OPERATING EXPERIENCE SUMMARY

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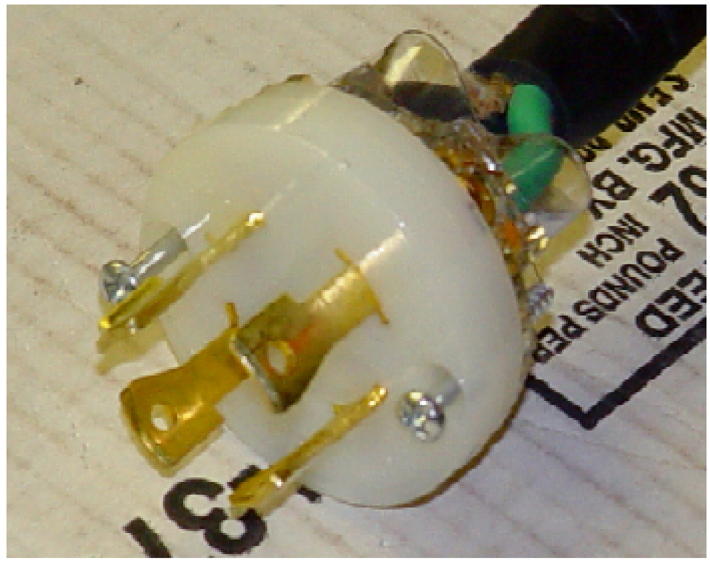

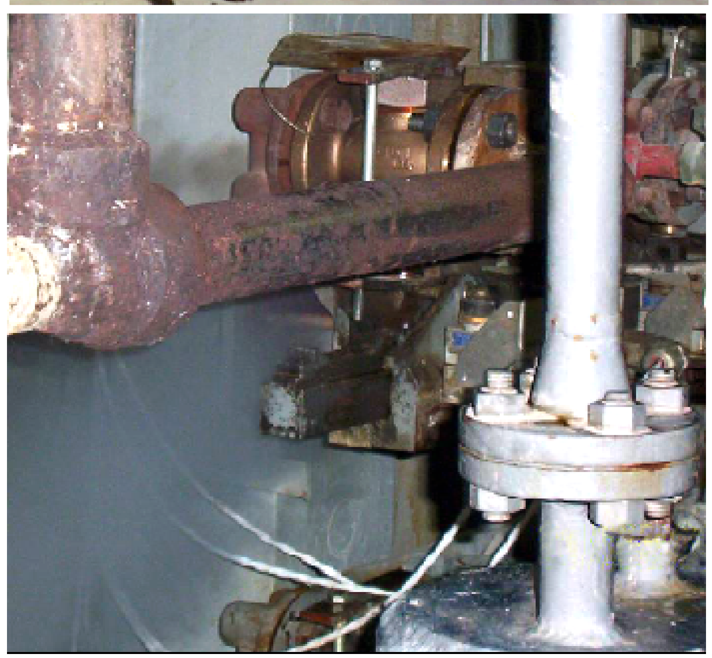

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The Office of Environment, Safety and Health, Office of Corporate Performance Assessment publishes the Operating Experience Summary to promote safety throughout the Department of Energy complex by encouraging the exchange of lessons-learned information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

To issue the Summary in a timely manner, EH relies on preliminary information such as daily operations reports, notification reports, and conversations with cognizant facility or DOE field office staff. If you have additional pertinent information or identify inaccurate statements in the Summary, please bring this to the attention of Frank Russo, 301-903-8008, or Internet address Frank.Russo@eh.doe.gov, so we may issue a correction. If you have difficulty accessing the Summary on the Web (URL http://www.eh.doe.gov/paa), please contact the ES&H Information Center, (800) 473-4375, for assistance. We would like to hear from you regarding how we can make our products better and more useful. Please forward any comments to Frank.Russo@eh.doe.gov.

