Operating Experience Summary

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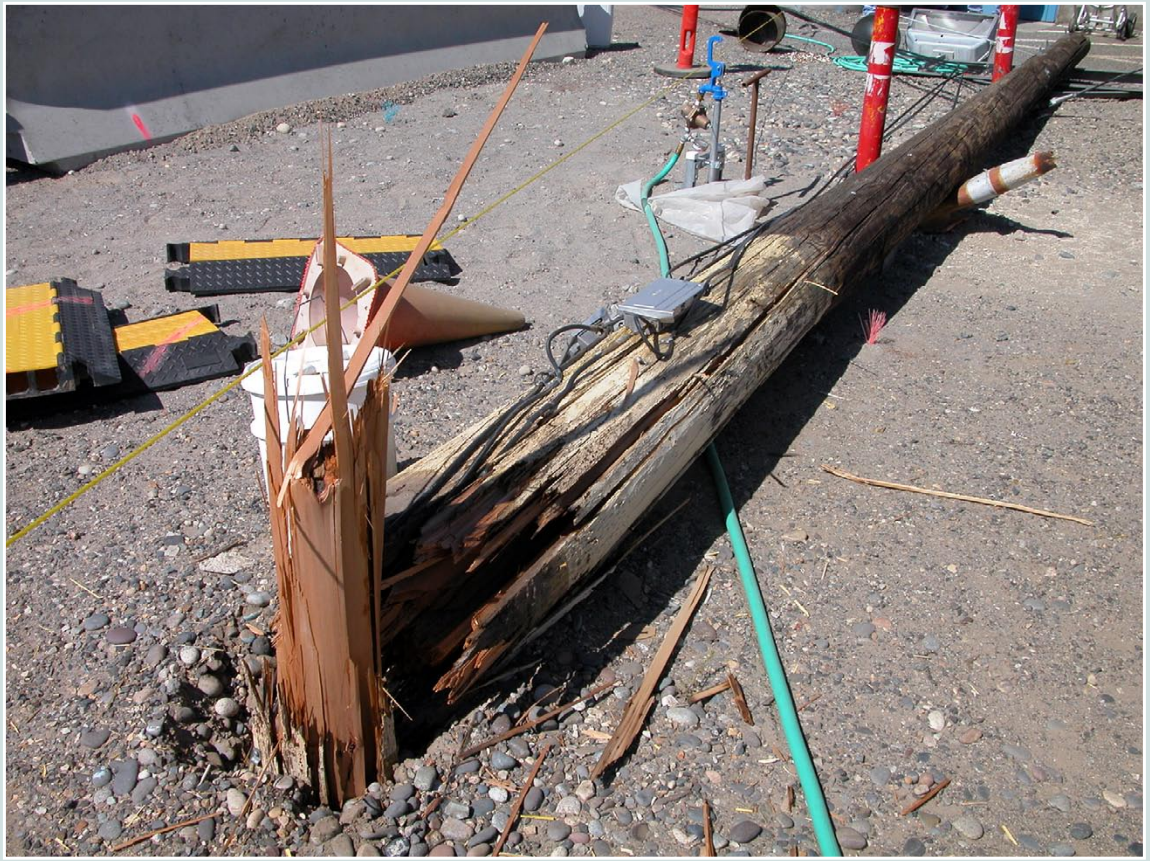

Always Check for Overhead Lines When Moving Large Equipment

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On September 10, 2008, at the Hanford Site, an equipment operator was moving an excavator out of a construction area when the excavator boom hit an overhead communication line, pulling down two poles and exposing underground electrical lines (Figure 1-1). The equipment operator chose not to interrupt other work to get a spotter or flagman and did not lower the primary boom for transport. (ORPS Report EM-RL--PHMC-PFP-2008-0005; final report issued October 8, 2008)

Figure 1-1. The accident scene with excavator and downed utility pole

While the excavator was moving, the boom snagged communication lines that were 17 feet above the roadway, causing a utility pole to break off near ground level and fall to the ground. The nearest worker was more than 20 feet away from where the pole landed. The falling utility pole caused a second utility pole to snap off (Figure 1-2) and fall toward a small concrete out-building containing diesel generators. The fallen poles displaced three underground 110-volt and 240-volt electrical lines that were run inside conduit. The 110-volt line shorted out and tripped the supply circuit breaker.

