Operating Experience Summary

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Helping the field succeed with safe and reliable operations.

The Office of Environment, Safety and Health, Office of Corporate Performance Assessment publishes the Operating Experience Summary to promote safety throughout the Department of Energy complex by encouraging the exchange of lessons-learned information among DOE facilities.

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EVENTS

1. DEMCO RECEIVES SAFETY AWARD FROM DOE

The DOE Oak Ridge Operations Office has presented Decommissioning and Environmental Management Company (DEMCO) of West Seneca, New York, with a Safe Work Performance Award. The award recognizes DEMCO for their safe work record in cleaning up the David Witherspoon Inc., site in South Knoxville, Tennessee.

DEMCO was recognized for working over 40,000 hours without a recordable injury and for logging over 50,000 miles, transporting more than 500 truckloads of debris, without a transportation incident, while cleaning up the Tennessee Superfund Site.

Over a 40-year-period, DOE used the David Witherspoon, Inc., site for processing scrap metals contaminated with radioisotopes, asbestos, and various chemical dioxins. DEMCO, under subcontract to Bechtel Jacobs Company, was responsible for the D&D of 10 radiologically contaminated buildings that were also contaminated with asbestos, heavy metals, and volatile organic compounds. DEMCO was responsible for characterization, stabilization, and disposal of over 200 drums of unidentified waste; characterization and removal of over 32 radiologically contaminated debris piles, totaling over 9,500 cubic yards of debris; and treatment of 2,000 cubic yards of RCRA/TSCA waste. Figure 1-1 shows some of the debris involved and the magnitude of the hazards.

The DEMCO scope also included characterization, decontamination, segregation, packaging, and treatment to meet the waste acceptance criteria of the disposal facilities,

Figure 1-1. Debris at the David Witherspoon Site, clearly depicting the magnitude of the prevailing hazards

transportation of all wastes generated from the demolition of buildings, and removal of debris for permanent disposal.

DEMCO provided a field staff composed of one foreman, eight laborers, three equipment operators, and five truck drivers. Management and oversight were provided by one project manager, one safety representative, and two supervisors. Field staff used specialized mechanical equipment to accomplish this project, including a bulldozer, a skid-steer loader, and two excavators fitted with various attachments (i.e., grapple, pulverizer, and hydraulic shear). The crew also used a power screen to assist with the segregation of materials retrieved from the debris piles.

The prevailing conditions of the project site, the nature of the work performed, and the type of equipment used all contributed to a work environment full of potential hazards. The more significant job hazards, and the successful preventative measures DEMCO workers used, are listed in the following table.

Identified Job Hazard	Preventative Measure(s)
Exposure to hazardous materials	• Establish clear controls and work practices • Maintain awareness through daily pre-job briefings • Use approved PPE
Personnel contamination (radioactive)	• Pre-job briefings • Use of PPE appropriate for the job • Use local containments
Slips, trips, and falls in cluttered debris areas	• Designate personnel walking areas • Maintain restricted access to job site
Manual labor type injuries (e.g., strains, sprains, abrasions, pinches) while sorting and segregating debris	• Use of mechanical equipment whenever practical
Personnel working in proximity to heavy equipment	• Use only fully qualified equipment operators • Maintain restricted access to job site

DEMCO attests that their accident-free performance was in part due to a safety culture that makes the employees take ownership of all elements of the project, empowering them to make decisions, promote constant feedback for improvement, and reward individuals for safe work performance.

For DEMCO, safety is not considered a line management function, but a function of all employees. Every workday on this project started with a plan-of-the-day meeting where detailed activities of the day were discussed and individuals responsible for each activity were identified by name. Everyone on the work crew was encouraged to provide input to the assigned activities. This not only allowed direct feedback, but also promoted an understanding of what different activities were going on simultaneously, so everybody had a true understanding of the big picture and the associated hazards.

