Operating Experience Summary

U.S. Department of Energy
Office of Health, Safety and Security
OE Summary 2009-10
November 6, 2009

Inside This Issue

Type B Accident Investigation of Hanford Worker Fall from Catwalk

1

On July 1, 2009, at Hanford, a millwright working on an elevated catwalk to prepare a bridge crane for removal fell through an open hatch to the floor below. As he fell, he struck the guardrail of a midpoint platform 25 feet below the catwalk and then fell another 25 feet to the concrete floor. Figure 1-1 is a diagram of the accident scene. Fortunately, the millwright survived the fall, but he sustained two cracked vertebrae in his back, broken bones in both legs, and damage to his left knee. The millwright was hospitalized for 2 weeks, then was released to continue his recovery at home for several months. A Type B Accident Investigation Board was assigned to investigate this accident. (ORPS Report EM-RL--WCH-DND-2009-0005)

On the day of the accident, two riggers and two millwrights ascended the ladder to the catwalk and began working. One of the riggers descended from the catwalk and the catwalk hatch to retrieve bottles to collect gear box oil, closing the hatch behind him. Later, one of the millwrights also descended the ladder, leaving the hatch open because he thought the other millwright would follow directly behind him as soon as they had performed the final task of cutting the guardrails. However, after the guardrails were cut, a support rigger on the ground asked the two remaining crew members to secure the crane trolley to the bridge before they descended, which was not part of the original work scope. Figure 1-2 shows the crane and trolley above the catwalk.

The millwright and rigger who had remained on the catwalk decided to bring the crane closer by pushing the crane wheels from both ends of the crane bridge. As the millwright began to walk toward the west end of the catwalk to push the crane wheels, he was focused on the crane and did not notice that the

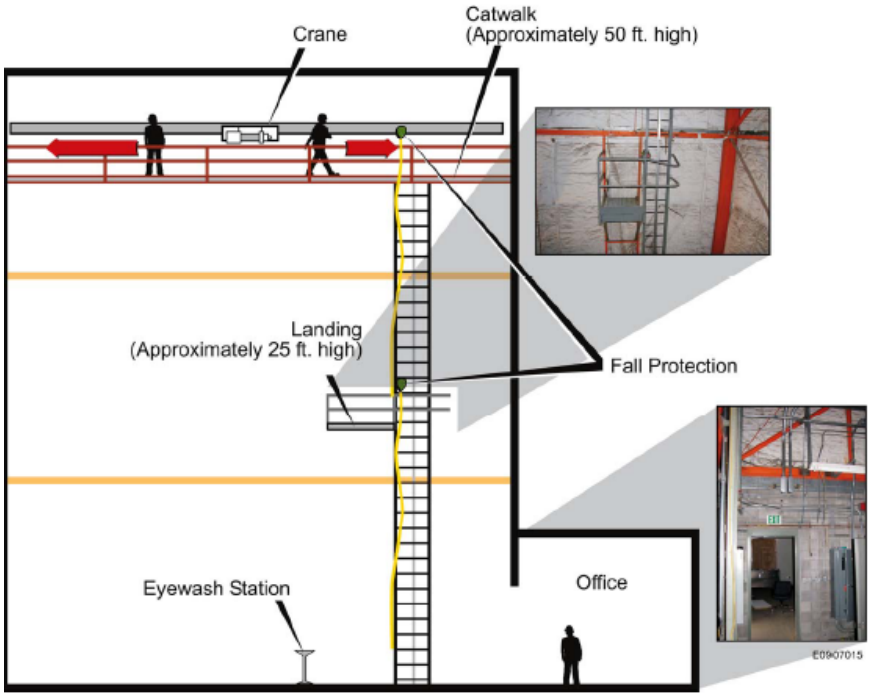

Figure 1-1. Diagram of accident scene

Figure 1-2. Crane and trolley above the catwalk

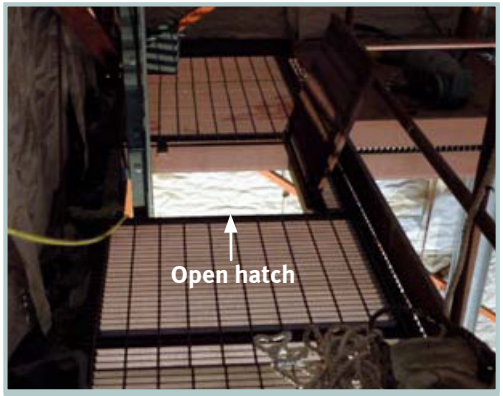

Figure 1-3. Open hatch on the catwalk

catwalk hatch had been left open. He stepped into it and fell. Figure 1-3 shows the catwalk and open hatch; Figure 1-4 shows the guardrail at the midpoint after it was bent by the millwright as he fell.