The work package identified the overhead hazards and the requirements for spotters and full retraction of the boom. Although the equipment operator was aware of these requirements, he did not follow them.

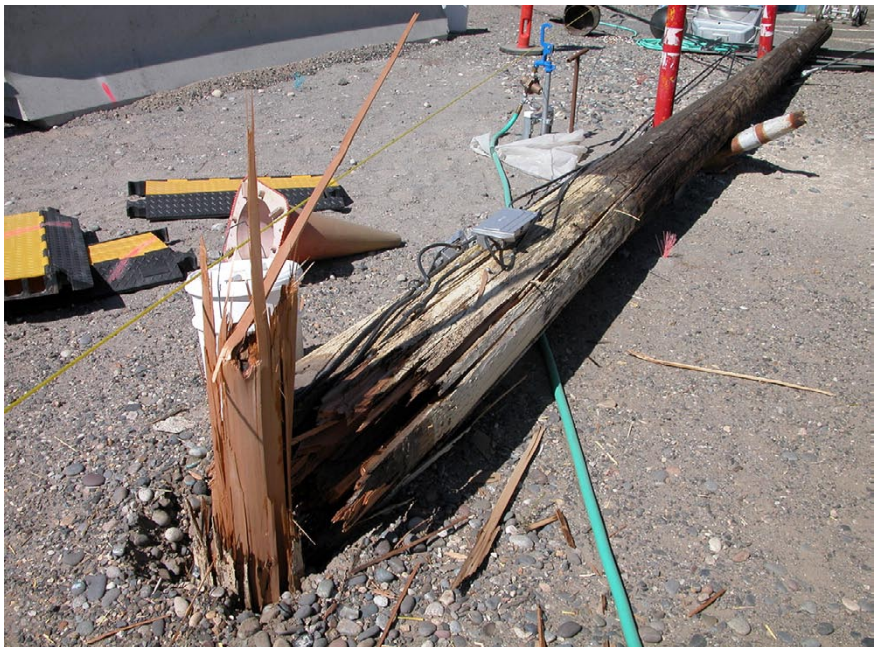

Figure 1-2. Snapped off utility pole

This incident resulted in two destroyed utility poles; damaged underground electrical lines, conduit, and boxes; downed communication lines; and dislocated communication line connections to buildings.

At least two OSHA requirements were violated in this incident. OSHA regulation 29 CFR 1910.333(c)(3)(III)(A) states, in part: "Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized lines shall be operated so that a clearance of 10 feet is maintained." (NOTE: If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 feet.) In addition, OSHA regulation 29 CFR 1910.550(A)(15)(IV) states: "A person shall be designated to observe clearance of the equipment and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means."

There have been a number of recent events involving heavy equipment across the Complex.

- On May 21, 2008, at the East Tennessee Technology Park (ETTP), an equipment operator relocated an excavator to the west side of the K-25 building, then exited the cab and left the area. A coworker noticed that the boom of the excavator was touching a 480-volt double insulated overhead line and notified management. (ORPS Report EM-ORO--BJC-K25ENVRES-2008-0007)

  The excavator operator was an experienced Journeyman, who had successfully moved equipment around with the assistance of a spotter. However, in this event, the operator did not walk down the transit path or use a spotter. The operator indicated that he was unaware of the overhead line.

