Operating Experience Summary

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Inside This Issue

Ladders: What Goes Up Must Come Down — Safely

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In 2006, OSHA issued 2,115 citations for violations of 29 CFR 1926.1053, *Ladders*. Bureau of Labor Statistics (BLS) data for 2005 show 129 fatalities in the United States that were attributed to falls from ladders, with an average of 122 fatalities per year between 2000 and 2004. The Office of Health, Safety and Security searched the ORPS database from 2000 through 2006 and found 43 events involving ladder safety issues. These events resulted in 33 injuries and 1 fatality.

In October 2006, a Type B accident investigation was completed for a serious ladder fall injury that occurred at Lawrence Livermore National Laboratory (LLNL) on July 31, 2006. An electrician was working alone to replace four air-conditioning units on the roof of a building. He had to access the units from an exterior fixed ladder. While ascending the ladder, the electrician missed a step, lost his balance, and fell approximately 5 feet to a deck below the ladder (Figure 1-1). Fire Department paramedics responded to the scene and transported the electrician to a local hospital where he was diagnosed with multiple fractures of his left wrist, shoulder, and pelvis, along with other injuries. He was hospitalized for 8 days and transferred to a recovery center for another 18 days. (ORPS Report NA--LSO-LLNL-LLNL-2006-0037)

The Accident Investigation Board determined that human error (missing the step) was the direct cause of the accident. They also concluded that the accident could have been prevented if the worker had used the prescribed climbing technique of maintaining three points of contact with the ladder (i.e., using his feet and hands in any combination of three). During an interview with the Board, the electrician recalled missing a rung with his foot, reaching out and trying to grab a rung with his hand, and then falling to the ground. Had he followed the three points of contact technique, he would have been able to recover from the missed step without falling.

The proper climbing technique of moving only one limb at a time while three others remain in contact with the ladder is required by ANSI A14.3-2002, *American National Standard for Ladders - Fixed - Safety Requirements*, which is addressed in LLNL's ladder safety training. However, the Board believes that the training did not instill an adequate understanding of the safety importance of this climbing technique and did not ensure that the electrician was proficient in using it.

Figure 1-1. The accident scene showing the fixed ladder and an extension ladder added post-accident for temporary roof access

The Board also determined that the fixed ladder was not OSHA-compliant in the following four areas.

1. The first rung was about 17½ inches from the ground instead of the required 12 inches.
2. The ladder rungs were not skid-resistant, which is a requirement for fixed metal ladders manufactured after March 15, 1991. (The ladder was installed after 1991.)
3. The rear ladder clearance in the upper section was less than the required 7 inches.

4. The side rails of the upper portion of the ladder were constructed with angle iron, which does not afford an adequate gripping surface (Figure 1-2).

The first two areas were likely contributors to the accident; the last two could have resulted in a misstep similar to what the electrician experienced.

Figure 1-2. Walk-through section of the ladder with angle iron at the grips

The complete details of the causal analysis and the judgments of need for this accident can be found in the accident investigation report at https://reports.hss.doe.gov/csa/accidents/typeb/LLNL_073106.pdf.

More recently, on December 20, 2006, at the Nevada Support Facility (NSF), a subcontractor maintenance worker fell approximately 6 feet from a 10-foot extension ladder, fracturing his upper arm and wrist and spraining a finger. The worker was attempting to close a large gate valve to support cooling tower maintenance, when the valve handwheel came off, causing him to lose his balance. (ORPS Report NA--NVSO-GONV-NSF-2006-0001)

The investigation of this event is ongoing. However, what is known is that the valve is located approximately 15 feet above a gravel area, and the height of the valve required the worker to reach above his head while standing on the ladder . Also, the position of the ladder required the worker to turn his body sideways 90 degrees from the ladder to face the valve. Figures 1-3 and 1-4 show the position of the ladder and the valve handwheel on the gravel. The worker's awkward position on the ladder, coupled with an inadequately installed valve handwheel, resulted in the worker falling from the ladder.

