OPERATING EXPERIENCE SUMMARY

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U.S. Department of Energy
Office of Environment, Safety and Health
OE Summary 2004-15
July 26, 2004

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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EH Publishes "Just-In-Time" Reports

The Office of Environment, Safety and Health recently began publishing a series of "Just-In-Time" reports. These two-page reports inform work planners and workers about specific safety issues related to work they are about to perform. The format of the Just-In-Time reports was adapted from the highly successful format used by the Institute of Nuclear Power Operations (INPO). Each report presents brief examples of problems and mistakes actually encountered in reported cases, then presents points to consider to help avoid such pitfalls.

1. Deficiencies in identification and control of electrical hazards during excavation have resulted in hazardous working conditions.
2. Deficiencies in work planning and hazards identification have resulted in electrical near misses when performing blind penetrations and core drilling.
3. Working near energized circuits has resulted in electrical near misses.
4. Deficiencies in control and identification of electrical hazards during facility demolition have resulted in hazardous working conditions.
5. Electrical wiring mistakes have resulted in electrical shocks and near misses.
6. Deficiencies in planning and use of spotters contributed to vehicles striking overhead power lines.

The first six Just-in-Time reports were prepared as part of the 2004 Electrical Safety Campaign. In April, the Office of Environment, Safety and Health published a Special Report on Electrical Safety. The purpose of this report is to describe commonly made electrical safety errors and to identify lessons learned and specific actions that should be taken to prevent similar occurrences. This report can be accessed at http://www.eh.doe.gov/paa/reports/Electrical_Safety_Report-Final.pdf.

EH plans to issue more Just-in-Times soon on other safety issues, such as lockout and tagout, fall protection, and freeze protection. All of the Just-in-Times can be accessed at http://www.eh.doe.gov/paa/reports.html.

1. GOOD PRACTICE: WEAR A SEAT BELT WHEN OPERATING FORKLIFTS AND HEAVY EQUIPMENT

On July 12, 2004, at the environmental restoration facilities at the Paducah Gaseous Diffusion Plant, a forklift, with the operator inside, lost its brakes and rolled 20 feet down a steep incline into a landfill. The operator was wearing his seat belt and received only minor injuries. (ORPS Report ORO--BJC-PGDPENVRES-2004-0010)

The operator was placing waste boxes weighing about 8,000 pounds in the landfill. He had placed the fourth box when the brakes failed, and the forklift began to roll down the incline. When the forklift stopped, the operator signaled that he was all right and exited the cab. A health physics technician surveying the operator for contamination found none, but he noticed abrasions on the operator's shins. The operator was later examined by site medical personnel, given an over-the-counter medication for pain relief, and released to work without restriction.

Seat belts also prevented injuries at Los Alamos National Laboratory (LANL) recently. The Laboratory reported two events in June in which vehicles tipped over but the drivers escaped injury because they wore seat belts. (ORPS Report ALO-LA-LANL-LANL-2004-0009)

On June 28, 2004, at LANL, a truck and trailer tipped over onto its left side after the truck's wheels sank into loose fill material that a Bobcat operator had placed and leveled. The driver removed his seat belt and exited the cab on the right side. No one was injured. On June 20, 2004, a small bulldozer tipped over when it hit a soft spot while driving over demolition debris. Neither the driver, who was wearing a seat belt, nor anyone else at the work site was injured. The bulldozer was undamaged, subsequently was righted, and is still in use at the site.

Drivers should use seat belts when operating any type of vehicle, but this is especially true for operators of powered industrial trucks (i.e., forklifts) and heavy equipment (e.g., bulldozers, loaders, graders). When belted in, an operator cannot be thrown into the path of the rolling equipment, as occurred when a heavy equipment operator, working for a commercial logging company, was ejected from a front-end loader when it went off the road in Alaska.

The 58-yr-old operator was driving to a logging camp site from a work site when the loader went off the road, rolled down the slope, then rolled over and ejected him. The operator was found about 100 feet down the slope, crushed beneath the loader, and was declared dead at the scene. Figure 1-1 shows the accident scene.