Another element of the DEMCO approach that contributed to the success of this project is the belief that project superintendents and managers need to maintain a visible presence in the field. This concept reinforces to the work crew the importance of the project and the importance of their contribution to the project. It also helps to relieve the anxiety that workers may feel when management shows up in the field unannounced. If the work crew sees management in the field on a regular basis, they tend to relax and function uninhibitedly allowing their work practices to be truly evaluated.

When asked, "What is DEMCO's 'secret' to a successful safety record?," Corporate Safety Director, Mike Pauly stated:

> DEMCO's basic safety philosophy is routed into the belief that safety is an integral part of the overall project equal to and/or more important to project performance, cost, and schedule. Our goal is to remain innovative and create synergy. DEMCO incorporated the Behavioral Based Safety approach in the 1990s and has maintained safety as a constant core value. The combination of this with the DOE ISM Principles has been our secret of safety success. This blend basically shows us how to combine proper top-down support and values with bottom-up involvement.

DEMCO is the second company honored as part of the DOE program that recognizes contractors with outstanding safety accomplishments.

2. NEVER ASSUME A ZERO-ENERGY CONDITION — VERIFY AND WORK SAFELY

Verifying a zero-energy condition is an important part of any hazardous energy control program. Failure to do so can result in worker injury. The Office of Environment, Safety and Health reviewed occurrence reports from 2000 through 2005 in which workers assumed that safe-to-work conditions existed rather than actually verifying the absence of hazardous energy. The majority of these events (80 percent) involved electrical energy, while the other events involved pressurized systems (e.g., air or hot water). The following events are examples of this dangerous situation.

On August 12, 2005, at the Fernald Environmental Management Project, electricians saw an arc and heard a "pop" that resulted in circuit breakers tripping while they were removing 110-volt electrical leads from two solenoid-operated valves. The electricians were replacing valves in a mixer room and believed the solenoid actuators were isolated based on a conversation with the shift engineer. However, the shift engineer had assumed all systems were isolated, when in fact only the mechanical components and mixer motors were isolated, not the valve actuators. The electricians failed to perform a zero-energy check of the solenoids based on their belief that all isolations had been made. (ORPS Report EM-OH-FN-FFI-FEMP-2005-0027; final report filed September 26, 2005)

On July 6, 2005, at the Hanford Plutonium Finishing Plant, a millwright received small blood blisters on his left forearm when he was exposed to low pressure air while performing preventive maintenance on an instrument air compressor. The millwright had removed a bolt from the high-pressure head of the air compressor, which released air and carbon buildup. The air compressor was isolated and verified safe on the previous day; however, air slowly had re-accumulated in the compressor because of a leak path between valves and an errantly closed vent valve. The millwright assumed that conditions from the previous day had not changed; therefore, he believed a second zero-energy (which could have identified a pressurized condition) was not necessary. (ORPS Report EM-RL--PHMC-PFP-2005-0015)

On June 2, 2005, at the Lawrence Berkeley Laboratory, a mechanical technician was cutting off electrical conduits with a portable band saw and heard a loud popping sound when the saw cut into an energized 120-volt line. The conduits were remnants of a transformer substation that had been dismantled 10 years earlier. The technician assumed that everything at the high-voltage distribution pad was de-energized because the transformer had been removed. His assumption was wrong, and he is fortunate there were no injuries. (ORPS Report SC--OAK-LBL-AFRD-2005-0001)

DE-ENERGIZED??
Don't assume — VERIFY.
You could be DEAD wrong!

The following event occurred outside of DOE and is an example of the serious consequence of not ensuring that a piece of equipment has been properly isolated and that hazardous energy has been removed or blocked by barriers.

