OPERATING EXPERIENCE SUMMARY

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U.S. Department of Energy

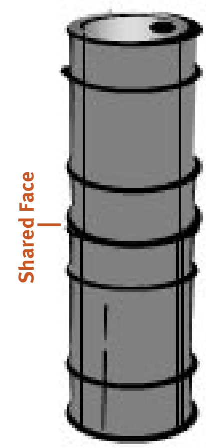
Office of Environment, Safety and Health

OE Summary 2005-06

March 21, 2005

Attention Users of KENO V.a Criticality Evaluation Software

The Standardized Computer Analyses for Licensing Evaluation (SCALE) at Oak Ridge National Laboratory recently informed the Office of Environment, Safety and Health that a programming error exists in version V.a of the KENO criticality safety computer code. Specifically, in a stacked geometry where drums with cylindrical holes in them such as bungs share top or bottom faces (example shown in the figure to the right), neutrons may not be tracked as they cross the shared top or bottom face of the cylinder. The calculated k-effective (k-eff) value may be underestimated from a few tenths of a percent to several percent. This defect may also occur when using mirror boundary conditions, periodic boundary conditions, replicate, and reflect.



The Office of Environment, Safety and Health recommends that potentially affected Category II sites and facilities recalculate k-eff values and suspend hot work and fissile material movements until the k-eff values are verified.

If you have any questions on this issue, please contact Robert Loesch, Office of Quality Assurance Programs, at 301-903-4443. The Office of Environment, Safety and Health will provide further details when they become available.

EH Publishes "Just-In-Time" Reports

The Office of Environment, Safety and Health publishes a series of Just-In-Time reports on its Lessons Learned and Best Practices web site. These reports are targeted to work planners and workers and discuss safety topics relevant to the work they do. Each report presents examples of problems and mistakes encountered in actual reported cases and offers points to consider to avoid similar mistakes in the future.

EH plans to issue more Just-in-Times soon on other safety issues. All of the Just-in-Times can be accessed at http://www.eh.doe.gov/paa/jit.html.

The Office of Environment, Safety and Health, Office of Corporate Performance Assessment publishes the Operating Experience Summary to promote safety throughout the Department of Energy 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. If you have difficulty accessing the Summary on the Web (URL http://www.eh.doe.gov/paa), please contact the ES&H 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 Frank.Russo@eh.doe.gov.

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EVENTS

1. RECENT PINCH-POINT EVENTS RESULT IN SEVERE INJURIES

Over the past month, the Office of Environment, Safety and Health has noticed a growing trend in the number of finger and thumb injuries that occurred because workers were inattentive to pinch-point hazards. Below is a brief description of each event and its causal factors.

On March 10, 2005, at the National Renewable Energy Laboratory's National Wind Technology Center, a subcontract worker was adjusting the tilt of the wind turbine blade test stand when the portable power driver he was using rotated counterclockwise and severed part of his right thumb. (ORPS Report GO--NREL-NREL-2005-0004)

To make adjustments to the blades, workers turn 8-inch-long screw jacks built into the test stand. The worker, who was wearing gloves at the time of the accident, used a Ridgid® Model 700 Portable Power Driver (Figure 1-1) while standing on a 5-foot stepladder to reach the screw jacks. As the worker was using the power drive, the handle broke away, causing the main body of the tool to rotate counterclockwise, pinning the operator's right thumb. A raised section on the body of the tool created a pinch point that severed the tip of the worker's right thumb and exposed the bone.

The worker was transported to a hospital emergency room, where a hand specialist determined that the severed portion of the thumb could not be reattached. A surgeon amputated the protruding bone between the nail bed and the knuckle. Following surgery, the worker was released.

Figure 1-1. Portable power driver

Although the investigation is not yet complete, the Ridgid web site advises that a support arm (Figure 1-2) should be used with the power driver to resist torque.