The front-end loader was equipped with a rollover protection system (ROPS) that was incorporated into the operator's compartment. Seat belts are an important component of ROPS because they hold operators in place and keep them from being thrown from the equipment. Investigators learned that the operator of the front-end loader lacked this protection because his seat belt was defective and could not be used.

Another fatality involving a forklift occurred at a commercial site in California, when an operator was backing a forklift down a 3 to 5 percent grade and tried to make a left turn. The forklift turned over and he was thrown onto the pavement, pinned beneath the equipment cab, and crushed. The forklift was not equipped with a seat belt. State investigators stated that "employers should have seat belts installed on all industrial trucks with ROPS and require that employees wear them whenever operating such equipment."

Figure 1-1. View of front-end loader from top of slope

OSHA regulations specify that for the logging and construction industries seat belts must be installed on most specialized vehicles and equipment designed for operation at off-highway work sites. The requirements in 29 CFR 1926.602 (a)(2)(i) apply to earthmoving equipment, including scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment. The section states that "seat belts shall be provided on all equipment covered by this section and shall meet the requirements of the Society of Automotive Engineers, J386-1969, *Seat Belts for Construction Equipment*."

OSHA's policy on seat belts in powered industrial trucks is less clear. Their applicable standard, 29 CFR 1910.178 and the therein adopted ASME B56.1-1969, *Safety Standard for Powered Industrial Trucks*, have no specific provisions concerning seat belt use. However, the 1993 revision to ASME B56.1 requires operator restraint systems (i.e., seat belts). In recognition of this change, OSHA's policy can be summarized as follows: if a forklift comes with a seat belt, the operator must wear it; if a forklift is not equipped with a seat belt and the manufacturer offers a retrofit, employers should have seat belts installed and ensure that operators wear them. However, if neither of these options is available, seat belt use is not required.

These events illustrate the importance of using seat belts while maneuvering powered industrial trucks and heavy equipment. Managers should ensure that seat belts and harnesses are in good condition and should require workers to wear them whenever motorized vehicles are operated. Vehicles that are not equipped with seat belts should have them installed when feasible.

KEYWORDS: *Forklift, powered industrial trucks, operator, landfill, seat belt, overturn; industrial equipment*

ISM CORE FUNCTIONS: *Analyze the Hazards, Develop and Implement Hazard Controls, Provide Feedback and Improvement*

2. UNSAFE CRANE OPERATION RESULTS IN FAILED SLING

On June 21, 2004, at the Sandia National Laboratory, a wire-rope sling failed under load during demolition work at the Proto II Accelerator. The sling was connected to a 10-ton overhead bridge crane and to a section of ⅜-inch-thick steel plate when it failed. The demolition crew was using the crane and sling to bend the plate while it was still welded to I-beams. Facility management reported the event as a near miss because of the potential for injury when the sling parted. (ORPS Report ALO-KO-SNL-NMFAC-2004-0003; final report filed July 26, 2004)

The demolition crew (site supervisor, equipment operator, and three environmental technicians) was removing a large steel tank by cutting it into sections with a plasma torch and lifting the sections out with the bridge crane. The top and sides of the tank had been removed, and work progressed on removing the carbon steel tank bottom, which was attached to structural I-beams every 1½ feet. Work planners believed the plate was tack welded to the outside edge of the I-beams; however, investigators determined that a continuous weld bead was used instead.

After workers cut a 6-foot by 12-foot section of plate from the I-beam at the edge of the tank, they cut two circular holes (Figure 2-1) in the plate to attach a shackle for lifting. They planned to attach two ends of a 4-foot-long, ½-inch-thick wire rope sling to the shackle and loop it over the crane hook. The overhead bridge crane would then be used to bend the steel plate to allow better worker access to cut the welds and separate the plate from the I-beam and sections of angle iron.

After the crew rigged the plate, the site supervisor directed the equipment operator to lift the section. The operator refused because he believed the operation was unsafe. The site supervisor then gave the controls to an environmental technician and directed him to lift the steel plate. The technician used the crane to bend the plate until it was approximately 90 degrees to the tank floor, at which time the wire rope suddenly failed.