The Accident Investigation Board concluded that the event occurred due to multiple distractions and interruptions while workers were performing an unplanned and unanalyzed task. Distractions included collecting containers for gear box oil and retrieving a chain to secure the trolley. The workers also believed that their task had been completed when the guardrail was cut. This led to one of the workers descending the catwalk and leaving the hatch open because he thought the other two workers would be following him down. In addition, after the other workers had left the catwalk the millwright and rigger were asked to secure the crane, which was not part of the original scope of work, so they had to decide how to best address moving the crane without knowing whether there were additional hazards when performing the task. In the absence of direction, the two workers decided that pushing the crane from either end of the catwalk was the best way to perform the task. This involved the millwright walking to the end of the catwalk. He was focused on getting to the crane, and because he did not see that the hatch had been left open, he fell through it.

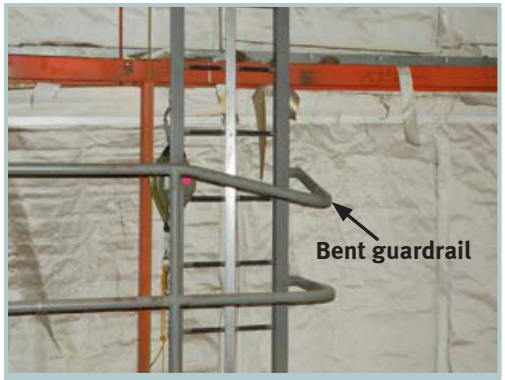

Figure 1-4. Guardrail bent by millwright fall

Schedule pressures also contributed to this event. Board interviews with staff indicated that workers were hesitant to exercise a work pause because of perceived pressures to accomplish the project mission. Although the Board did not believe that workers would hesitate to use stop work when faced with an imminent personnel safety hazard, their concern was that workers knowingly took on unplanned tasks under the guise of skill of the craft without adequate hazard identification and planned controls.

The Board identified a number of issues with work planning and task analyses. For example, when developing the Job Hazard Analysis (JHA), the catwalk was not accessed to determine if there were hazards that required mitigation. In an interview with Board members, the work planner indicated that he did not think the catwalk opening included a hatch and that he thought the opening was controlled by chain guards. If the catwalk had been accessed during the planning phase, this misconception would have been avoided. In addition, neither a bridge crane Subject Matter Expert (SME) nor a millwright, who would have been familiar with the details of the crane based on maintenance and repair of bridge cranes, was included in development of the JHA.

The Board concluded that the contractor work control process was not adequate to sufficiently identify the work scope, hazards, and associated controls to safely perform the bridge crane removal task, and identified the following specific issues.

- Work scope, hazards, and related controls were not adequately defined.
- Coordination and communication affecting work planning and execution were less than adequate.

- Work scope changes were not adequately managed to assess additional hazards and controls.
- Schedule was a controlling priority.

Among the Accident Investigation Board's Judgments of Need were the following.

- Ensure that the full scope of work within each work package is comprehensively evaluated and planned, including full and complete walkdowns to identify potential hazards prior to the release of work.
- Clearly delineate the boundaries for skill-of-the-craft work versus detailed planned work, so that hazards are adequately analyzed and controlled.
- Instill a work force culture that ensures that workers understand and take appropriate action when the actual work being performed begins to extend beyond the planned and analyzed work scope.
- Balance the work schedule commensurate with its trained and qualified work force, continually assess work force capabilities and limitations, and apply them to perform work safely.

All of the Board's conclusions and Judgments of Need for this accident, as well as other details of their investigation, are included in their Type B Accident Report, which is available at http://www.hss.energy.gov/csa/csp/aip/accidents/typeb/board_report_final.pdf.

This accident demonstrates the importance of in-depth job planning, work control, and hazard analysis. It also illustrates the effects of schedule pressures that can impact safety, especially when workers continue work rather than ensuring that all hazards have been identified and controlled. In this event, distractions, lack of hazard identification and control, schedule pressures, the addition of an unplanned work task, and a belief that originally planned work had been completed culminated in a fall that could have been fatal.

KEYWORDS: Type B Accident, fall, catwalk, injuries, distractions, schedule, work planning, hazard analysis, work control, skill of the craft

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

Time to Prepare for Winter Weather 2

Figure 2-1. Denver area snowfall October 10, 2009

Winter weather is once again on its way, and some areas of the country have already had sub-freezing temperatures, snow, and freezing rain. Denver, Colorado, for example, set a new record low temperature of 17 degrees on October 10, 2009, along with an early snowfall (Figure 2-1), and on October 29, the area received nearly 30 inches of snow. So, it is time to start preparing facilities for weather-related hazards and to begin reminding employees to use caution when walking and driving on icy roads and walkways. The following events from the winter of 2008/2009 show the types of problems that inclement weather brings.