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EVENTS

1. WIRING ERROR RESULTS IN ELECTRICAL SHOCK

On December 3, 2003, at the Hanford Waste Treatment Plant Construction Project, an ironworker repositioning a 480-volt portable electric heater grasped the leg of the heater with one hand while touching a metal table with the other (see Figure 1-1) and received an electrical shock that literally knocked him to the floor. Investigators determined that the power plug for the heater had been miswired. (ORPS Report RP--BNRP-RPPWTP-2003-0006, final report filed January 23, 2004)

The ironworker cut his hand and bruised his knee when he fell backward to the floor. He went to the onsite medical facility for evaluation and treatment. Medical staff found no sign of an electrical burn or entry and exit wounds and treated the injuries he suffered in the fall. An EKG taken the following day was within the normal range.

An experienced journeyman electrician had installed the plug on the new heater a few hours before the incident occurred. He incorrectly connected a hot leg of the three-phase, 480-volt conductor to the ground screw and the ground wire to a power prong. This caused the heater housing to become energized with 277 volts. The electrician did not test for continuity or proper grounding after he installed the plug. Figure 1-2 shows the miswired plug, with the ground (green) wire attached to the power prong.

Figure 1-1. Re-creation of incident

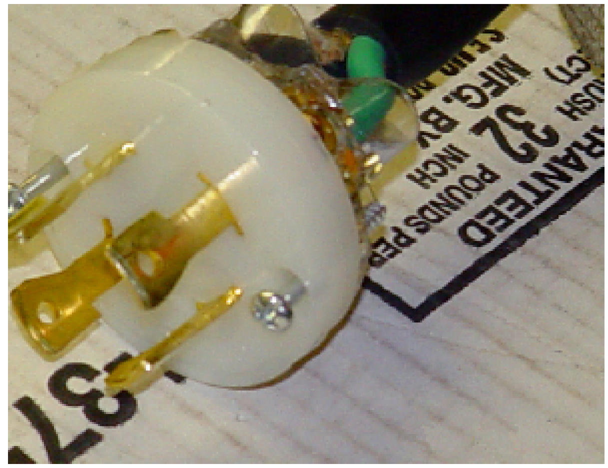

Figure 1-2. The miswired plug

Investigators identified the principal cause of this incident as inattention to detail on the part of the electrician. They also determined that site management had not established a policy requiring testing after performing work on electrical equipment. If the electrician had checked his work, he probably would have caught the error before allowing the heater to be used. The electrician resigned because he held himself accountable for creating the unknown electrical hazard produced by the miswired plug. However, at the time of the incident, it was not standard practice for electricians to conduct acceptance testing after wiring components.

Investigators learned that no one controlled and tagged the heater with a "Do Not Operate" placard immediately after the occurrence. They also determined that proper notifications were not made until the day after the incident.

Corrective actions included the following.

- Develop a guidance document instructing electricians to inspect their work and perform circuit testing at the completion of a task.
- Develop a grounding program, with procedures, including those for circuit and continuity testing.
- Issue instructions to site workers to tag equipment "Do Not Operate" immediately when they suspect it to be hazardous or defective.
- Reiterate the need for prompt notification and categorization of reportable occurrences.

GOOD PRACTICES FOR ELECTRICAL COMPONENT MODIFICATIONS

- Perform a self-check of work before putting the component or equipment into service.
- Require competent, independent, verification of tasks as they are completed.
- Perform checks on modified circuitry (e.g., voltage, continuity, phasing and polarity).
- Avoid distractions when performing tasks that could create hazards if not performed correctly.
- Perform integrated acceptance testing of the component or equipment upon the completion of work.

Wiring errors have caused several other electrical shock events reported in ORPS. In fact, two such events occurred on May 27, 2003. On that day at the Los Alamos National Laboratory, a machinist received an electrical shock when he simultaneously touched a mobile welding cart and another piece of equipment. The shock was of such a magnitude that it caused numbness in the machinist's left arm that lasted for several days. Improper wiring of the 480-volt welding cart plug (i.e., reversal of power lead and the ground lead) resulted in a measured 260 volts on the body of the welding cart. (ORPS Report ALO-LA-LANL-NUCSAFGRDS-2003-0002)

