Operating Experience Summary

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Battery Explodes While Charging

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On January 8, 2010, at Idaho National Laboratory (INL), a crane oiler heard a hissing sound while two batteries on a mobile crane were being charged with a manual, portable charger. The worker moved toward the charger to turn it off, and was splattered with acid when one of the batteries exploded. He immediately went to an eyewash station to rinse off the acid and later was taken to the onsite dispensary for treatment for three minor burns to his forehead. (ORPS Report EM-ID--CWI-RWMC-2010-0001; final report issued February 22, 2010)

After several unsuccessful attempts to start the engine on the crane, an equipment operator connected the battery charger to the two, 12-volt crane batteries. He attempted to start the crane twice after charging the batteries, but was unsuccessful, so he left the work area, leaving the battery charger connected to continue the charging operation. The crane oiler was checking on the status of the crane when he heard the hissing sound and decided to turn off the charger. He was about 4 feet away when the battery exploded, splashing acid on him. The crane oiler was wearing appropriate PPE for the work area, including safety glasses. However, he was not wearing the PPE specifically required for battery charging (e.g., goggles and gloves) because he was not involved in performing the task.

Unlike an automatic ("smart") charger, the manual charger output does not gradually step down the charging rate as the battery reaches a fully charged condition. The owner's manual for this charger states that these battery chargers are "not automatic and can overcharge a battery if permitted to operate for extended periods of time. Monitor the charging often." When not properly monitored and shut off when the battery is charged, this type of charger can overheat and destroy a battery, which appears to be the case in this event. Figure 1-1 shows the battery after the explosion, and Figure 1-2 shows a portion of the battery on the ground post-explosion.

Investigators could not determine if the battery exploded because it had been overcharged. However, the hissing sound the crane oiler heard is an indicator of overcharging. In addition, the equipment operator indicated that he did not check the electrolyte level of the battery prior to charging it, and a potential problem with manual chargers is that a battery cell that is frozen or has a low electrolyte level can result in overcharging. The equipment operator also told investigators that he had not read the owner's manual before he began charging the battery.

Figure 1-1. Battery after explosion

Figure 1-2. Battery part on the ground post-explosion

One issue that contributed to this event was that the work was considered "skill of the craft," but this was not a "skill" that the equipment operator could develop through job experience alone.

Investigators determined that the equipment operator did not have appropriate training for the task and that there was nothing in his training or qualifications that specifically addressed the hazards of charging lead-acid batteries. In addition, job-scoping did not identify any special circumstances or conditions that workers might encounter, and the equipment operator did not fully understand the potential problems associated with using a manual charger versus an automatic (i.e., "smart") charger. Corrective actions for this event included developing a Job Safety Analysis (JSA) addressing this specific work task.

Similar Event

On August 19, 2009, at the Savannah River Site (SRS) MOX Fuel Fabrication Facility, two subcontractor employees were charging a dead battery on an air compressor when the battery case ruptured, spilling battery acid on the ground. The incident was classified as a near miss because of the potential for injury; however, no one was injured or splashed by battery acid. (ORPS Report NA--SRSO-MOXS-MOX-2009-0006)

Investigators learned that the two subcontractor workers assigned to the battery charger task were neither trained nor qualified to perform the task. The battery charger the workers were using had several voltage settings, and the workers incorrectly set the charger at 24 volts for the 12-volt air compressor battery. As a corrective action, only personnel who have been properly trained on a specific task will be allowed to perform that task.

In both the INL and SRS events, there was reliance on "skill of the craft" when assigning the work task. However, in both cases, the workers were inexperienced with the type of battery charger they were using and were not trained in its proper use. In the event at INL, the worker was unaware that an explosion was an identified hazard if the battery was overcharged. He also did not know that if any of the battery cells were frozen or had low electrolyte levels, the battery could overcharge, so he did not check the levels in the battery before he began to charge it. In the event at SRS, neither of the subcontractor employees was experienced enough to understand that a 24-volt setting on the charger could result in destruction of a 12-volt battery.

OSHA regulations in 29 CFR 1917.157, *Battery Charging and Changing,* state that only designated persons shall change or charge batteries. In addition, the following regulations and standards apply to battery handling and charging.

- 29 CFR 1910.133, *Eye and Face Protection*, which states that protective and face equipment must be available where there is a good chance that injuries could be prevented by using such equipment.
- 29 CFR 1910.151, *Medical Services and First Aid*, which states that where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.
- 29 CFR 1910.178g), *Powered Industrial Trucks*, which includes basic battery charging and changing guidelines, such as ensuring that vent caps are functioning and that battery (or compartment) cover(s) are open to dissipate heat.