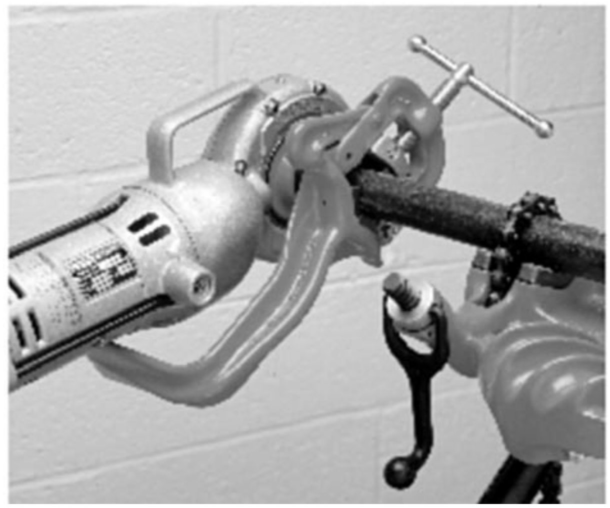

Figure 1-2. Recommended support arm

Another event involving a pinch point occurred the week before, on March 4, 2005, at the Kansas City Plant, where a material handler suffered multiple fractures of his right middle finger and a chip fracture of his right ring finger when his hand was pinched between a working platform and operator cage as he and another material handler prepared to move a portable ladder stand. (ORPS Report ALO-KC-AS-KCP-2005-0005)

The ladder stand had a working platform 6½ feet above the floor. To move it, the workers removed two retaining bolts to allow the operator cage to pivot down to the platform level. When the operator cage rotated downward, it pinched the worker's hand against the platform.

The day before, at Los Alamos National Laboratory, a team leader tore two fingertips on his left hand when he tried to help slide an 800-pound pipe along a piece of timber that was being used as cribbing and his hand became caught between the pipe and cribbing. (ORPS Report ALO-LA-LANL-FIRNGHELAB-2005-0004)

Dynamic Experimentation Division personnel were setting up a dry run on a newly developed foam containment system for dynamic tests containing hazardous materials. The containment system consists of steel pipes, each 22 feet long and 6 inches in diameter, that slip-fit into steel sleeves located in the center of concrete-filled bases. The pipes lay on the ground in two layers, with two blocks of 6-foot by 6-foot timber under each layer to serve as cribbing.

A crane operator was using a mobile crane to lift each pipe to a vertical position, move it to a concrete base, and lower it into the sleeve. As the first of the pipes was being lifted, its lower end began to drag along the cribbing. The signalman instructed the crane operator to stop lifting and tried to free the pipe by pushing it toward the crane with his hands, without result.

The team leader stepped in to help, putting his hands inside the pipe and pushing toward the crane. The pipe slid forward off of the cribbing and dropped 6 inches to the lower layer of pipes, pinching the team leader's left middle and ring fingers between the end of the pipe and the cribbing.

On February 13, 2005, at Rocky Flats, a subcontractor worker was loading a piece of angle iron into a nearly-full cargo container when his finger was crushed against a piece of ductwork in the container, causing a compound fracture of his right middle finger. (ORPS Report RFO--KHLL-371OPS-2005-0007)

Investigators determined that the worker did not have his full attention on the task at hand. As he was placing the angle iron, he hesitated a moment and caught his finger between the two pieces of metal. In addition, although the worker was experienced in this type of work, he had not done it for nearly a year and so lacked recent hands-on experience.

On February 10, 2005, at the Pantex Plant, a subcontractor electrician fractured his right index finger when his right hand became caught between a cooling section for a newly installed transformer and other sections stacked nearby. (ORPS Report ALO-AO-BWXP-PANTEX-2005-0024)

The cooling sections were 9 feet long, 5 feet wide, and 2 feet deep, and weighed about 2,600 pounds each. The potential for pinch-point hazards was addressed at the daily briefing and on the project activity hazard analysis.

The crane operator, believing he could control the load better by hand than by using tag lines, asked two electricians to stand on either side of the cooling section that was being lifted to stabilize it. As the section was being raised, it shifted and slid up against another cooling section nearby, catching one electrician's right hand between the cooling section being raised and the sections stacked to his right. The operator raised the section when he heard the electrician yell.