On May 27, 2003, at the Oak Ridge Spallation Neutron Source construction site, a worker received an electrical shock when he touched a metal component while working on a locked-out circuit. Investigators discovered a miswired 120-volt receptacle inside a communication cabinet that had a hot lead connected to the ground terminal and the ground lead connected to a power terminal. The worker experienced no lasting effects from the electrical shock. (ORPS Report ORO--ORNL-X10SNS-2003-0002)

All cord sets and receptacles that are not part of the permanent wiring of a building or structure, as well as equipment connected by cord or plug, should be tested in accordance with an assured grounding program. Program requirements are stated in National Electrical Code®, Section 305 and in 29 CFR 1926.404, *Wiring Design and Protection*, section (b)(1)(iii). In addition, the Occupational Safety and Health Administration (OSHA) requires two tests. The first is a continuity test to ensure that the equipment grounding conductor is electrically continuous. It must be performed on all cord sets and receptacles and on cord- and plug-connected equipment that is required to be grounded. The second test is to ensure that the equipment grounding conductor is connected to the proper terminal. These tests are required before first use, following repairs or suspected damage, and at 3-month intervals.

These events demonstrate that electrical wiring errors resulting from inattention to the task at hand can create life-threatening hazards for workers. After performing modifications or maintenance on electrical components, it is important to re-check the work, have an independent verification performed, and conduct acceptance testing. If these checks are not performed or are performed incorrectly, component wiring errors can result in unsafe conditions that can cause severe injuries to unsuspecting workers.

KEYWORDS: *Electrical shock, electrical safety, inattention to detail, miswired equipment, post-work testing*

ISM CORE FUNCTION: *Perform Work within Controls*

2. NEAR MISS TO SCALDING WHEN STEAM LEAKS FROM PIPE FLANGE

On November 20, 2003, at the Savannah River H-Canyon facility, a construction worker preparing to remove insulation from a steam manifold assembly narrowly escaped being scalded when 365° F steam leaked from a defective pipe flange. The worker was removing the piping insulation in proximity to a gang valve that provided steam for process transfers. Workers were aware that the flange sometimes leaked, and had closed the steam stop valve, but they did not lock or tag it out. No injuries resulted from this near-miss occurrence. (ORPS Report SR--WSRC-HCAN-2003-0030, final report filed January 2, 2004)

Facility policy for removing insulation from steam pipes did not require the energy source to be locked closed and posted, with the steam stop valve barricaded, because the system would not be penetrated. However, a lockout/tagout should have been applied because workers knew that the flange leaked at the work location and that pressurized steam in the line could present a scalding hazard. Work planners also knew the task involved erecting a plastic tent (glovebag) to contain airborne asbestos and that heat from the steam lines could compromise the integrity of the glovebag. Investigators identified these work planning deficiencies as the root cause of the occurrence.

Although they used a "plan-of-the-day" process, work planners did not recognize the conflicts between the insulation removal task and the process transfer task. They performed a hazards analysis as part of the work planning, but incorrectly concluded there were no harmful sources of energy in the work area. Figure 2-1, a photograph taken after the insulation was removed from the piping, shows steam leaking from the defective flange.

Investigators found evidence of several inadequacies in work planning and communications. First, the shift operations manager should have recognized the proximity of the work location to the equipment providing steam flow for the process transfer. In addition, control room personnel should have provided communication between the workers removing insulation and operations personnel to ensure that the hazardous energy source (steam line) remained isolated. Investigators identified this lack of coordination between the insulation removal task and the process transfer task as a second causal agent for the occurrence.

Corrective actions resulting from this incident included the following.

- Facility management will issue a standing order to establish a lockout/tagout on the steam stop valve for any insulation work in the area of known steam leaks.
- Facility management will issue an operating experience description to the planning group to ensure that all sources of hazardous energy are identified in task hazards analyses.
- Facility personnel will walk down work spaces to identify unsafe conditions and ensure that appropriate postings and/or barricades are established.