In addition to the General Industry regulations, OSHA provides battery/ battery charger safety requirements in the following Construction and Marine standards.

- 29 CFR 1926.44, *Batteries and Battery Chargers*
- 29 CFR 1917.157, *Battery Charging and Changing*

Charging batteries can be hazardous, and relying on skill of the craft creates an error-prone situation. It is important to correctly analyze the skill and knowledge needed for a work task before assigning workers to perform the work and to provide workers with the training necessary to perform the task safely. Although workers who have experience with one type of battery charger (e.g., "smart" chargers) may assume that they understand the task, they may be unaware of potential hazards involved with a different type of charger. In addition, if workers have little or no experience with a task, they may not be aware that performing it incorrectly (e.g., setting a charger at 24 volts for a 12-volt battery) creates a hazardous situation.

Skill-based errors can be anticipated or prevented by using tools such as peer-checking, self-checking, and pre-job briefings where the correct procedures are discussed and potential hazards are identified.

KEYWORDS: Battery, charging, explosion, frozen cell, electrolyte level

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

Now is the Time to Start Implementing Winter Weather Good Practices

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With the advent of spring, it may seem a little early to think about the winter of 2010/2011. However, now is actually the best time to use lessons learned and good practices from other sites to get prepared for the upcoming winter season. A winter weather management good practice from the Kansas City Plant (KCP) offers a host of winter hazard mitigation measures that can be implemented before future snow and ice conditions become slip and fall hazards. (Lessons Learned ID: 2010-KCP-0001)

During the winter season of 2003/2004, there were 10 slip and fall events related to winter weather at KCP. Six of the events resulted in workers requiring first aid, while the remaining four injury events were OSHA reportable. Because of the number of winter-related incidents and injuries, a number of mitigation measures were developed and implemented for the winter of 2004/2005. As a result, by the winter of 2009/2010, there were zero OSHA-reportable slip and fall events at the site and only 3 slip and fall first-aid events (Figure 2-1). The mitigation measures implemented by KCP are discussed below.

Following the winter of 2003/2004, KCP site management tasked a team of employees, maintenance workers, and contract snow removal service personnel with identifying potential winter weather slip and fall hazards and developing measures to address them. The team researched KCP injury records, survey data, and benchmarking information and reviewed historical weather patterns to develop a standard, repeatable approach to managing resources during adverse weather.

Multiple communication methods were developed to increase employee hazard awareness, such as a hotline for employees to report slick spots needing treatment and an all-employee online training module on winter weather hazards. They also sent employees winter weather hazard reminders throughout the winter season.

To address the issue of ice- and snow-covered walking surfaces, the team identified appropriate materials to treat them, such as ice melt and rock salt. Ice melt and other useful supplies were also placed at strategic locations (e.g., guard stations) so employees had easy access to them and could treat any slick spots they noticed. The team also ensured that ice cleats were provided to employees who worked or traveled outside during winter weather, and employees were regularly reminded about proper footwear and walking techniques during inclement weather.

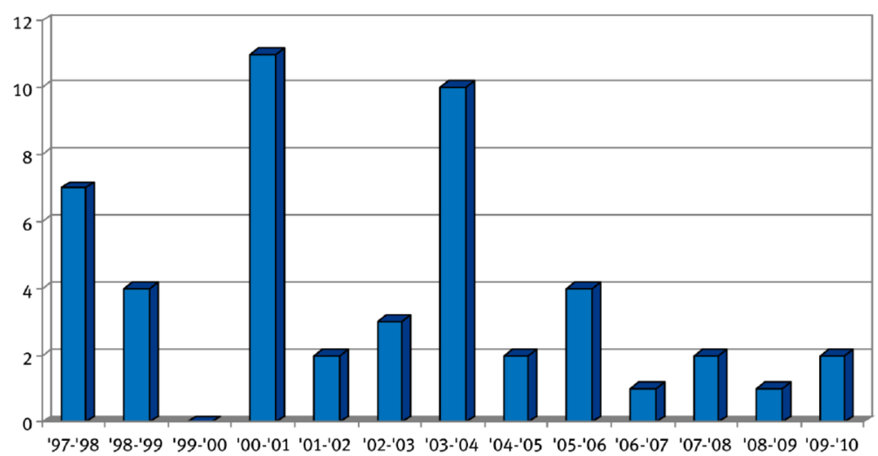

Figure 2-1. Weather-related injuries from winter 1997 through winter 2010
(including both OSHA-recordable and first aid cases)

Another innovation developed by the team was the "Snow Brigade," which monitored weather conditions and was activated during significant winter weather events that affected KCP employees during shift change. Members of the Brigade monitored entry routes into the facility from parking lots, providing pedestrian assistance and directing workers to the safest route into the facility. They also monitored walking conditions and communicated any issues that arose to the Brigade coordinator so action could be taken to resolve them.