Figure 1-3. A reenactment showing a worker reaching to operate the valve

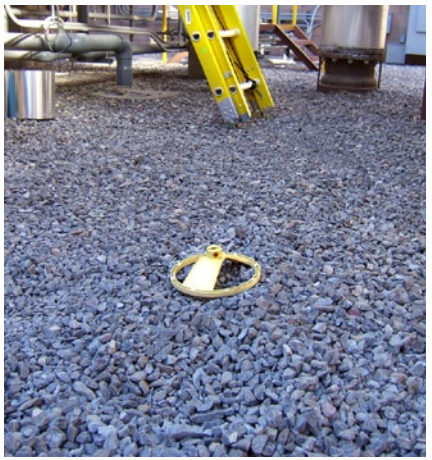

Figure 1-4. The valve handwheel near the base of the extension ladder

Unlike the October 2006, Type B event at LLNL, which involved a fixed ladder, the event at NSF involved a portable ladder. Data from BLS indicate that there is a much greater incidence of falls and injuries when workers use portable ladders, as opposed to fixed ladders. Portable ladders are more widely used by many types of workers for a multitude of different tasks. Of the 43 DOE events evaluated, 77 percent involved portable ladders. Forty-nine percent of these events resulted from loss of balance or footing, 44 percent occurred because of unsafe use, and 7 percent involved defective ladders.

According to the U.S. Consumer Product Safety Commission, there are more than 164,000 emergency room-treated injuries each year related to ladder use. Because ladders are handy and

Causes of Ladder Fall Injuries Reported to ORPS

- Forgetting rung position on the ladder while descending
- Carrying materials while ascending or descending ladders
- Climbing the ladder without three points of contact
- Losing footing
- Choosing the wrong ladder for the task
- Not securing the ladder base or having someone hold the ladder to prevent shifting
- Positioning the ladder on unstable surfaces
- Working outside the footprint of the ladder
- Not paying attention when working around fixed ladders and fixed-ladder openings

simple to use, workers sometimes forget to use them safely. Accident prevention requires proper planning, correct ladder selection, adequate ladder maintenance, and application of safe ladder work practices.

Subpart X of the OSHA standard for construction, 29 CFR 1926, addresses all aspects of ladder safety. The following specific citations contain requirements that very likely would have prevented many of the events reported at DOE.

- 1926.1053(b)(20): When ascending or descending a ladder, the user shall face the ladder.
- 1926.1053(b)(21): Each employee shall use at least one hand to grasp the ladder when progressing up or down the ladder.
- 1926.1053(b)(22): An employee shall not carry any object or load that could cause the employee to lose balance and fall.

The "Safe Ladder Setup and Use" text box shows tips on using ladders safely. Many of these safety tips were taken from the Consumer Product Safety Commission website (http://www.cpsc.gov).

Safe Ladder Setup and Use

- Place ladders on clean, slip-free, level surfaces.
- Check for potential obstructions (e.g., overhead utilities or doorways) that could interfere with safe ladder use.
- Extend the ladder at least 3 feet above the top support or work area.
- Anchor the top of the ladder to a solid point or have the bottom of the ladder attended by another worker.
- Place the base of the ladder one-quarter of the height of the ladder from the wall when using an extension ladder (e.g., the feet of a 20-foot ladder should be 5 feet from the base of the wall).
- Never allow more than one person on a ladder at a time.
- Use carriers and tool belts to carry objects up a ladder.
- Do not lean out from the ladder. Work within the footprint of the ladder by keeping your waist inside the side rails.
- Do not allow others to work under a ladder while it is in use.
- Do not climb a ladder if you have a fear of heights.

These events underscore the importance of taking appropriate safety precautions when using ladders and of paying attention both to the task and the task location when working on ladders. Managers and supervisors should communicate the necessity of understanding and following ladder safety procedures to their workers and should ensure that they are proficient in safe climbing techniques. Remember, what goes up must come down, safely.

KEYWORDS: *Ladders, portable ladder, fixed ladder, fall, injury*

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

Valley Fever Cases Reported at Lawrence Livermore National Laboratory

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The Office of Health, Safety and Security recently issued a *Safety Advisory* (No. 2007-01) about the hazards of a serious respiratory infection known as Valley Fever (*coccidioidomycosis*), which is caused by a fungus commonly found in soil in the southwestern area of the United States. Figure 2-1 shows the areas where the fungus is prevalent. Infection occurs when airborne spores (*C. immitis*) are inhaled. The advisory was issued after Lawrence Livermore National Laboratory (LLNL) reported that four cases of occupational Valley Fever had been diagnosed at the Laboratory between June and November 2006.