The critique conducted the next day disclosed that the crane operator failed to use tag lines although the activity hazards analysis required them. Also, the prime contractor's OSHA competent person was not present to oversee the job.

These five events demonstrate the importance of hazard recognition and control. As well as being aware of all potential hazards (pinch points being just one example), workers need to ensure that they are not inadvertently injured through inattention to detail or failure to comply with procedures.

KEYWORDS: *Pinch point, finger, thumb, injury, near miss, industrial operations*

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

2. *MISHANDLED RADIOACTIVE SOURCES DAMAGED, RESULTING IN CONTAMINATION*

On November 11, 2004, at the Lawrence Livermore National Laboratory, a sealed 50-microcurie, cobalt-57 source was damaged when a researcher and machine shop technician tried to remove it from a metal assembly (collimator) and it released radioactive powder. The work was being performed without the support of radiological controls personnel in a shop that was not authorized to work with radioactive materials. (ORPS Report OAK--LLNL-LLNL-2004-0062; final report filed March 14, 2005)

The researcher needed to remove the source from the collimator to replace it with a new cobalt-57 source. He tried to remove the source by hitting the assembly with his hand and then with a rubber hammer. He even tried to extract it with tape. After these attempts failed, he took the assembly to the machine shop to try to remove it there. Figure 2-1 shows the ventilated worktable in the machine shop.

A shop technician placed the collimator source-side down on an anvil and hit it a few times with a small dead-blow hammer, then switched to a larger hammer, but he could not remove the source. The technician then suggested using differential thermal expansion to remove the source. He placed the collimator on a block of graphite and heated the back of the collimator with an oxyacetylene torch. After it cooled, he picked up the collimator with tongs and discovered the powder that had been released from the source on the graphite block.

Figure 2-1. Contaminated work area and the gas bottles for the torch used to heat the collimator

Neither the researcher nor the technician understood the construction of the source. They incorrectly believed it was a solid matrix of material embedded in aluminum, when it actually was a ceramic source covered by a thin metal window. Investigators believe that the hammering initially breached the source and applying heat ultimately resulted in the source failure and release of radioactive material.

A health and safety technician monitored the workbench area for contamination. A direct survey of the graphite block indicated 2,000,000 dpm/100 cm^2 beta-gamma. Figure 2-2 shows the contaminated graphite block and the collimator in a plastic bag to contain the spill. A survey of the workbench showed 500,000 dpm/100 cm^2 beta-gamma and a swipe survey of the tongs showed 50 dpm. The researcher and technician did not have any contamination on their clothing, and whole body scans were negative.

Figure 2-2. Graphite block with tape to fix the cobalt-57 powder and the collimator that held the source

Investigators identified the apparent direct cause of the incident as the researcher's failure to recognize the escalation of risk involved with the attempts to remove the source. The researcher did not analyze or appropriately control the hazards associated with using mechanical force to remove the source. He also failed to stop work to redefine the scope, identify new associated hazards, develop and implement new controls, and obtain authorization to proceed. The apparent root cause was the less than adequate implementation of Integrated Safety Management that allowed personnel to proceed based on what they believed was safe to do instead of following procedures.

Investigators also determined that the training for custodians of sealed sources was not specific enough regarding the risks posed by applying pressure and temperature or by taking other actions that could cause the sources to leak.

On September 13, 2004, at the Fernald Closure Project, a subcontractor analyst damaged a 100-microcurie sealed cesium-137 source while removing it from a calibration holder. The damaged source (Figure 2-3) leaked, and the analyst unknowingly spread beta-gamma contamination both in the trailer he was working in and to another building where radioactive sources are stored. The analyst went home for the evening with both palms of his hands contaminated. The spread of contamination was not discovered until the next day by another analyst. (ORPS Report OH-FN-FFI-FEMP-2004-0028)

The analyst, who was cross-trained as a radiological control technician, was performing