Work planning inadequacies contributed to many occurrences reported in ORPS. On September 10, 2003, at Rocky Flats, workers isolated and drained a riser for the building automatic sprinkler system and began to remove a sprinkler head. Water started to flow from the loosened sprinkler head and a riser firewater flow alarm was received. Workers had isolated the wrong

Figure 2-1. Actual steam leak

riser because of inadequate work planning, inadequate verification of orally transmitted information on equipment status, and failure to walk down the piping to ensure that the proper sections of the system were isolated. (ORPS Report RFO--KHLL-WSTMGTOPS-2003-0017)

Attachment I to DOE Order 5480.19, *Conduct of Operations Requirements for DOE Nuclear Facilities,* chapter 1, section C.6, "Planning for Safety," states:

> Facility guidance should exist which describes safety preplanning requirements for all operational activities. The guidance should explain the role of safety analysis reviews, job safety analyses, and the handling of safety matters. All operations personnel should understand the safety planning requirements.

These events illustrate the importance of careful work planning in the interest of ensuring safety in the workplace. Work planning includes performing a comprehensive hazards analysis, implementing hazard controls, and developing formal procedures for performing work within established controls. Incomplete hazards analyses, inadequate hazards controls, and improvised procedures jeopardize the safety of workers.

GOOD WORK PLANNING PRACTICES

- Perform a comprehensive hazards analysis that identifies all the hazards associated with the work scope
- Document the results of the hazards analysis in a form suitable for input to the work planning process.
- Identify hazard controls to be applied during the performance of the work.
- Document the needed hazard controls in a format suitable for incorporation into work plans and procedures.
- Establish formal procedures to the degree required to ensure compliance with the hazard controls.
- Walk down the work to be performed in the workplace with the workers and supervisors involved.
- Before beginning work, present a briefing that describes the hazards involved, the controls established, the need to follow procedures, and the need to stop work if unanticipated conditions arise.

KEYWORDS: *Near miss, steam scalding hazard, steam leak, lockout/tagout, job planning, communications*

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

3. FALL PROTECTION NEAR MISS

On March 22, 2004, at the Hanford Waste Treatment Plant construction project, an ironworker fell nearly 6 feet before his fall protection equipment arrested the fall when he was about 3 feet above a concrete basement slab. The worker's fall protection system, which included a body harness and lanyard, saved him from a serious injury. (ORPS Report RP--BNRP-RPPWTP-2004-0004)

The iron worker was securing splice bars on a wall of reinforcing rods (rebar) about 14 feet above the slab. He was using a rebar chain assembly (Figure 3-1) attached to the front of his harness to position himself on the rebar wall so he could work with both hands. However when he changed positions during the task, he apparently did not ensure that the positioning hook was fully engaged. When he leaned back, the positioning hook came free and he fell.

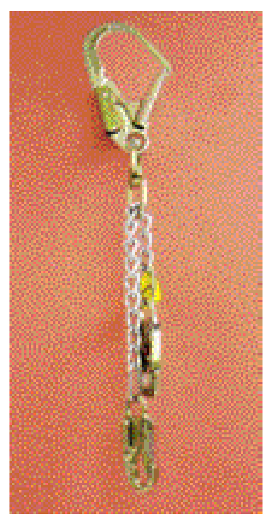

Figure 3-1. Chain assembly and positioning device

The worker was using a double shock absorber/ lanyard system (Figure 3-2). This system allows the worker to be tied off with one lanyard while he is moving the other one. When the worker began to

Figure 3-2. Double-lanyard

fall, the lanyard performed according to design and stopped his fall before he hit the concrete floor.

The lanyard the ironworker was using attaches to a full-body harness (Figure 3-3), and is designed to decelerate a fall, bringing the worker to a smooth, easy stop. Shock-absorbing material in the lanyard's inner core is surrounded by an extra-strong outer jacket. When a force of about 600 pounds is exerted on the lanyard, the outer jacket extends to its full length and acts as a backup web lanyard. After the worker's fall was arrested, he regained his footing and re-ascended the rebar wall, apparently preparing to return to work. A supervisor saw the lanyard warning flag (indicating that it had been used during a fall) and told the worker to come down from the wall to replace the lanyard. The worker was treated for an abrasion at the project medical facility and returned to work with a new fall protection system, full body harness, and shock-absorbing lanyard.

Several actions were taken as a result of this occurrence.