On April 8, 2004, an oil refinery explosion occurred in the alkylation unit at the Giant Industries' Ciniza Refinery in New Mexico. Alkylate, which is highly flammable, is used to boost the octane rating of gasoline. At the time of the accident, mechanics were attempting to remove an alkylate recirculation pump that would not rotate and had a leaking mechanical seal. Believing that the pump had been depressurized when it was isolated, the mechanics began to pull the pump. Suddenly, alkylate at 150 psig and 350°F was released, producing a loud roar heard throughout the refinery. The first of several explosions occurred about 30 seconds later. One of the mechanics was blown over an adjacent pump, breaking his ribs, and a plant operator, who had assisted in isolating the pump, was seriously burned when alkylate that was covering his body ignited. Other personnel suffered burns and eye injuries.

Investigators determined that refinery operators did not effectively isolate the pump and verify it was depressurized before they attempted to remove it. (U.S. Chemical Safety and Hazard Investigation Board Case Study No. 2004-08-I-NM)

Performing a proper zero-energy check not only ensures that the work can proceed safely by verifying the absence of hazardous energy, but also helps to ensure that the barriers identified during job planning are adequate. It is always good practice to re-verify safe conditions if the job is delayed following the initial verification, if the job takes longer than expected, or if any working conditions have changed. Job planners and workers need to consider each of the following hazard sources and verify that the barriers established will provide a safe work environment.

- Electrical sources
- Pressure sources
- Temperature (heat and cold) sources
- Radiant sources
- Chemical sources
- Motion sources
- Gravity-mass (falling objects) sources

DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, states that potentially hazardous stored or residual energy must be relieved, disconnected, restrained, or otherwise rendered safe. If it is possible for stored energy to re-accumulate, a means should be provided so workers can continue to verify that a safe level exists until completion of the work. This verification may be provided by opening a valve for draining or venting, breaking a flanged connection, installing grounding devices, or by other similar means.

The protection against stored energy and the verification of isolation is also addressed in 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*. OSHA states that following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, and otherwise rendered safe. The standard also states that before starting work on machines or equipment that have been locked out or tagged out, the authorized employee shall verify that isolation and de-energization of the machines or equipment have been accomplished.

Mistakes and Assumptions

- Assuming that a local electrical switch would provide adequate protection rather than the circuit breaker at the source.
- Performing a zero-energy check at the time of the lockout/tagout but not performing a check on the circuits before disconnecting them.
- Assuming that safe-to-work conditions did not change from day to day.
- Assuming that abandoned systems no longer possess hazardous energy.
- Assuming that turning off a piece of equipment has removed all sources of hazardous energy within the equipment.
- Assuming that like components or equipment have similar electrical configurations; therefore, after verifying zero energy on the first one, there would be no need to check the others.
- Assuming that safe working conditions exist based on what others have said and not verifying them yourself.

These occurrences illustrate the importance of performing a zero-energy check (safe-to-work) before working on equipment that could contain hazardous energies. Never assume a zero-energy condition, and always stop work if the status cannot be determined. Workers should perform zero-energy checks as a matter of good practice, regardless of whether they are specified in a procedure or work instruction. Personnel safety can only be ensured if the work is performed within established controls, and zero-energy or safe-to-work checks are the last line of defense to prevent injury.

KEYWORDS: *Zero-energy, safe-to-work check, lockout/tagout, hazardous energy control*

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

3. *WHAT IS COLD AND DARK?*

The term "cold and dark" is used to describe the end-state condition of a deactivated facility when it is turned over for demolition. For facilities that will not undergo immediate demolition, the concept of the cold and dark end state is to place the facility in a configuration that will greatly reduce post-deactivation surveillance and maintenance costs.

When demolition commences promptly after deactivation, the cold and dark end state primarily serves to ensure worker safety. However, an emerging safety issue stems from varied interpretations of the term. When unsuspecting workers perform work on what they believe are de-energized systems, but which, in fact, are energized, near misses or injuries can result. The likelihood of this scenario is increasing as more and more excess facilities are readied for demolition under accelerated closure schedules. Several recent events involving facilities designated as cold and dark are discussed below.