On December 13, 2006, LLNL reported that, based on medical evaluations and the employees' work tasks and activities, all four cases of Valley Fever were work-related. Those who contracted Valley Fever included a firefighter, a laborer, a senior scientific associate, and a subcontractor environmental technician. All four lived in the area surrounding LLNL in addition to working at the Laboratory. (ORPS Report NA--LSO-LLNL-LLNL-2006-0066)

The fireman was diagnosed with Valley Fever on June 8, 2006. One of his work activities was checking site fire trails. He was hospitalized for 4 days as a result of the illness and was not returned to full duty until October 16, 2006. The laborer, who was diagnosed with the illness on July 12, reported that he had been working on a soil job for about a week at the end of May and during the first week of June. Although he was not hospitalized and did not lose any time from work, he was on modified duty for 27 days and did not return to full duty until September.

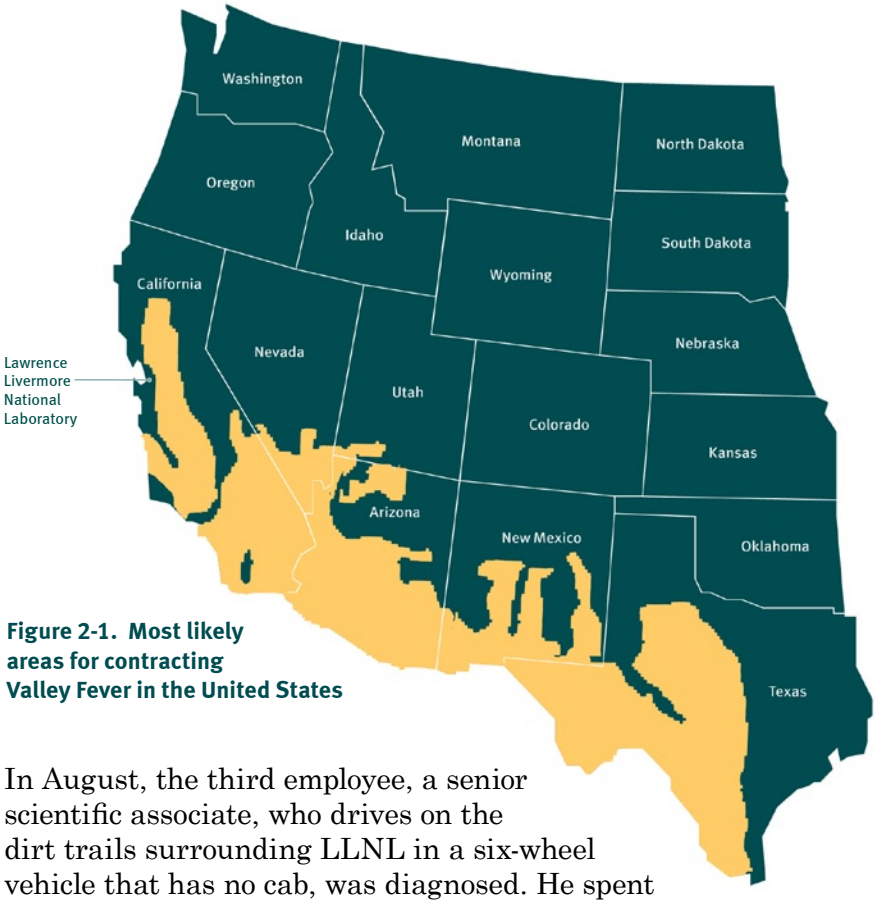

Figure 2-1. Most likely areas for contracting Valley Fever in the United States

In August, the third employee, a senior scientific associate, who drives on the dirt trails surrounding LLNL in a six-wheel vehicle that has no cab, was diagnosed. He spent 18 days in the hospital and was then transferred to a skilled nursing facility for another 10 days. He did not return to work until November, after accumulating 129 lost work days.

The fourth case of Valley Fever was diagnosed in early November. The worker, a subcontract environmental technician who worked outside on the fire trails and took well samples, initially was hospitalized for 7 days. He left the hospital and was returned to work (with restrictions) on November 6, but 11

days later he was re-admitted. The technician lost a total of 57 workdays before he was cleared to return to work.

Laboratory management has been proactive in trying to prevent work-related exposures to Valley Fever and has been educating its employees about the illness for over 30 years. In fact, both employee and visitor training include information on Valley Fever, as does the LLNL *Environment, Safety, and Health Manual.* Corrective actions taken following the recent infections included the following.

- Incorporate dust control evaluations into the review of new work activities.
- Categorize all work activities by the level of risk to dust exposure.
- Identify actions to control dust exposure (e.g., respirators, wet methods).
- Provide additional site-specific training to employees and visitors about work activities that have an elevated risk for dust exposure and discuss the resources available to protect employees and visitors.