- The worker involved in the fall discussed the incident and lessons learned with co-workers before work began the next morning.
- Supervisors reminded the workers that all positioning and fall protection devices need to be verified as operable before relying on them.
- Supervisors reminded the workers that fall protection equipment involved in a fall needs to be removed from service immediately (this is important because the device is only designed for one fall).

OSHA requirements for fall protection are presented in 29 CFR 1926, Subpart M, Standard 1926.502, *Fall Protection Systems Criteria and Practices.* Section (d) of this standard is titled *Personal Fall Arrest Systems,* and section (e) is titled *Positioning Device Systems.* Each section presents requirements for several fall protection-related topics, including anchorages, support lines (e.g., lanyards and lifelines), connectors (e.g., D-rings and snaphooks), body belts and harnesses, and equipment inspection.

Figure 3-3. Typical full-body harness

A search of the ORPS database for other events where fall protection lanyards worked properly revealed several occurrences. On June 5, 2003, at the Miamisburg Closure Project, a construction worker tripped on a protruding bolt while disassembling a 16-foot-high steel-frame scaffold and fell through an opening in the top of the scaffold. The worker's fall was arrested by a properly installed lanyard and he was not seriously injured. However, he struck the scaffolding and sustained arm and back abrasions. (ORPS Report OH-MB-BWO-BWO04-2003-0008)

On August 3, 2000, at the Savannah River Site, workers were removing sections of deck grating on an elevated platform to access a pump at a cooling tower. A worker wearing a fall protection harness attached to a lanyard lost his balance and fell through an opening where grating had been removed. The lanyard arrested the worker's fall and suspended him approximately 7 feet above the ground. A loose piece of grating subsequently fell through the opening and struck the suspended worker, causing an open wound on his left leg. (ORPS Report SR--WSRC-FDP-2000-0001)

These events underscore the importance of using safe practices when working at elevation, including the proper use of positioning and fall protection equipment. Workers need to stay focused on the task at hand and pay attention to their surroundings to avoid falls. These occurrences also illustrate that sometimes the benefit from fall protection is not injury *avoidance, but rather changing a potential serious injury to a minor injury. Workers and supervisors should not lose sight of the fact that fall protection equipment, when properly selected and used, does work in protecting the lives of workers.*

KEYWORDS: *Fall protection, body harness, lanyard, positioning device, D-ring, anchorages*

ISM CORE FUNCTIONS: *Perform Work within Controls, Provide Feedback and Continuous Improvement*

4. PIPEFITTER'S FOOT INJURY RESULTS IN TYPE B ACCIDENT INVESTIGATION

On December 17, 2003, at the K-31 building, East Tennessee Technology Park, a pipefitter using a wrecking/pry bar to remove concrete blocks from the inside web of a steel column severely injured his left foot when a block weighing nearly 50 pounds fell about 11 feet and struck his steel-toed boot. The pipefitter, who refused medical attention at the time of the injury, later required surgery to relieve the pressure in his swollen foot. Surgeons also inserted pins in two of his toes, and a few weeks later amputated his fifth toe and performed skin grafts because of complications from the injury. The Oak Ridge Operations Office Manager convened a Type B accident investigation when he learned of the severity of the pipefitter's injuries. (ORPS Report ORO--BNFL-K31-2003-0003)

Demolition of the K-31 control room began in December 2003. Workers used a trackhoe with a bucket attachment to knock down some block walls and then pried concrete blocks loose by hand when access became difficult.

The pipefitter had been removing blocks with the wrecking/pry bar and a sledgehammer for 2 days before the accident without incident. At the time of the accident, he was unable to pry loose blocks located at chest height in the column (Figure 4-1). He stopped working and, as he began to walk away, the top block fell, glanced off his raised face shield, and struck his left foot. After the accident, the blocks between the top block and those at chest height fell out of the column. Reportedly, no one in the area observed this.

Figure 4-1. Wide-flange column involved in the accident (blocks removed)

Five minutes later, the Area Manager noticed the pipefitter limping and asked what happened. The pipefitter replied that a block had struck him on the steel toe of his boot. The Area Manager asked the pipefitter if he needed to go to the site medical clinic, but the pipefitter declined treatment and said he would be all right if he walked it off.