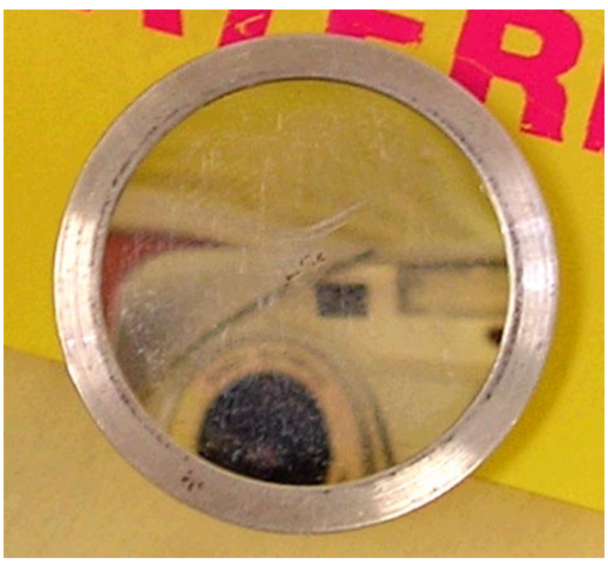

Figure 2-3. Magnified photo of source showing scratches on the face

an annual calibration of a high-purity germanium (HPGe) detector, which is used for gamma spectrometry measurements of soil surfaces. While setting up the calibration, he inadvertently placed the sealed source into the source jig (calibration holder) incorrectly with the active surface facing toward the back of the jig. Removing the source from the jig requires inserting a metal rod through a drilled hole in the jig and pushing it against a metal backing plate behind the source to push it out. However, with the source reversed in the jig, the backing plate damaged the thin (0.254 mm) Mylar cover on the source, allowing the cesium salts to leak out. Figure 2-4 shows the wooden jig.

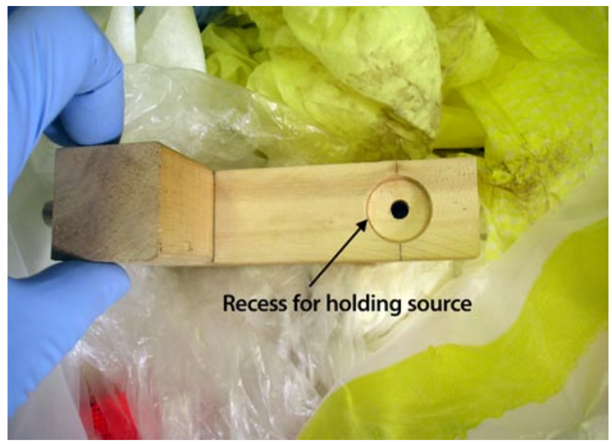

Figure 2-4. Jig for holding the source showing hole in center for source removal

The trailer where the incident occurred is a radiologically uncontrolled area, and there is no requirement for contamination monitoring to detect the release of radioactive material. The contaminated analyst had 25,000 dpm/100 cm^2 on his hands, but no contamination was found in his home. Many items within the trailer had beta-gamma contamination ranging from 3,000 to 450,000 dpm/100 cm^2 (the source jig) that could not be decontaminated and were disposed of as contaminated waste.

Some of the findings from the investigation included the following.

- The source users did not understand the fragile nature of the Mylar-encapsulated source, and there were no engineering or administrative controls to ensure that users did not damage them.

- Design of the source jig and methods used to remove the source from the jig were not evaluated.
- Contamination monitoring was not required for handling and using sealed sources; therefore, the damage to the source was not detected during the calibration process.

On February 28, 2005, at the Nevada Remote Sensing Laboratories, a 66-microcurie sealed cesium-137 source was damaged while it was being used to calibrate an HPGe detector. The source was attached to the calibration jig by double-stick tape, and the technician who was conducting the calibration mistakenly placed the active side of the source on the tape, which had a 0.01-inch-thick Mylar covering. When the source was removed the Mylar cover was damaged, allowing radioactive cesium salts to leak from the source. The technician received hand and facial contamination, and the source jig was contaminated to 800,000 dpm/probe. (ORPS Report NVOO--BN-RSL-2005-0001)