On March 17, 2005, at the Savannah River Site, Deactivation Team members were removing electrical conduit from the exterior wall of a building when a portable electric band saw came in contact with energized electrical wiring inside conduit, creating sparks and causing the ground fault circuit interrupter to trip the breaker. A misunderstanding of the facility service and the perceived state of the lighting systems led personnel to incorrectly conclude that the system was de-energized and in a safe state to begin intrusive work on the electrical conduit. (ORPS Report EM-SR--WSRC-FCAN-2005-0002)

On July 19, 2004, at the Plutonium Finishing Plant at the Hanford Site, an electrician cut an electric cord to a piece of glovebox equipment and saw an electrical spark. Although the glovebox had been isolated, some circuits were left in service to provide convenience power for D&D work. Because of poor documentation in the work package, the equipment removal team was not informed about which electrical circuits remained in service. The electricians did not perform a zero-energy check before cutting the cord because of the cold and dark status. (ORPS Report EM-RL--PHMC-PFP-2004-0018)

The term "cold and dark" has come to mean an abandoned facility where all systems have been shutdown and permanently isolated. However, cold and dark is also used to describe a similar condition, where most systems are isolated but some are left in service either to provide convenience power for D&D work or because they may be valuable during the conduct of D&D activities (e.g., an overhead crane within an industrial facility that would be useful for maneuvering heavy items within the facility).

In some instances, continued operation of certain systems may be required to maintain a minimum safe condition within the facility. For example, at the PUREX facility at the Hanford site, all systems in the building were completely stabilized during deactivation, and the building was totally isolated from the site infrastructure. A new transformer was installed to supply power to operate a portion of the ventilation system to provide control over the spread of radioactive contamination during the long-term "mothballed" storage configuration.

Mishaps involving cold and dark interpretations are not limited to electrical issues, as illustrated by the following event. On February 24 and 25, 2004, an asbestos subcontractor assigned to remove asbestos from a section of steam pipe located outside a building at the Savannah River Site cut three sections of piping (one section was an electrical conduit, and the remaining two sections were believed to be old deactivated process lines) to locate a manlift under the steam line. Subsequent radiological surveys revealed that the sections of pipe that had been cut and placed on the ground were off-gassing tritium. Bioassay samples of the workers involved indicated that two of the three showed evidence of internal tritium contamination.

The subcontractor mistakenly assumed that all piping in the work area was flushed and drained, based on the designation of the area as cold and dark and their understanding that cold and dark equated to all hazards being removed from the work area. (ORPS Report EM-SR--WSRC-FDP-2004-0002)

The table on the following page presents various meanings of cold and dark, along with the specific conditions that coincide with its meaning.

Characteristics of Cold & Dark End State	Drivers / Facility-specific Conditions
All systems shutdown and permanently isolated; facility completely isolated from site infrastructure.	Configuration for nearly all Industrial safety class facilities and out-buildings.
All systems shutdown and permanently isolated; fire detection/annunciation system operational.	Authorization Basis requires fire detection/suppression to remain operational.
All systems shutdown and permanently isolated; fire detection/annunciation system and/or ventilation system operational.	Ventilation system required for contamination control and/or personnel entry. Authorization Basis requirements, usually for Cat II and III facilities.
All systems shutdown and permanently isolated; convenience power provided.	Typical configuration, especially if supplying temporary power is not possible. Creates potential safety risks.

The term "cold and dark" probably cannot be standardized because circumstances vary from building to building and site to site. In some buildings, HVAC systems must remain operational; in others, operational sump pumps or groundwater monitoring systems are required; and some buildings require lighting for personnel safety.

The configuration of a facility depends on the end-state vision, which is driven by the following factors.

- Facility Authorization Basis/Hazard Class
- Need for fire detection/suppression
- Residual inventory or material holdup
- Extent of contamination and need for ventilation to control spread of contamination
- Need for heating to prevent liquid lines from freezing
- Need to provide acceptable/safe conditions for personnel entry

To protect themselves from serious injury when working in these environments, workers should not assume that the designation of a facility as cold and dark is a blanket certification that frees the job area of all potential hazards. Workers should ensure that the following measures have been taken before work begins.

