, the rig supervisor continued operating the rig and sent the designated rig operator on an errand. While the designated operator was still away from the work site, the supervisor inadvertently lowered the rig block, which nicked the top of the casing joint and slid off the side of the pipe. There was no damage to the fiberglass pipe, and the crew continued to pull casing.

When the designated rig operator returned to the work site, no one told him about the incident. Later, as the crew was pulling one of the joints, the rig supervisor attempted a lift and failed to properly engage the brake. This allowed the rig block to travel downward and contact the top of the fiberglass casing. This time the weight of the block (11,000 lb.) broke the fiberglass joint, which fell to the floor and struck the roustabout.

Investigators determined that the procedure for removing casing did not address the unique characteristics of fiberglass casing and that the Job Hazards Analysis (JHA) did not include precautionary steps for working with fiberglass pipe. Rigs like the one being used by the work crew (workover rigs) are designed to work with heavy gauge metal casing. Because of the weight of the rig components, the use of light-weight fiberglass casing introduced a new hazard that had not been considered in the JHA.

Investigators also determined that both the rig supervisor and his manager considered him to be a qualified operator of the rig because he had experience operating an older model. However, the rig supervisor had no training on the rig being used for the work task and was not aware of the differences in operating the controls on the newer rig versus the older one. Investigators determined that considering the rig supervisor to be qualified to operate the rig rather than treating him as a trainee was a significant management oversight.

The lack of communication between the supervisor and the designated rigger contributed to this accident. During a post-event interview, the designated rig operator told investigators that if he had been made aware of the incident that occurred while he was away from the work site (i.e., inadvertent lowering of the block) he would have stopped activity and taken over the rig controls when he returned. Had information about the first incident, when the block hit the casing, been communicated to the rig operator, the accident might have been averted. In addition, if procedures had been properly communicated to the work crew and been followed correctly, the rig operator would not have been allowed to leave the work site while the rig was under the control of the rig supervisor.

OE Summary 2008-08 detailed the investigation into the June 9, 2008, plutonium spill at the National Institute of Standards and Technology laboratories in Boulder, Colorado. In that event, a guest researcher was working alone in the laboratory when a bottle containing a sample of plutonium sulfate tetrahydride cracked and broke. The researcher had received no previous training in handling the sample, was not wearing gloves, and, although he noticed that the bottle was cracked, he continued to handle it. When the bottle broke, spilling the plutonium, he was unaware of the course of action that needed to be taken. The researcher spread contamination in the work area (via his shoes and body), then left the area and spread contamination outside the affected laboratory.

An investigation team determined that the guest researcher did not seem to understand the severity of the contaminated conditions in the lab; had no training or experience in reporting a potential radiological event; did not adequately describe the nature of the incident, the current status in the laboratory, or the actions he had taken to the Principal Investigator (PI); and did not appear to convey any sense of urgency to the PI. The investigation team concluded that actions and decisions leading to this event included lack of training specific to the source, lack of appropriate controls, missing or inappropriate hazard communication, lack of experiment planning, and lack of review and reporting.

Less than adequate communication can result from a variety of problems ranging from inaccurate information, poor quality information, or missing information to failing to provide information or neglecting to carry it forward from shift to shift. Misunderstanding information also can impact work activities and safety and is likely to occur when two people or two groups of people have a different understanding of a process. Some methods of improving communication include the following.

- Carefully specify what key information needs to be communicated.
- Eliminate transmission of unnecessary information.
- Use aids (e.g., logs, computer displays, signage) to enhance accurate communication of key information.
- Repeat key information, both orally and in writing.
- Allow sufficient time for communication, particularly at shift turnover.
- Encourage two-way communication with both the giver and recipient of the information taking responsibility for accurate communication (i.e., repeat back).
- Encourage workers to ask for confirmation, clarification, and repetition.
- Encourage face-to-face communication when feasible.

In addition, all work documents, procedures, and pre-work instructions should clearly address hazards associated with the work activity in a way that ensures that all workers understand the significance of hazards and how to implement the necessary safety controls and barriers.

Chapter IV in Attachment 1 to DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, states:

> Oral instructions should be clear and concise. In all communications, the sender and intended receiver should be readily identifiable. Instructions involving the operation of equipment should be repeated by the receiver to the extent necessary for the sender to ensure the instructions are correctly understood.

The Order can be accessed at http://www.directives.doe.gov/pdfs/doe/doetext/oldord/5480/o548019c2.pdf.

These events show the importance of clearly communicating all information about potential hazards and hazard controls both before work begins and while work is in progress. Although it is essential for pre-job briefings and procedures to accurately communicate hazards and appropriate controls, it is equally important that workers communicate with each other while performing a work task to ensure that all workers are in a safe position in the event that equipment moves inadvertently or material falls unexpectedly.

KEYWORDS: Less than adequate communication, LTA, backhoe bucket, injury, near miss, pre-job briefing, JSA, JHA

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

The Office of Health, Safety and Security (HSS), Office of 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, HSS 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 Mr. Charles Lewis, (301) 903-8008, or e-mail address Charles.Lewis@hq.doe.gov, so we may issue a correction. If you have difficulty accessing the Summary on the Web (http://www.hss.energy.gov/csa/analysis/oesummary/index.html), please contact the Information Center, (800) 473-4375, for assistance. We would like to hear from you regarding how we can make our products better and more useful. Please forward any comments to Charles.Lewis@hq.doe.gov.

The process for receiving e-mail notification when a new edition of the Summary is published is simple and fast. New subscribers can sign up at the Document Notification Service web page: http://www.hss.energy.gov/InfoMgt/dns/hssdnl.html. If you have any questions or problems signing up for the e-mail notification, please contact Mr. Charles Lewis by telephone at (301) 903-8008 or by e-mail at Charles.Lewis@hq.doe.gov.

Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
CPSC	Consumer Product Safety Commission
DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
INPO	Institute for Nuclear Power Operations
NIOSH	National Institute for Occupational Safety and Health
NNSA	National Nuclear Security Administration
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration

Units of Measure	
AC	alternating current
DC	direct current
mg	milligram (1/1000th of a gram)
kg	kilogram (1000 grams)
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
TWA	Time Weighted Average
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards Analysis
JSA	Job Safety Analysis
NOV	Notice of Violation
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act

Miscellaneous	
ALARA	As low as reasonably achievable
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
MSDS	Material Safety Data Sheet
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SME	Subject Matter Expert