Similar events involving mishandled and leaking sources have also occurred outside of DOE. For example, a radiation safety officer at a gauge manufacturing company in California caused a 100-millicurie sealed americium-241 source capsule to explode and release its contents when he tried to remove the capsule (protective envelope) from its tungsten holder by melting an epoxy coating. He used a small handheld butane torch to heat the epoxy and unknowingly subjected the capsule to conditions beyond those for which it was designed, resulting in dispersal of radioactive material. The activity was performed inside a fume hood; however, alpha contamination from the source was detected on the safety officer's clothing, on the floor, and on tables in the room. The hood and exhaust ductwork was so contaminated it had to be dismantled and disposed. (NRC Event Number 33603)

The dispersal of radioactive source material can be hazardous. A few years earlier, an employee of the same California company received an internal exposure of up to 85 rem committed effective dose equivalent after inhaling americium-241 oxide powder when a welded seal plug on a 10-millicurie source failed while he was checking it for leaks. (NRC Event Number 30137)

These events underscore the importance of exercising care when working with radioactive sources. The release of source material from mishandled or leaking sources can lead to the spread of contamination and personnel exposure. Exercising sound radiological practices and common sense is important when handling sealed sources. Procedures and processes should be evaluated for potential safety hazards, including the risk of jeopardizing the integrity of the source capsule, which can be very fragile.

KEYWORDS: *Radiation protection, sealed source, radioactive, leak, damaged, cobalt, americium, cesium, contamination*

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

3. CARBON MONOXIDE EXPOSURES

On January 20, 2005, at the Idaho National Laboratory (INL), four construction workers grouting a line with a gas-powered grout pump were exposed to carbon monoxide gas when the building's ventilation system drew the pump's exhaust in as they were working. The workers all were wearing full-face respirators, but they experienced eye and nose irritation, as well as headaches. (ORPS Report ID--BBWI-PHASEOUT-2005-0001; final report filed March 3, 2005)

Because the ventilation system of the building was designed to prevent the spread of airborne contaminants to the atmosphere, air is drawn from outside toward the inside, resulting in the exhaust from the grout pump being drawn into the building. Although the workers were wearing full-face HEPA-filtered respirators, the respirators were designed for protection from potential airborne radiological contamination, not carbon monoxide.

An industrial hygienist measured the carbon monoxide concentration at the door and in the work area, and found levels as high as 300 parts per million (ppm) at the door and 200 ppm in the work area. All affected personnel were sent for medical evaluation, the building was ventilated; no additional corrective actions were deemed necessary. The workers were in the area and exposed to the CO for 1½ hours. This resulted in a calculated 8-hour time-weighted exposure average of 20 ppm. The table in the next column shows the effects of varying CO exposures and durations.

On February 4, 2005, at the Hanford Waste Treatment Plant construction project, construction workers were potentially exposed to carbon monoxide. The workers were using a propane-powered manlift at a lower level of the building with its exhaust directed toward the room entrance. Both carbon monoxide monitors on the lower level activated. The monitor closest to the manlift indicated 193 ppm. (ORPS Report RP--BNRP-RPPWTP-2005-0004)

Workers did not turn on the mechanical ventilation units that had been put in place to control the carbon monoxide buildup. In addition, the room was to have been sealed off using plastic material, but the plastic was improperly installed and the exhaust fumes spread throughout the building. All of the workers involved were examined, and none required medical attention.

On January 12, 2004, at Los Alamos National Laboratory, a maintenance supervisor smelled a gas-like odor coming from an indirect-fired heating unit in the shop (although CO is odorless, the odor indicated incomplete combustion). The supervisor informed two industrial hygienists of the odor. They detected elevated levels of carbon monoxide that ranged from 60 ppm to 100 ppm. (ORPS Report ALO-LA-LANL-ADOADMIN-2004-0001)

Personnel working in the maintenance shop typically spend only short periods of time there. Following the event, everyone in the shop was evacuated and sent home because it was near the end of the workday. The heating unit was locked and tagged out, and the shop was ventilated. No one reported symptoms, and no overexposures were detected.