The dynamic load placed on the sling exceeded its 2.2-ton rating and caused it to fail in the

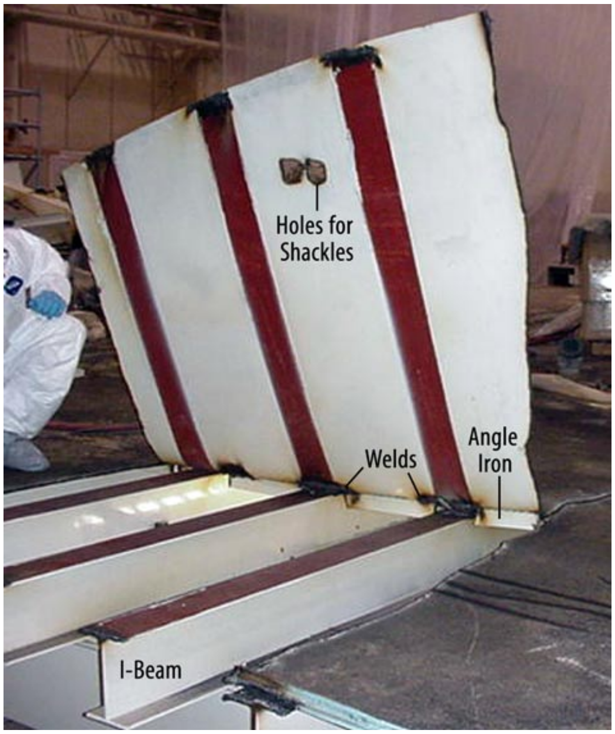

Figure 2-1. Steel plate section of tank floor

center. Both sections of the sling remained attached to the shackle. Figure 2-2 shows the failed sling. No one was injured because the crane was operated by a remote control device, and the equipment operator and two other environmental technicians had moved away from the lifting area.

Investigators learned that the site supervisor directed the equipment operator and environmental technicians not to report the event to management, and the failed sling was hidden in a dumpster used for construction debris. Investigators also learned that earlier in the day,

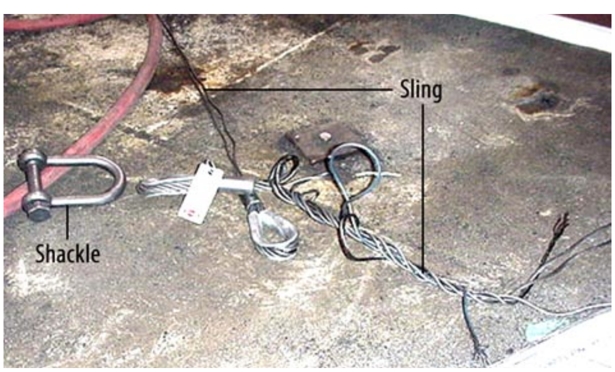

Figure 2-2. Failed wire-rope sling and shackle

while removing the tank center section, a 4-foot section weighing 200 pounds was inadvertently cut and fell 11 feet to the tank floor. The site supervisor did not stop work to determine what may have caused the problem, nor did he inform management. The approved removal plan was not followed and changes to the plan were not discussed with the work group to resolve concerns or to suggest alternative methods.

Investigators determined that the root cause of the event was the failure of the contractor's project manager to ensure that the supervisor was performing work activities in accordance with the contract-specific safety plan. The direct cause was the supervisor's unsafe use of the bridge crane, even though he knew it should not be used in that manner, and the failure of the sling when used beyond its design specification. Crane operators are prohibited from lifting "bound" loads because the weight of the load cannot be established.

Contributing causes included ignoring signs to stop work, placing emphasis on schedule rather than safe methods for performing the work, and failure to communicate problems (e.g., dropped tank section and failed sling) to project management. Another contributing cause was the interference with the supervisor's overall role by conflicting assignments (e.g., safety contact, using plasma torch, directing lifting operations, and controlling schedule). The site supervisor was terminated, and the contractor's oversight process has been improved.