- Another ETTP event occurred on the east side of the K-25 building on August 8, 2008, when an excavator was being relocated, but in that event, the excavator hit only the power pole, not the overhead line. After the event, use of heavy equipment was restricted. (ORPS Report EM-ORO--BJC-K25ENVRES-2008-0020)

- On May 5, 2008, at the Hanford Site, while electrical linemen were moving a bucket truck that had been used during electrical switching, the cradled boom on the truck hit a low-hanging abandoned communication line and pulled down a pole. (ORPS Report EM-RL--PHMC-ELEC-2008-0001)

  The truck driver drove the truck into the work area and underneath the overhead line without any problem; however, while exiting the area, the driver took an alternate route underneath the communication line because other vehicles parked in the area prevented him from exiting at the same point he entered. He assumed he had adequate clearance and focused his attention on the roadway, not on the overhead line.

Contact with energized overhead lines can be extremely dangerous, as demonstrated by the following industry event.

On September 17, 2008, at the Monticello Nuclear Generating Plant, a worker for an equipment rental company was electrocuted when the manlift he was driving came in contact with an energized 115-kV power line. The worker was at the plant to assist electrical crews fixing a circuit breaker problem. Investigators from OSHA are reviewing the circumstances of the worker's death. (NRC Event Report 44498)

Remain in the Vehicle Until Electrical Power Has Been De-Energized

If your vehicle or equipment makes contact with an overhead power line, attempt to break contact by lowering any raised sections or by moving the vehicle. If you cannot do either, remain in the cab until electrical personnel indicate that it is safe to exit. The vehicle could have become electrically energized, so do not leave the cab without permission to do so.

The textbox lists questions that should be considered when moving heavy equipment in areas where there are overhead lines.

These events underscore the importance of exercising extreme caution when working from or moving equipment near overhead power lines. DOE facility managers should ensure that facility and subcontractor equipment operators are aware of any overhead electrical hazards. Contact with overhead power lines presents a significant personnel safety hazard, as well as the potential for interruption of electrical power to facility operations and safety systems. Work planners and vehicle operators must know about and maintain minimum safe working clearances near power lines.

KEYWORDS: Overhead, power line, communication line, excavator, crane, bucket truck, manlift, energized, power pole, electrocution, spotter

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

Considerations When Moving Equipment Near Overhead Lines

- Have pre-job planning and hazard analyses restricted vehicle travel and activities to include only areas where overhead lines and other hazards have been addressed?
- Have overhead power lines been identified and their heights verified for the travel routes to be taken and the work activities?
- Will any operation of a vehicle place it, its mechanical equipment, or its load within 10 feet of overhead lines, utility poles, or supporting guy wires?
- Are all guy wires, utility poles, communication lines, and overhead power lines clearly visible to drivers and spotters?
- Are trained and dedicated spotters provided for all travel routes and for all work activities? (If not, why not?)
- Is the number of spotters assigned adequate to detect all hazards, and can they quickly and clearly communicate hazards to the vehicle drivers or equipment operators?
- Have steps been taken to ensure continuous communications between spotters and vehicle drivers or operators (e.g., use of radios)?

Propane-Fueled Forklift Trucks—A Potential Carbon Monoxide Hazard

2

The Washington State Department of Labor and Industry is investigating an apparent forklift-related carbon monoxide poisoning that occurred on September 23, 2008, at Ocean Gold Seafoods in Westport, Oregon. Twenty-eight workers at the company's cold storage facility were hospitalized after local fire, police, and ambulance service personnel responded to an emergency call from Ocean Gold and found more than 20 workers outside the plant vomiting and experiencing headaches. Of the 28 workers initially treated at a local hospital, 11 were transferred to a medical center in Seattle for additional treatment. (http://www.lni.wa.gov/news/2008/pr080924a.asp)

Figure 2-1. Typical propane-powered forklift operating indoors

Ocean Gold Seafoods had a previous incident involving carbon monoxide in 2007, when a worker was operating a propane-powered forklift in a plant freezer. (Figure 2-1 shows a typical propane-powered forklift truck.) Co-workers found the forklift operator sitting on the forklift, unresponsive. The worker was admitted to the hospital for hyperbaric chamber treatments and survived the incident.