During 2003 and 2004, the number of cases of Valley Fever in the United States increased 32 percent. By 2006, there was a 56 percent increase in cases reported in Arizona alone, where a record 5,493 cases were diagnosed. (*Washington Post,* January 11, 2007) The increase is probably attributable to recent changes in land use, demographics, and climate. Natural disasters have also triggered a rise in Valley Fever cases. The Central Valley of Southern California, for example, had a 4-year epidemic of Valley Fever in the early 1990s after a severe drought. Cases of Valley Fever also increased in those exposed to billowing dust released by the January 1994 earthquake in Northridge, California.

A search of the ORPS database revealed no other reported cases of Valley Fever across the Complex. However, Valley Fever is a relatively obscure disease and fewer than half of those exposed develop symptoms. About 60 percent of those who inhale the spores and contract the disease have mild, flu-like symptoms, but a small percentage experience severe effects (e.g., extreme pain in joints, difficulty breathing). The disease can also result in a fatality if disseminated to other parts of the body (e.g., the infection can migrate to the brain).

The chest x-ray in Figure 2-2 shows some effects of Valley Fever in the lungs. In the middle of the left lung (seen on the right side of the picture) there are multiple, thin-walled cavities (seen as light areas) with a diameter of from 2 to 4 centimeters. To the side of these light areas are patchy light areas with irregular and poorly defined borders. Cavities such as these occur in about 5 percent of patients who develop pneumonia as a result of inhaling spores; in about one-third of these cases, patients may cough up blood. The severity of the disease is, to some extent, related to the number of spores inhaled.

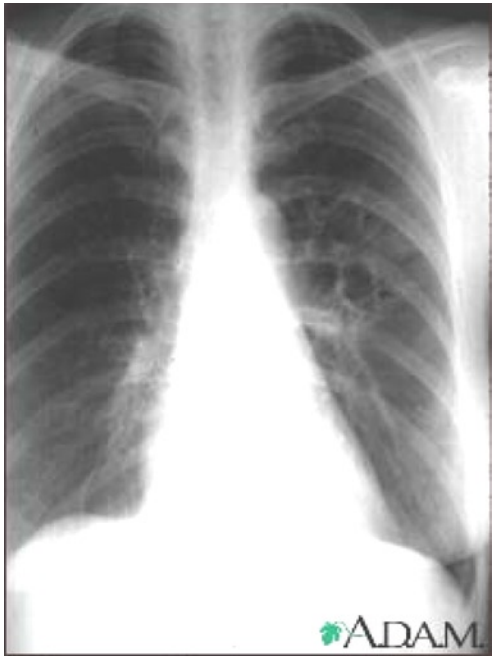

Figure 2-2. Chest x-ray showing effects of Valley Fever on the lungs

Wearing a NIOSH-approved respirator or equivalent respiratory

protection can reduce the inhalation risks. Establishing an appropriate respiratory protection program that meets the OSHA requirements in 29 CFR 1910.134 is also an essential element of preventing exposures to the spores that cause Valley Fever.

Anyone who lives, visits, or travels through areas where the fungus grows in the soil can contract Valley Fever. However, people working in occupations such as construction, excavation, and other occupations that disturb the soil or those who pursue recreational activities such as biking, driving all-terrain vehicles, or riding in four-wheel-drive vehicles in these areas may also be at increased risk.

Common Symptoms of Valley Fever

- Fatigue, cough, and fever
- Profuse night sweats
- Loss of appetite
- Chest pain
- Muscle and joint aches, especially ankles and knees
- Rash (tender red bumps on shins or forearms)

Workers at DOE sites in the Southwest, particularly those engaged in construction activities or other outdoor occupations, may be exposed to the spores that cause Valley Fever. A blood test that measures the level of antibodies to the fungus is needed to diagnose the disease, as are chest x-rays and sputum, tissue, or body-fluid cultures. Most physicians in endemic areas are well versed in the diagnosis and treatment of Valley Fever. However, the Valley Fever Center for Excellence can provide a physician referral and will also consult with a physician about diagnosis and treatment. The contact number for the Center is (520) 629-4777.