Freezing Temperatures Result in Arc Flash/Oil Leak/Water Line Rupture

On December 27, 2008, at Hanford, an arc flash/fire occurred in an exterior electrical raceway that delivered power from a building power transformer to switchgear for the facility, damaging the raceway, blowing the transformer fuses, and activating the transformer automatic deluge system. Because the power distribution system automatically switched to an alternate source of power, there was no effect on building activities or personnel injuries and no loss of ventilation to the building. (ORPS Report EM-RL--WCH-DND-2008-0004; final report issued February 9, 2009)

Investigators determined that the arc flash/fire resulted from a buildup of water and ice within the busway, causing a fault path between the bus bars. After a heavy snowfall, temperatures rose above freezing for several days, and snow that had melted inside the ventilated busway re-froze when the temperature dropped at night. Under normal circumstances, the system design allows sufficient room for water (rain or melting snow) to pass between the bus bars without creating a fault, but investigators concluded that after a few days, there was sufficient ice buildup and melting to create a fault path between the bus bars.

On December 31, 2008, at the Nevada Test Site, a fuel truck leaked more than 300 gallons of used oil when water that had accumulated between a ball valve and its pipe cap froze, breaking the valve. The spilled oil spread out over an approximately 60-square-foot area, but did not seep into the ground more than 1 or 2 inches in most places. The State of Nevada Division of Environmental Protection was notified of the leak. (ORPS Report NA--NVSO-NST-NTS-2009-0001; final report issued February 17, 2009)

Investigators determined that the truck was parked over the holiday break when temperatures were at freezing or below. They determined that the waste oil was allowed to remain in the tank longer than normal, and a slow seepage of water between the valve and pipe cap accumulated around the valve. Freezing temperatures (24°F) caused the water to freeze, stretching the threads of the valve assembly and causing the ball valve to fail. They also determined that maintenance procedures did not include provisions for extended freeze protection.

On February 6, 2009, at Idaho National Laboratory, workers investigating abnormal cycling of fire water service pumps found that a capped section of a water line that protruded from the building had frozen and ruptured. (ORPS Report EM-ID--CWI-BIC-2009-0001; final report issued March 31, 2009)

Investigators determined that the line was a legacy raw water line that had been capped and removed from the fire water system drawings at some point in the past. The planning walk-down for this work package did not identify the line as being connected to an active system, so the assumption was made that the line was inactive. Because workers who monitored the portable heating system were leaving for the weekend and believed that all active wet systems had been isolated, the heating system was shut down. When the building temperature dropped below freezing, the line froze and ruptured. Corrective actions included requiring zero energy checks on all systems identified as abandoned or inactive.

Useful freeze protection measures that address potential cold weather-related hazards include the following.

- Increase surveillance of building pipelines, flow lines, and safety-related equipment during periods of extreme cold.
- Examine wet-pipe sprinkler systems for areas susceptible to freezing and develop preventive or compensatory measures to ensure operation.
- Check heating systems to ensure sufficient heat is delivered to keep sprinkler piping from freezing, especially during idle periods when temperatures are extremely cold.
- Install temperature alarms or automatic backup heat sources on vulnerable systems that require special protection because of hazards or costs associated with freeze damage.
- Inspect outside storage pads and unheated storage areas, and provide additional protection if needed to ensure that stored materials are not affected by inclement weather or freeze damage.
- Inspect and repair outdoor circuits (e.g., those used for vehicle block heaters and power tools).
- Ensure that any systems that may have outdoor components or vehicles that may be parked outdoors for long periods of time are included in freeze protection planning and maintenance programs.

Ice- and Snow-Covered Walkways and Parking Lots Result in Slip/Fall Injuries

On January 12, 2009, at Brookhaven National Laboratory, an automotive shop mechanic trying to start a disabled government vehicle slipped and fell on the ice, breaking his hip when he hit the pavement. The mechanic was transported to a local hospital and treated for a fractured left hip. (ORPS Report SC--BHSO-BNL-BNL-2009-0001; final report issued February 26, 2009)

Investigators determined that because the weather in the preceding days had a small amount of snow and a period of sunshine, most of the exposed pavement of the parking lot was dried by the sunshine. However, the area near the vehicle was in the shade and, although the mechanic was aware of the icy conditions in the area, he did not notice the clear ice that had formed in the shade of the car.