Guidance for proper care and use of wire-rope slings can be found in Chapter 11, "Wire Rope and Slings," of DOE-STD-1090-2004, *Hoisting and Rigging Standard (Formerly Hoisting and Rigging Manual)*. Section 11.3.1.4 of the Standard states that overloading shall be avoided, as shall sudden dynamic loading that can build up a momentary overload sufficient to break the sling.

This event underscores the importance of stopping work when confronted with uncertainties, conflicts, or safety concerns. Stopping work to address safety concerns is usually the last chance to get it right before proceeding with the task. Stopping work is one of the most basic safety rules. When there is doubt, confusion, *unexpected conditions, or obvious violations, it is each worker's responsibility to exercise his/her Stop-Work Authority. Supervisors, foremen, and managers not only need to oversee work and ensure that it is completed on time, but also have an obligation to ensure that work is performed safely and within a safe work environment and to suspend work when necessary.*

KEYWORDS: *Hoisting, rigging, crane, sling, wire rope, near miss, stop work*

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

3. INADEQUATE WORK PLANNING RESULTS IN HEAVY EQUIPMENT ACCIDENTS

Nearly two dozen heavy equipment accidents have occurred across the DOE Complex since the first of this year. Currently, a Type A investigation is underway at Savannah River Site where a trackhoe partially fell off a trailer, resulting in the death of a worker. Although some of these events resulted from inattention, inadequate work planning and pre-work checks contributed to the majority of them.

On June 8, 2004, at Fernald, the operator of a heavy-duty forklift knocked down a parking lot light pole while attempting to avoid another hazard. The driver had parked and exited the forklift earlier in the day. When he returned, he noticed that someone else had used the forklift in his absence, slightly changing the parking position, but he did not re-walk the space before moving the forklift. As he maneuvered to avoid hitting a gravel pile, he hit a light pole that was in his blind spot. (ORPS Report OH--FN-FFI-FEMP-2004-0015)

On March 25, 2004, Brookhaven National Laboratory filed an Occurrence Report because of recurring material handling problems. Inadequate planning was a contributory cause for three of these incidents: a forklift struck overhead power lines because no measurements were taken to ensure the equipment would clear the line; a lifting magnet device released and dropped a 1,600-pound steel plate that exceeded the magnet's 1,210-pound lift limit; a restraining strap broke, dumping the load, while a truck was transporting a package whose weight had been underestimated by half. Figure 3-1 shows the results of this incident. Thorough planning would have helped to ensure that load height and weight measurements were taken before the work started, enabling projects to be completed without incident. (ORPS Report CH--BH-BNL-BNL-2004-0005)

On March 11, 2004, at Argonne National Laboratory West, a Lift-All forklift ran into and damaged a roll-up door when its brakes failed. Investigators determined that the 27-year-old forklift had been designated as "excess" in October 2003, and all preventive maintenance activities had been cancelled. An equipment operator drove the forklift in January 2004, realized that the vehicle had almost no brakes, and turned the keys in to his supervisor. The supervisor placed the keys in his desk but did not have the vehicle tagged out of service. Sometime in the following 2 months, the keys were placed in the forklift, making it available for use. If the required pre-operational check had been performed on March 8, the driver would have seen the previous inspection report and known that the brakes were suspect. (ORPS Report CH--AA-ANLW-ANLW-2004-0003)

On February 12, 2004, at Savannah River's H Tank Farm, a driver maneuvered around a sharp turn and had started through a fence gate when the crane boom struck a 480-volt overhead power line. Investigators determined that

Figure 3-1. Dropped load

work planning was less than adequate because planners did not consider factors such as night work, inadequate street lighting, gate entry (coupled with a sharp, 45° turn), and closeness of the overhead lines. Additionally, no one performed a pre-work walkdown. (ORPS Report SR--WSRC-HTANK-2004-0007)

On January 29, 2004, at Fernald, a front-end loader struck and tipped over a 20-foot-high light plant when the driver backed out of the way of an oncoming fuel truck in a highly congested area. Job planners did not consider the multiple activities and extremely tight quarters in which the loader would have to be maneuvered. The driver's attention was focused on avoiding obstacles while backing up, and he did not see the light plant trailer tongue. The event was categorized as a near miss because of the potential for injuring personnel and the lack of barriers to injury in the congested work area. (ORPS Report OH--FN-FFI-FEMP-2004-0004)