Improvements for keeping walkways dry inside the facility included upgrading to equipment such as the riding scrubber shown in Figure 2-2 and implementing a process for replacing wet mats with dry ones at entry points (Figure 2-3) on a timely basis. Outside maintenance began with selecting a contractor and conducting a preliminary performance test. Among other responsibilities, the contractor was required to subscribe to a local weather service to more easily forecast the need to perform weather-related maintenance, identify an onsite contractor supervisor, and provide KCP site management with a contact list.

Figure 2-2. Riding auto scrubber

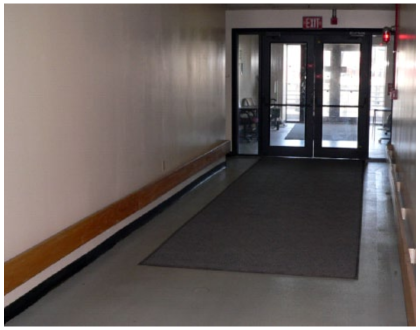

Figure 2-3. Entry mat system

The success of the KCP winter weather management program is reflected in the continuing reduction in weather-related injuries, as shown in Figure 2-1. Management continues to analyze the slip and fall data to determine systemic issues and address them.

For additional information about the KCP program, contact Kevin Allgeyer (kallgeyer@kcp.com) or Kent Klug (kklug@kcp.com) at Honeywell FM&T/Kansas City.

Other Winter-Related Good Practices

After two electrical cords were damaged during snow removal at the Idaho National Laboratory by a worker who was not qualified to perform the task, a lessons learned submitted to the DOE Corporate Lessons Learned Database stressed the importance of performing pre-job briefings to identify any hazards, as well as the need to ensure that only qualified workers perform snow-removal work. Another good practice to help avoid such damage, during both snow removal and grass cutting, is to require electrical cords to be elevated above the ground to preclude entanglement and contact issues. (Lessons Learned ID: 2010-ID-AMWTP-0002)

Two additional good practices implemented at Los Alamos National Laboratory (LANL) were discussed in previous OE Summary winter hazard preparation articles.

1. OE Summary 2009-10 described the LANL Winter Campaign, which routinely kicks off in late fall. The 2009/2010 Winter Campaign included an all-employee communication that provided tips on how to lessen the impact of falls, and employees were given a carry bag they could use to carry street shoes to work in while wearing weather-appropriate outdoor footwear.
2. OE Summary 2007-07 discussed practices put in place to prevent worker injuries in parking lots because of refreezing after plowing and sanding and because some employees did not remove their private vehicles from the lots to permit plowing. In addition, the use of sand for parking lots and procedures for addressing snow piles had not been incorporated into the Laboratory's snow removal plan.

> Management devised a mechanism that could be used to disseminate snowstorm information to employees and established an employee hotline to alert snow removal crews to areas needing attention. An electronic message was also sent to all employees asking them to take personal responsibility for wearing appropriate winter footwear, walking defensively, and for spreading de-icer on walkways if they noticed a problem.

A winter weather program to significantly reduce slips and falls related to ice and snow should be developed months before the winter season begins. The good practice implemented at KCP provides a useful model for other sites across the Complex: identify the issues; use multiple communications methods to increase hazard awareness; and develop a standard, repeatable approach to managing adverse weather conditions.

The winter hazard program at LANL also can effectively address slip and fall injuries. In addition, as pointed out by the Idaho National Laboratory lessons learned, it is important to ensure that anyone who is involved in snow removal activities is qualified to perform the task and to require pre-job briefings to identify potential problems or hazards that may arise during snow removal. Finally, the use of good practices, such as elevating electrical cords, is important to eliminate or reduce hazards.

KEYWORDS: Good practice, ice, snow, winter weather, slips, falls

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

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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