Ocean Gold was fined $10,050 and was cited for six serious violations relating to training forklift operators, educating drivers on carbon monoxide hazards, not controlling carbon monoxide hazards in an enclosed area, and hazardous noise levels for operators.

An event with a potentially similar result recently occurred at Argonne National Laboratory. On October 21, 2008, firefighters responding to a pre-alarm from a smoke-detection system smelled engine exhaust when they entered a building. They found personnel using a propane-fueled forklift truck to perform a lift operation, and left the building to obtain a portable meter to measure air quality. When the firefighters re-entered the building, the meter alarmed and showed a reading of 80 parts per million (ppm) of carbon monoxide. They ordered workers to shut off the forklift truck and evacuated seven people from the building, all of whom were evaluated by medical personnel. None of the workers showed symptoms of carbon monoxide poisoning. (ORPS Report SC--ASO-ANLE-ANLEFMS-2008-0011)

Initial reports indicated that the forklift had been operating between an hour and an hour and a half inside the building with one of the three exterior doors closed. After the event the door was opened and portable fans were placed at the entrances to help with inside ventilation. Although there appeared to be no carbon monoxide overexposure, concerns about work planning and hazard identification will be evaluated, and an investigation will be conducted before the forklift truck is used again inside buildings.

When workers in a leased storage warehouse at the National Renewable Energy Laboratory requested an indoor air quality survey on April 17, 2008, carbon monoxide readings in a building research laboratory ranged from 64 ppm to 67 ppm, and measurements in other areas of the facility ranged from 19

ppm to 37.2 ppm. The ACGIH Threshold Limit Value (TLV) is 25 ppm. Investigators checked for sources of carbon monoxide in the building, including newly installed gas-fired heaters, which they found to be properly installed and vented. The highest readings were found when taking readings along a dividing wall to an adjoining space. The landlord indicated that another renter was using propane-powered forklift trucks in that area of the building for 8 to 16 hours a day, 5 days a week. Investigators determined that the forklift trucks were the source of the carbon monoxide emissions. (ORPS Report EE-GO-NERL-NREL-2008-0004)

Carbon monoxide is produced during the incomplete combustion of carbon-containing substances (paper, wood, and petroleum products). Forklifts powered by gasoline, natural gas, or propane can emit dangerous levels of carbon monoxide, as can other gasoline-, natural gas-, diesel-, or propane-fueled vehicles, power tools, or equipment used indoors. Carbon monoxide can rapidly build up in any indoor area.

Carbon monoxide poisoning can cause permanent brain damage, including changes in personality and memory. Once inhaled, carbon monoxide decreases the ability of the blood to carry oxygen to the brain and other vital organs. Even low levels of carbon monoxide can cause chest pains and heart attacks in people with coronary artery disease. Because carbon monoxide has no warning properties, workers can be exposed to high levels without even realizing that there is a problem, but inhaling it can cause headache, nausea, dizziness, weakness, rapid breathing, and, finally, unconsciousness. If high concentrations are inhaled, carbon monoxide can rapidly be fatal.

An article in OE Summary 2003-19, *Small Gasoline-Powered Engines Can Present a Carbon Monoxide Hazard,* included an ORPS review of carbon monoxide exposures caused by internal combustion engine exhaust. The review indicated that DOE workers had been exposed to carbon monoxide from larger engines in manlifts, forklifts, trucks, and tractors using gasoline (69 percent), propane (26 percent), and diesel (5 percent) fuels. The textbox, taken from that article, lists a number of precautions that can be taken to prevent carbon monoxide poisoning. In addition, an OSHA factsheet on carbon monoxide can be accessed at http://www.osha.gov/OshDoc/data_General_Facts/carbonmonoxide-factsheet.pdf.