On January 20, 2009, at Y-12, a building manager attempting to inspect a failed sprinkler system to determine needed repairs accessed the roof of a building, fell when he slipped on a patch of ice covered by a dusting of snow, and broke his wrist. Rooftop work was suspended, and the building manager was taken to a medical facility and diagnosed with two broken bones in his wrist. All rooftop work was suspended until a critique was performed and workers were provided with cleats for their shoes. (ORPS Report NA--YSO-BWXT-Y12NUCLEAR-2009-0002; final report issued March 2, 2009)

Investigators determined that a heater in a room of the building failed over a particularly cold weekend and the sprinkler line in the room froze and broke, resulting in a failed sprinkler line. When the building manager returned to work following the

weekend, he accessed the roof to find the cause of the leak and determine the necessary repairs to put the sprinkler back on line so that fire watches could be discontinued. He was not wearing shoes with cleats and did not use any ice melt to clear his path. Although he noticed a thin dusting of snow, the gravel on the roof was visible, and he believed he had good traction. However, as he moved across the flat part of the roof toward some piping, he slipped and fell.

The following tips can help avoid typical winter slip/fall accidents.

- Wear the proper footgear (e.g., shoes, boots, or overshoes with anti-slip soles or cleats).
- Keep both hands free for balance.
- Be careful of wet shoes on a dry floor; they can be just as slippery as dry shoes on a wet floor.
- Keep walkways and parking lots clear of water, snow, and ice.

Treacherous Driving Conditions May Result in Vehicle Accidents

The best advice in bad winter weather is to stay off the roads; however, staying home is not an option for most workers. The following winter driving tips from The Weather Channel can reduce the potential for a vehicle accident during inclement weather. Additional tips are available on the Weather Channel site (http://www.weather.com/activities/driving/drivingsafety/drivingsafety-tips/snow.html).

- Decrease your speed and leave plenty of room to stop. Allow at least three times more space than usual between you and the car in front of you.
- Brake gently to avoid skidding. If your wheels start to lock up, ease off the brake.
- Turn on your lights to increase your visibility to other motorists.
- Keep your lights and windshield clean.
- Use low gears to keep traction, especially on hills.
- Don't use cruise control or overdrive on icy roads.
- Be especially careful on bridges, overpasses and infrequently traveled roads, which will freeze first. Even at temperatures above freezing, if the conditions are wet, you might encounter ice in shady areas or on exposed roadways such as bridges.
- Do not pass snow plows and sanding trucks. The drivers have limited visibility, and you're likely to find the road in front of them worse than the road behind.
- Do not assume your vehicle can handle all conditions. Even four-wheel and front-wheel drive vehicles can encounter trouble on winter roads.

One step site management can take to reduce the potential for winter weather-related events is to communicate with workers before the winter season begins about safety precautions they can take when stormy weather brings additional hazards to the work place. An example of a good practice in this regard is the Los Alamos National Laboratory (LANL) Winter Campaign, which routinely kicks off in late fall with an all-employee communication and site-wide meetings.

During the 2008/2009 Winter Campaign, each LANL worker received a "campaign bag," that could be used to carry their street shoes to work in while wearing weather-appropriate outdoor footwear. The bag, shown in Figure 2-2, contained useful items for the winter season (e.g., de-icer, ice scraper). An all-employee communication included tips on how to lessen the impact of falls, including: roll with the fall (try to twist and roll backwards, rather than falling forward); relax as much as possible when you begin to fall; and toss the load you are carrying and protect yourself instead of the objects being carried.

Figure 2-2. LANL Winter Campaign Bag 2008/2009

Each year OE Summary articles that address winter preparations are issued to provide various tips, checklists, and pertinent seasonal-related information. Earlier OE Summary articles have included an example of the cold weather checklist provided in DOE G 433.1-1; freeze protection guidance for fire suppression systems, piping, HVAC systems, and outdoor circuits; and appropriate winter PPE and protective measures to take when working outdoors in cold weather.

OE Summaries with winter weather-related articles from 2002 through 2008 are available at http://www.hss.energy.gov/CSA/analysis/oesummary/index.html. DOE G 433.1-1, N*uclear Facility Maintenance Management Program Guide for Use with DOE O 433.1,* can be accessed at http://www.hss.energy.gov/nuclearsafety/ns/reg/g4331-1.pdf.

These events illustrate the importance of preparing for cold weather before its onset. Managers should ensure that current policies, procedures, and work planning efforts reflect the lessons learned from previous inclement weather and that systems with outdoor components or vehicles that are parked outdoors for long periods of time are included in freeze protection planning and maintenance programs. In addition to taking precautions to ensure that buildings, systems, and equipment are not negatively impacted by inclement weather, employees need to be reminded to take precautions to avoid injuries from slips, falls, and vehicle accidents in treacherous weather conditions.

KEYWORDS: Winter, freeze protection, arc flash, fire, ice, snow, oil spill, ball valve, legacy water line, sprinkler system, slips, falls, injuries, fatality, good practice

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

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.

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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