Another CO exposure event occurred at Los Alamos on November 20, 2003, when an employee suffered a headache and nausea after he had been reading procedures on a desktop computer in a newly constructed building for about 3 hours. The employee's symptoms

Table 1. CO exposure symptoms

PPM	Duration	Symptoms
35	8 hours	Maximum workplace exposure allowed by OSHA over 8-hour period
200	2–3 hours	Mild headache, fatigue, nausea, and dizziness
400	1–2 hours	Serious headache—other symptoms intensify
800	45 minutes	Dizziness, nausea and convulsions. Unconscious within 2 hours and death within 2–3 hours
1,600	20 minutes	Headache, dizziness and nausea. Death within 1 hour
3,200	5–10 minutes	Death within 1 hour
6,400	1–2 minutes	Death within 25–30 minutes
12,800	1–3 minutes	Death

resolved after he was given oxygen. (ORPS Report ALO-LA-LANL-FIRNGHELAB-2003-0013; DOE Lessons Learned Identifier LANL FIRNGHELAB-2004-0001)

Air samples from the office where the employee was working indicated elevated levels of carbon monoxide (ranging from 10 to 15 ppm), but not in excess of the limit established by the American Conference of Governmental Industrial Hygienists (ACGIH) of 25 ppm over 8 hours. The ensuing investigation revealed that the building's direct-fired furnace was installed with a burner much larger (750,000 BTU) than the manufacturer recommends (500,000 BTU), while having insufficient ventilation.

The U.S. Coast Guard issued an alert on the use of gas detectors and personal protective equipment that cited three events. In the first event, an instructor from the Coast Guard's Marine Safety Unit was conducting a barge examination when the alarm on his Gas Alert Micro® activated, reflecting carbon monoxide levels near the IDLH level. The inspector ordered the space evacuated immediately.

The Coast Guard also reported a near miss at a marine safety detachment, where a gas heating system in the building malfunctioned. A lethal level of carbon monoxide was being produced, and several Gas Alert Clips® on desktops near the heater activated. Personnel in the area experienced slight headaches and dizziness.

In the third event, Coast Guard members of a law enforcement team were inspecting a vessel carrying high-sulfur-content coal. Normally, the Coast Guard equips its team members with Gas Alert Clips or their Gas Alert Micros (illustrated in Figure 3-1); however, the team brought neither with them. The boarding officer and a ship's crewmember entered a small watertight hatch leading to the cargo area (an enclosed space). The boarding officer noticed a strange taste and smell, began to have difficulty breathing, and quickly left the space with the crewmember. The boarding officer, gasping for breath, stated that he felt disoriented and dizzy for about a minute.

Figure 3-1. Gas Alert Micro (left) and Gas Alert Clip detectors

An OE Summary article, *Small Gasoline-Powered Engines Can Present a Carbon Monoxide Hazard*, in Issue 2003-19 discusses the hazards of carbon monoxide exposures in greater detail and provides more information on circumstances under which carbon monoxide exposures could occur.

The DOE events point to the need for workers who use gasoline-powered equipment indoors or in enclosed spaces to ensure that the equipment exhausts outside and away from ventilation intake. The Coast Guard events highlight the importance of wearing the proper personal protection equipment to protect against exposures. Because CO is odorless and invisible, leaks can be difficult to detect without monitoring equipment.

KEYWORDS: *Carbon monoxide, CO, ventilation, exhaust*

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

4. PASSENGER FALLS FROM UTILITY VEHICLE AND FRACTURES LEG

On October 8, 2004, at the Pacific Northwest National Laboratory (PNNL), a grounds crew member fell out of the passenger side of a 2004 Toro Workman® 3200 utility vehicle and fractured his right leg above the ankle. The vehicle had no hip or shoulder restraints and no doors, and their absence allowed the worker to fall out of the vehicle as it rounded a curve. All similar vehicles onsite were removed from service pending an investigation, and a Type B Accident Investigation Board was appointed after the worker remained hospitalized for 5 consecutive days following surgery for the fracture. (ORPS Report RL--PNNL-PNNLBOPER-2004-0015; final report issued March 1, 2005)

Two grounds employees were riding around the site in a newly purchased Toro Workman that had been delivered to the site about 2 weeks earlier. A rollover protection system (ROPS), seat belts, and hip restraints were standard, factory-installed equipment on the vehicle; but, unlike earlier Workman models, the ROPS on the new model was not equipped with shoulder restraints. Figures 4-1a and 4-1b show both models and how the safety features differ between the two.