Preventing Carbon Monoxide Poisoning in The Workplace

- Install and use ventilation systems that effectively remove carbon monoxide from work areas.
- Do not operate engines near building air intakes and windows.
- Consider using electric-, battery-, or air-powered equipment rather than gasoline powered equipment.
- Prohibit the use of gasoline-powered engines or tools in poorly ventilated areas.
- Test the air regularly in areas where carbon monoxide may be present (e.g., confined spaces).
- Provide personal carbon monoxide monitors with audible alarms if there is the potential for exposure.
- Maintain equipment that produces carbon monoxide in good working order.
- Educate workers about the sources and conditions that can result in carbon monoxide exposure, including symptoms and controls.

A Washington State Department of Labor and Industry publication on forklift safety advises that propane forklifts must be regularly inspected and maintained and that concerns about the exposure level in an enclosed area where a forklift operates should be addressed by having an industrial hygienist take air quality measurements and make recommendations to improve ventilation. The publication can be accessed at http://www.lni.wa.gov/IPUB/417-031-000.pdf.

OSHA requirements in 29 CFR, 1917.24, *Carbon Monoxide,* state that the carbon monoxide content of the atmosphere in a room, building…or any enclosed space shall be maintained at not more than 50 ppm as an 8-hour average area level and that employees shall be removed from the enclosed space if the carbon monoxide concentration exceeds a ceiling of 100 ppm. OSHA also requires testing to determine carbon monoxide concentration when necessary to ensure that employee exposure does not exceed these limits.

These events illustrate the dangers of operating a propane-powered engine, or any internal combustion engine, in an enclosed space. Outdoor use of this equipment generally is not hazardous, but in buildings or enclosed spaces, carbon monoxide can quickly build up to dangerous or even lethal amounts. Propane-fueled forklifts that will be operated indoors should be regularly inspected and maintained, and operators should be made aware of the potential for hazardous carbon monoxide emissions.

KEYWORDS: Carbon monoxide, forklifts, propane, exhaust, ventilation, illness

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

3 Effective Flowdown of Hazardous Energy Controls to Subcontractor Workers

Flowdown of hazardous energy controls to subcontractors and vendors requires both clear communication of potential hazards and requirements and effective oversight to ensure that site safety requirements are followed. A number of recent events across the Complex involved vendors and subcontractors failing to implement required hazardous energy controls. Several of these events are discussed below.

On July 18, 2008, at the National Renewable Energy Laboratory (NREL), an NREL electrician observed subcontractor workers installing conduit, pulling cables and working near open, energized control boxes and panels (internal voltages of 480 volts, 120 volts, and 48 volts) without using lockouts/tagouts (LO/TO) or wearing personal protective equipment (PPE) as required by the site Electrical Safety Program. The NREL electrician informed one of the workers that he was not following site safety practices and requested that he stop work and correct the situation. When the worker ignored the request and continued working, the electrician notified the subcontractor's ES&H point of contact, who issued a stop work order. (EE-GO--NREL-NREL-2008-0010; final report issued August 29, 2008)

Investigators confirmed that the subcontractor workers had performed energized electrical work without proper PPE, without an LO/TO, and without an NREL Electrical Safe Work Permit. Records indicated that the construction contractor had attended subcontractor orientation, during which applicable ES&H requirements were reviewed, and that the contractor was informed of his responsibility to verify that all workers, including subcontractor workers, were familiar with the requirements. Hard copies of the site electrical safety and LO/TO procedures were available at the orientation, but the construction contract manager did not receive them. Investigators learned that the construction contractor failed to flowdown the NREL safety and health requirements to the subcontractors conducting the work. A stop work order was issued to the construction contractor citing concerns about noncompliance with site and regulatory standards for electrical work.

The lessons learned from this event included the following.