Dust controls (e.g., wearing respirators and wetting the soil), along with the actions listed in the HSS Safety Advisory, *are key to mitigating Valley Fever exposure. Raising awareness about the disease by educating both workers and site visitors is also important. Evaluating environmental conditions before work begins and minimizing soil disturbance may also result in fewer exposures to the spores that cause Valley Fever.*

KEYWORDS: *Valley Fever, spores, dust control, respirator, occupational exposure*

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

Operating Vehicles or Equipment While Fatigued Can Be Fatal

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On the afternoon of July 24, 2006, a Lawrence Livermore National Laboratory employee was killed when the government-owned pickup he was driving crossed into oncoming traffic and collided head-on with a tractor-trailer. Because of sunny, dry weather conditions and witness statements, and in the absence of other contributing factors, the Coroner and Sheriff's Office believe that the driver fell asleep at the wheel. (ORPS Report NA--LASO-LLNL-LLNL-2006-0035)

Department of Energy employees who work long hours or on the night shift may never be the victims of such a serious event, but a large percentage of them could be impacted by fatigue. In fact, a study published in the January 2007 *Journal of Occupational and Environmental Medicine* found that nearly 40 percent of workers experience fatigue during the workday. The study looked at the relationship of fatigue and productivity; specifically, where workers had problems concentrating or took longer to accomplish regular tasks. The study indicated that workers on the night shift are at greater risk of fatigue-related accidents for the following reasons.

- Fewer workers may be present to help with work or to provide stimuli.
- Darkness exacerbates fatigue.
- Workers on night shift may have less seniority and less experience and be provided with less oversight.
- Hazardous work is often assigned when the larger workforce has gone home.

Fatigue and the resulting errors are most obvious in shift work because the body's natural circadian rhythms, or cycles, are disrupted. Workers at nuclear facilities that operate 24/7 can be particularly vulnerable because low lighting, warm temperatures, and heavy or vision-restricting PPE may contribute to or exacerbate fatigue.

On August 28, 2002, at Hanford, a Nuclear Chemical Operator performing cell cleanout on the night shift was found to have skin contamination when he exited. Subsequent analysis of the event identified many corrective actions, including the need for a higher level of supervision on the night shift because of the increased chance of personnel error through fatigue or inexperience. (ORPS Report EM-RL--PHMC-TPLANT-2002-0011)

Between July 29 and August 1, 2002, also at Hanford, two separate events occurred where Operations personnel on the night shift moved a waste box to the wrong storage pad. The subsequent analysis identified multiple causal factors, including worker fatigue when workers are assigned to the night shift; or, for example, in the July 29 event, when workers who had worked a complete day shift stayed to work overtime. One of the corrective actions was a lesson learned addressing human factors such as overtime fatigue and its effect on work. (ORPS Report EM-RL--PHMC-TPLANT-2002-0009)

On July 1, 2002, at Lawrence Livermore National Laboratory, a machinist using a horizontal boring mill with a four-blade cutting bit was momentarily distracted, bumped against the blade, and lacerated his shoulder. The wound required 12 sutures. Subsequent investigation discovered that, although there were multiple causal factors, including no engineered barrier around the mill's work zone during machine operation, the machinist consistently worked overtime in the weeks leading up to the event, reaching the standard 16-hour overtime

limit in 7 of the 9 previous weeks. The ORPS report stated that long-duration overtime, combined with the early morning hour of the event (6 a.m.), could have resulted in a level of fatigue that impacted the machinist's alertness and coordination. (ORPS Report DP-OAK--LLNL-LLNL-2002-0016)

On June 4, 2002, at Tonopah Test Range/Sandia National Laboratory, employees returning home after working their shift were in a single-vehicle accident when their van driver/coworker fell asleep at the wheel and the government-owned van went off the road and rolled over. The driver had had only 3 hours of sleep the night before, had a lengthy commute to get to the van pickup point, and had then worked a 12-hour shift. (ORPS Report DP-ALO-KO-SNL-15000-2002-0002)

Fatigue is also of great concern in the transportation industry, where a tired boat or airline pilot, long-haul trucker, or air traffic controller can make a mistake that could kill or injure hundreds of people.

OE Summary 2006-02 described lessons learned from the 2003 Staten Island Ferry crash—one of the worst mass-transit disasters in New York history (Figure 3-1). The boat's pilot was convicted of manslaughter for the crash, which killed 11 people and injured more than 30, including a young man who lost both legs.