The pipefitter showed the Area Manager the method he had used to remove the blocks, all of which were no higher than 5½ feet above the floor during the demonstration, and a couple of the remaining blocks fell out of the column. The Area Manager did not recognize the event as a near miss after the demonstration, and did not stop work on block removal with hand tools.

The Area Manager told the pipefitter that if his foot continued to hurt he should go to the site medical clinic. Other workers in the area, including the foreman, noticed the pipefitter limping, and repeatedly suggested that he go to the clinic, but the pipefitter stated that he did not think he was hurt that badly. He remained at the job site, taking intermittent rest breaks, until early afternoon and then drove home. When he got home, he removed his work boot and saw blood in it, so he applied ice to his foot. When the bleeding became worse, the pipefitter contacted his wife, who took him to the hospital emergency room.

The pipefitter was admitted with a diagnosis of compartment syndrome (pressure and swelling) in his left foot and dislocated fourth and fifth toes. He underwent surgery on the bottom of his foot to relieve pressure, and surgeons also inserted pins in the dislocated toes. After the holidays, the pipefitter returned to the hospital, where surgeons amputated his fifth toe, removed dead tissue, and performed a full-thickness skin graft. He remained in the hospital for 8 days. His physician released him to return to work on restricted duty on February 3, 2004.

The day after the accident, the pipefitter's wife reported his injury to the Area Manager, who informed BNFL management that afternoon. BNFL intended to stop work on concrete block demolition and schedule a critique when they learned about the pipefitter's hospitalization; however, the stop-work decision was not documented and apparently was never communicated to the general foreman. The general foreman went to the accident site and saw that the remaining concrete blocks had been removed from the column by other members of the work crew. He discussed the situation with the foreman and crew and decided that any further block removal would be done from the top of the column down, using a scissor lift, thus ensuring that the workers would not be struck by falling blocks.

On December 19, the Building Manager discontinued the critique process, and the Deputy General Manager elevated the investigation to Type C. On January 13, 2004, the Deputy General Manager signed a formal Stop Work, and DOE ordered a Type B investigation of the accident because of the pipefitter's second hospital stay.

The Type B accident investigation report was completed and approved on February 24, 2004. The investigation team identified 12 Judgments of Need, including the need to (1) improve communication between managers and workers, (2) improve worker involvement in the planning process, (3) ensure that managers and workers comply with work controls, (4) use stop-work authority when unexpected or unsafe conditions exist, and (5) verify that corrective actions are taken to prevent recurrence.

The team stated that although BNFL policy requires injured workers to report to the site medical clinic for evaluation, the pipefitter failed to do so, and his manager suggested, but did not require, that he do so. They also stated that both the foreman and the work crew recognized that the difficulty in reaching the columns with the trackhoe to remove blocks presented a change in working conditions, but no one thought to stop work and evaluate the changed condition until several weeks had passed.

FOCUS ON SAFETY

- All workers and managers involved in a task should contribute to the work planning process.
- Mentally walk down the job before starting, noting any changed conditions.
- Stop work and reevaluate safety when conditions change.
- Communicate concerns to management.
- Question anything that doesn't seem right.
- Don't hesitate to invoke stop-work authority.
- Consider using the buddy system if possible.
- Look out for co-workers as well as for yourself.
- Foster a culture of emphasizing safety over task completion.

The team believed that because the job was nearing completion, managers and workers were more focused on finishing the job than working cautiously.
The following text box gives some recommendations for working with an emphasis on safety.

This event illustrates the necessity of seeking immediate medical attention for injuries at work and stopping work when conditions change. Workers should think in terms of working safely instead of finishing a task quickly.

KEYWORDS: *Injury, Type B, work planning, stop work*

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

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienist
ANSI	American National Standards Institute
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 Requirements
USQ	Unreviewed Safety Question

Regulations/Acts	
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
RCRA	Resource Conservation and Recovery Act
D&D	Decontamination and Decommissioning
DD&D	Decontamination, Decommissioning, and Dismantlement

Miscellaneous	
ALARA	As low as reasonable achievable
HVAC	Heating, Ventilation, and Air Conditioning
ISM	Integrated Safety Management
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control