Hazard Identification and Control

- When new contractors or vendors come to work onsite, it is imperative that they have a clear understanding of site electrical safe work practices and expectations. These must be clearly communicated and documented during contractor/vendor orientation.
- It is important to communicate what constitutes energized electrical work to contractors and subcontractors to ensure that they can identify potential hazards and apply controls to mitigate them.
- It is important to inform contractors and vendors before they conduct onsite work that they will be required to demonstrate compliance with regulatory guidance, including appropriate PPE and LO/TO equipment.

Flowdown of Requirements

- Procedural documents must be provided to contractors during the contracting process either in hard copy or electronically.
- Periodically verify that contractors are flowing down requirements to subcontractors.

A similar event involving subcontractor electricians occurred at Idaho National Laboratory on January 10, 2008, when the subcontractors were replacing light ballasts. The electricians saw sparks coming from a fluorescent light fixture that they thought was de-energized. They immediately stopped work and notified the subcontractor technical representative. Investigators later learned that the electricians did not follow the specified LO/TO procedure, review applicable electrical configuration drawings, or wear appropriate PPE. All work under this subcontract was suspended pending an investigation. (EM-ID--CWI-LANDLORD-2008-0001; final report issued March 3, 2008)

Investigators found that a wire that had been cut and left in place was not terminated and capped during a modification to change the bulb configuration in the fixture from four bulbs to two. The wire had remained energized in the fixture since the late 1980s when the modification was performed. Because the bank of lights was for "night lights," which remained on at all times, they were on a separate circuit. However, the ballast in the fixture had failed, so the bulbs were not illuminated.

Investigators determined that the electricians did not use an LO/TO procedure to isolate the breaker, thus performing work without an approved hazardous energy controls procedure, even though compliance with the site LO/TO procedure was required. The subcontractor stated that the electricians isolated the breaker by having one of the crew guard the breaker while he was in sight of another crew member, who was in sight of the electrician doing the work.

Investigators also learned that the electricians did not wear the appropriate PPE when performing this work and that the pre-job briefing given by the subcontractor did not discuss the PPE required for the job. They found that the briefing did not clearly define the work scope or outline the required methods to be used when performing an LO/TO or zero-energy check. In addition, drawings showing the electrical configuration of the lighting fixtures were not obtained or reviewed.

The subcontractor electrician had told the Subcontractor Technical Representative (STR) escorting them that the panel schedule was difficult to understand and asked if circuit drawings were available. However, the STR, who was serving on an interim basis, was unable to access the database containing the drawings. Without drawings, the electricians had no way to determine which lighting block was controlled by the circuit, so they isolated the power by opening a breaker in the breaker panel.

Corrective actions for the event included developing methods to ensure better subcontractor oversight. In addition, training qualification requirements for STRs will be improved, and interim STRs will be mentored and provided with additional oversight until they are fully qualified. Steps will also be taken to ensure that interim STRs have access to the database in which required drawings are stored.

In 2006-2007, at Hanford, the following events involving subcontractor and vendor failure to control hazardous energy occurred at the Waste Vitrification and Treatment Plant. (ORPS Report EM-RP--BNRP-RPPWTP-2007-0007; final report issued October 4, 2007)

- On May 9, 2006, a vendor elevator technician failed to obtain a hazardous energy work package (LO/TO permit, locks, and tags) before performing work on low-voltage control circuits adjacent to 208-volt AC equipment. (EM-RP--BNRP-RPPWTP-2006-0014)
- On April 10, 2007, a vendor for a subcontractor failed to observe site LO/TO requirements before performing work and was exposed to live electrical components in a heat pump panel. (EM-RP--BNRP-RPPWTP-2007-0004)

- On April 17, 2007, a vendor for a subcontractor failed to observe site LO/TO requirements before performing work and was exposed to live electrical components in a dehumidifier. (EM-RP--BNRP-RPPWTP-2007-0005)

Based on a root cause analysis, Hanford investigators concluded that site hazardous energy controls were not being adequately communicated to vendors used by subcontractors. Because work hazard control requirements were not clearly communicated, vendors could not effectively implement controls. To address this problem, a control document was issued that identified activities (including maintenance activities) requiring a hazardous energy work package. A management assessment will verify that subcontractors have a process in place to ensure flowdown of this document, as well as applicable procedures, to their vendors and sub-tier contractors.