The ferry, carrying 1,500 passengers, was on a routine run across New York Harbor from lower Manhattan with its captain alone in the wheelhouse. The captain blacked out, and the ship ran full speed into a concrete pier. At his trial, he admitted to suffering from extreme fatigue and using painkillers, stating, "I will regret for the rest of my life that I did not call in sick." He was sentenced to 18 months in prison, and his supervisor was sentenced to a year in prison for failing to enforce the regulation that a ferry must be operated by two pilots whenever it is docking. Enforcement of that two-person

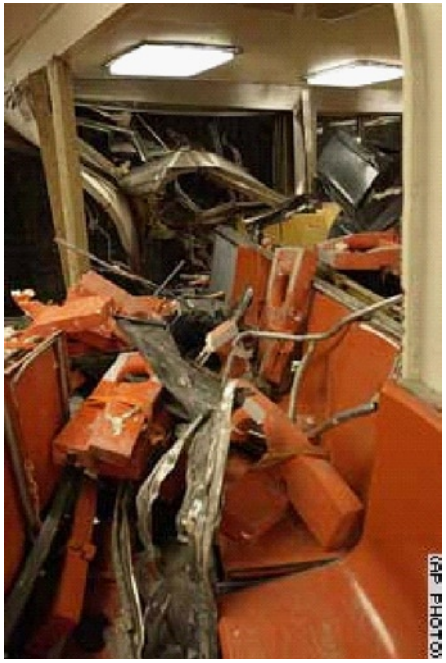

Figure 3-1. Interior of Staten Island Ferry post-accident (AP photo)

rule would have prevented this accident. (Sources: CNN News October 16, 2003; Fox News January 9, 2006; Gotham Gazette, November 9, 2006; and NTSB Abstract, MAR-05/01)

On November 29, 2006, the Federal Railroad Administration (FRA) released a study that provides a strong rationale for evaluating work schedules and resulting worker fatigue. In the past 5 years, human factor errors were responsible for 40 percent of train accidents, and 25 percent of these accidents were attributable to fatigue. A mathematical model is available to improve crew scheduling in order to reduce the fatigue-accident risk; the Department of Defense already uses a similar approach, according to the U.S. Department of Transportation. *Validation and Calibration of a Fatigue Assessment Tool for Railroad Work Schedules, Summary Report,* is available at www.fra.dot.gov.

Economics is another contributor to fatigue-caused accidents. As the transportation industry struggles financially, airline pilots and long-haul truckers may be forced to work longer hours either to make ends meet or to meet management demands. As organized labor's agreements (perhaps negotiated to include shorter shifts) end, more pilots may work the maximum 16-hour days, with potentially disastrous consequences.

On October 19, 2004, a Missouri plane crash killed the crew and 11 of 13 passengers. The two pilots were attempting to land their sixth flight of the day after more than 14 hours on the job. They had been given the required 8 hours "rest" between the shift and the previous day's work; however, that 8 hours was used getting from airport to hotel, eating dinner, sleeping, and then shuttling back to the airport by 5 a.m. on the morning of the crash. Such abbreviated breaks fulfill the letter of the law but fail to take into account the reality of travel. (*Washington Post*, January 25, 2006)

So what can you do if you find yourself working the night shift or becoming increasingly fatigued because of sleep problems or worries? Remember that fatigue causes more than grumpiness—it increases your chance of catching colds and flu and decreases appetite, coordination, and task performance. Take action by following these recommendations: set and follow a regular sleep schedule; avoid caffeine, alcohol, and tobacco before bedtime; exercise regularly or walk during work breaks; eat nutritious meals and snacks; wear PPE that will be comfortable for long periods; and reduce loud irritating noises in the workplace. (Source: Bongarde Media *Safety Smart!* Briefing #506-2)

These events demonstrate the importance of filling your individual sleep needs and being aware of coworker fatigue that may impact workplace safety.

Did You Know?

- During sleep, your brain is active, preparing you for peak functioning the next day.
- Raising the radio volume will not help you stay awake while driving. The only proven short-term solution is a caffeinated drink combined with a nap. (Caffeine alone will not prevent dangerous "micro naps" of 4 or 5 seconds.) And the only long-term solution is to prevent sleep loss by getting a good night's sleep.
- The human body never completely adjusts to night shift work because of circadian rhythms set by light and dark cycles.
- You cannot teach your body to need less sleep; each person's sleep need is biological. To determine how many hours of sleep you need, sleep until you wake without an alarm. Although you may not be able to sleep that many hours on a regular basis, your body needs that predetermined amount of sleep to function at an optimum level.

— The National Sleep Foundation

KEYWORDS: *Fatigue, sleep deprivation, night shift*

ISM CORE FUNCTIONS: *Analyze the Hazards; Develop and Implement Hazard 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.

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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
SELLS	Society for Effective Lessons Learned Sharing

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