When the accident occurred, both the factory-installed seat belts and the hip restraints were missing from the vehicle. Two glass latching side doors had also been removed for comfort during warm weather and because of post-delivery concerns about potential carbon monoxide buildup in the cab if the vehicle was idling for any length of time. Figure 4-2 shows the vehicle at the accident scene.

with the equipment. However, the grounds workers interviewed by the Board indicated that although they had reviewed these materials for the older model Toro Workman vehicles, they did not do so for the new model. The Board also learned that the required training on the new vehicle was not provided because the grounds supervisor erroneously assumed it was simply a new model of the previously purchased utility vehicles and was basically the same.

The Board concluded that this was a preventable accident. They determined that the direct cause of the accident was the lack of a seat belt and hip restraint to prevent the passenger from falling out of the vehicle. In addition, removing the cab doors after the vehicle was placed in service also removed the remaining safety barrier and allowed the worker to slide out of the vehicle.

The Board also indicated that the process used to accept the vehicle from the supplier and place it in service failed to identify the missing safety equipment. Based on their investigation, the Board determined that the root cause of the accident was a failure to effectively implement the hazards analysis process.

The Board identified 18 Judgments of Need, including the following.

‡ Conduct a comprehensive hazard analysis of the work performed by site grounds personnel to ensure that all hazards are identified and that controls are developed to mitigate them.

‡ Train both supervisors and workers on the importance of routine safety behaviors and the use of safety equipment (e.g., seat belts) and on the need to ensure that those operating utility vehicles are aware of vehicle safety features and any specific hazards.

‡ Require grounds staff to participate in a comprehensive review of the operating manuals for all grounds-related equipment before using it.

‡ Update procedures to require operators to familiarize themselves with vehicle/ equipment manufacturers' instructions before initial use of new equipment.

‡ Require operators to review new equipment information regardless of experience with previous model.

‡ Revise the procurement and inspection process to require a safety review of the procurement specifications and a validation that manufacturer safety features are installed.

‡ Ensure that vehicle custodians verify that safety equipment that should be present on the vehicle is in fact installed.

The American Society of Mechanical Engineers/ American National Standards Institute (ASME/ ANSI) Standard B56.8, *Safety Standard for Personnel and Burden Carriers*, requires the provision of handholds and hip restraints for both drivers and passengers to prevent occupants from falling from, or being thrown out of, a vehicle. The older vehicles being used at PNNL are in compliance with this standard and also have shoulder restraint bars to provide additional stability. The Standard does not require seatbelts. Toro does not provide shoulder restraints on the newer model Toro Workman, because seatbelts are now standard equipment and the shoulder restraints are no longer necessary.

Additional information about this incident was reported in a lessons learned article available at www.eh.doe.gov/DOEll. Photographs in that article show how the old and new Toro Workman models differ.

This event illustrates the importance of ensuring that users review all manufacturer-supplied operating manuals before operating any new equipment, as well as the need for thorough inspections upon delivery to ensure that all original safety features are in place. This event also demonstrates the need to evaluate new models of equipment for unidentified safety hazards rather than assuming that a new model is identical to an older one.

KEYWORDS: *Vehicle accident, utility vehicle, injury, seatbelts, ROPS*

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

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
SELLS	Society for Effective Lessons Learned

Authorization Basis/Documents	
JHA	Job Hazards 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
RCRA	Resource Conservation and Recovery Act
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement

Units of Measure	
AC	alternating current
DC	direct current
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Radiation Equivalent Man
v/kv	volt/kilovolt

Miscellaneous	
ALARA	As low as reasonably achievable
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
ORPS	Occurrence Reporting and Processing Syste
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control

Job Titles/Positions	
RCT	Radiological Control Technician