In 2006, *SafetyXChange* online newsletter published a two-part article on managing contractors. Part 1, which discusses issues related to ensuring contractor safety, states: "The challenge for safety managers is finding an effective way to extend the protections of their own safety programs to the workers of contractors who come to their workplace. Contractor personnel are unfamiliar with your machinery and work processes. You don't get to train them the way you do your own workers. They don't know their way around your site. They're apt to inadvertently work on energized equipment, improperly enter confined spaces, or otherwise get into trouble. In short, they're especially vulnerable to accidents and need protection." Part 2 of the article discusses solutions for effectively managing contractors and includes suggestions for creating a checklist that can be used to track contractors and their work while they are onsite. The textbox shows the type of information that can be used when preparing a checklist.

How to Create a Contractor Notification Form

A contractor notification form is simple and straightforward. It is a one-page checklist of key information about each contractor the company is working with. Include all the information necessary to track the contractor, such as the following.

- The contractor's name
- The name of a designated supervisor or other person from your site who's responsible for the contractor while it's onsite (and for filling out the form)
- The name of the supervisor from the contractor's staff in charge of the contractor's workers onsite (and who serves as your contact person at the site)
- Whether the contractor has met the requirements of your safety program
- How many workers are onsite
- Whether those workers have been oriented to your safety program
- The names of any subcontractors to be used
- A brief description of the work to be done
- The start and finish date of the work

— From *SafetyXChange* (www.SafetyXChange.com)

Part 1 of the *SafetyXChange* article can be accessed at http://www.safetyxchange.org/compliance-risk-management/how-to-prevent-contractor-accidents-part-1. The link to Part 2 is http://www.safetyxchange.org/compliance-risk-management/how-to-prevent-contractor-accidents-part-2.

Effective hazards recognition and control involves all workers, including subcontractor and vendor workers. To reduce the possibility of human error, it is important to effectively communicate requirements rather than depending on vendors or subcontractors to interpret requirements or make assumptions about potential hazards. Title 10, Code of Federal Regulations (CFR), Part 851, *Worker Safety and Health Program*, establishes the worker safety and health requirements governing the conduct of contractor activities at DOE-controlled workplaces, including those for subcontractors and vendors. The Rule requires contractors to provide a place of employment that is free from recognized hazards that are causing or have the potential to cause death or serious physical harm to workers.

DOE G 440.1-8, the Implementation Guide for 10 CFR 851, section 3.2.2.1.1 sets forth requirements for ensuring that subcontractor safety and health programs meet the requirements of the Rule. The Guide can be accessed at http://www.hss.energy.gov/HealthSafety/WSHP/rule851/g4401-8.pdf.

These events illustrate the importance of providing oversight for subcontractor and vendor workers and flowing down all safety requirements to ensure that they are aware of and follow all site procedures. Preparing, a control document identifying activities (including maintenance activities) that require a hazardous energy work package, such as is now done at the Hanford site, is a helpful method of flowing down hazard control requirements. It is also essential to ensure that subcontractor supervision has provided workers with clear instructions regarding the scope of work, potential hazards and methods for controlling them, and site procedures and safety requirements.

KEYWORDS: Hazardous energy control, oversight, subcontractors, zero-energy check, LO/TO, circuit breaker, lighting fixtures

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

The Office of Health, Safety and Security (HSS), Office of Analysis publishes the Operating Experience Summary to promote safety throughout the Department of Energy (DOE) Complex by encouraging the exchange of lessons-learned information among DOE facilities.

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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