- A detailed job hazard analysis has been performed to identify all prevailing hazards.
- A pre-job briefing has been performed to provide full understanding of job scope and associated hazards.
- Zero-energy checks have been performed before attempting to do any intrusive activities
- Air gapping has been performed or conductors have been completely removed before demolition work begins.

Ensuring that these steps have been taken can provide immeasurable dividends during the implementation of the work.

For more information on excess facility transition to deactivation and decommissioning and strategies for developing facility end states, please refer to the National Facility Deactivation Initiative (NFDI) program website, http://web.em.doe.gov/deact/.

These events firmly support the position that every job needs attention to proper up-front planning. Nothing should ever be taken for granted when it comes to personnel safety, even when working in facilities designated as cold and dark. A detailed job hazard analysis must be conducted before any work begins to identify all possible hazards and establish proper controls. Workers should constantly be reminded to remain vigilant to identify impending hazardous conditions and to exercise smart work practices during D&D activities.

KEYWORDS: *Cold and dark, deactivation, end state, D&D, electrical hazard, conduit, air gapping, contamination*

ISM CORE FUNCTIONS: *Analyze the Hazards, Perform Work within Controls*

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Be Alert for Hidden Electrical Hazards When Performing D&D Activities	EM-SR--WSRC-FCAN-2005-0004
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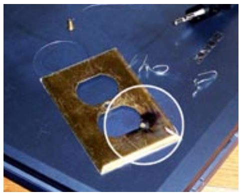
Keep Body Parts Out from Under Supported Loads	OH-FN-FFI-FEMP-2005-0011



OE SUMMARY 2005-07 (Published 4/11/05)

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Work Plan Deviation Results in Pressure Vessel Failure	ALO-KO-SNL-6000-2005-0001
Dilute Sulfuric Acid Overflow Results in Operational Emergency	ORO--ORNL-X10UTILITY-2005-0001

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Passenger Falls from Utility Vehicle and Fractures Leg	RL--PNNL-PNNLBOPER-2004-0015

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Avoid Overhead Crane Accidents—Check for Travel Path Obstructions	ORYS-YSO-BWXT-Y12SITE-2004-0023
Chemical Reaction Causes Waste Collection Bottle to Rupture	RL--PNNL-PNNLBOPER-2005-0004
Defeating Safety Interlocks Can Be Hazardous	N/A

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Incorrect Use of Knife Sharpener Results in Serious Hand Injury	RP--BNRP-RPPWTP-2005-0005
Dangers of Industrial Steam and Hot Water	OH-FN-FFI-FEMP-2005-0002
Hoisting Slings Snap, Dropping Two-Ton Steel Block	OAK--SU-SLAC-2004-0009
Good Practice—Properly Tied-Off Fall Protection Prevents Injury	RP--BNRP-RPPWTP-2005-0002

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Title	OR Number
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Don't Use Cheater Bars to Tighten Chain Binders	ID--BBWI-BIC-2005-0001
D&D Workers Engage in Unsafe Horseplay	ORO--BJC-K25GENLAN-2004-0012
Dangers of Unguarded Rotating Equipment	OAK--LLNL-LLNL-2003-0031

OE SUMMARY 2005-02 (Published 1/24/05)

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Replacing Old Systems Requires Careful Planning	OAK--LLNL-LLNL-2004-0023
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Report Safety Concerns Immediately	ID--BBWI-LANDLORD-2004-0018
Accident Investigation of Electrical Arc Flash Injury	OAK--SU-SLAC-2004-0010
Stored Energy a Hazard in Roll-up Door Torsion Springs	RFO--KHLL-371OPS-2004-0024

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

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

Job Titles/Positions	
RCT	Radiological Control Technician

Authorization Basis/Documents	
JHA	Job Hazards Analysis
NOV	Notice of Violation
SAR	Safety Analysis Report
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
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
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