Even well-planned activities can be impacted by time of day, visibility, and changing conditions. However, properly designed equipment or an operator's quick reactions can mitigate consequences or prevent serious injuries, as demonstrated by two events. Late on the evening of January 29, 2004, at the Hanford Site, the loaded dump bed of a Volvo articulated dump truck (ADT) overturned when the operator drove too close to a terrace bench edge in an excavation area. The design of the ADT allowed unlimited oscillation of the dump bed in relation to the tractor cab without affecting the cab, so the cab remained upright. This fail-safe feature prevented operator injuries and cab damage. (ORPS Report RL--BHI-ERDF-2004-0001)

On June 16, 2004, at the Savannah River site, the controls on a telescoping grader failed during operation. All parameters were within normal range at the pre-operational check, but after an hour spent removing silt from drainage ditches, the equipment began to move faster than expected. Although the operator released the control levers (which should have stopped the equipment) the grader continued to move and pick up speed. The operator dropped the bucket into a trench bank in an attempt to slow the vehicle, but it continued to move. After the emergency brake failed to stop the grader, the operator ran the front wheel into the trench bank, stopping forward movement. His prompt decisionmaking was instrumental in avoiding injuries or equipment damage. (ORPS Report SR--WSRC-SW&I-2004-0005)

These events demonstrate the importance of thorough pre-job planning with specific, not generic, work packages and the need for mandatory pre-work walkdowns that include task-specific "what-if" scenarios. Careful planning can also be augmented by using equipment with fail-safe design and by operators who react quickly to changing conditions.

KEYWORDS: *Heavy equipment, ADT (articulated dump truck), truck, near miss*

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

4. IMPROPER GROUNDING DURING WELDING RESULTS IN ELECTRICAL SHOCK

On February 17, 2004, at the Argonne National Laboratory–East, a welder in the Central Shops received an electrical shock while welding a stainless steel piece. The welder was holding the piece while it rested on a welding table instead of properly grounding it. The shock began in his right index finger, moved across his chest, and down his right arm. He completed the weld, but a short time later he informed his supervisor that he was experiencing muscle tightness in his chest. Medical personnel took the welder to a local hospital for evaluation. Hospital staff found no evidence of an electrical shock injury, and the welder returned to work the next day. (ORPS report CH-AA-ANLE-ANLEPFS-2004-0002; final report filed May 3, 2004)

The welder was initiating an arc to weld a stainless steel flange (1½-inches in diameter by ⅛-inch thick) onto an 8-inch-long stainless steel tube when he received the shock. He was holding the torch in his right hand and the workpiece in his left while resting the bottom on the welding table. The welding table was

ELECTRICAL SAFETY PRACTICES FOR ARC WELDING EQUIPMENT

- Ensure that you are insulated from the workpiece and ground (i.e., don't become part of the welding circuit).
- Stand on rubber mats or other dry insulation.
- Wear dry, hole-free welders' gloves.
- Ensure the welder is turned off when not in use.
- Check the welding equipment for proper grounding and ensure that it is in good operating condition.
- Do not weld when wet or dip the electrode in water to cool it.
- Avoid exposure to excessive electric and magnetic fields (EMF).
- Keep the electrode and work cables together, and never place your body between the two cables or coil the electrode cable around your body.
- Do not work directly next to the welder power source.
- Ensure that the workpiece is properly grounded to a welding table or firmly attached to the workpiece (ground) lead.

grounded back to the power source with a hand-clamp grounding fixture attached to the table. When he felt the shock through his leather welder's gloves, the welder immediately stopped work, readjusted the piece to rest on a metal jig instead of his hand, and completed the weld.

The welding machine was set to provide an initial high Radio Frequency (RF) voltage to the torch to initiate the welding arc. The RF is generated by applying voltage to a set of spark gap conductors that produces a static-type discharge of RF energy. The machine was set for 175 amperes, and the open circuit voltage was about 80 volts DC.

Investigators determined that the practice of holding small work pieces in one hand while resting it on the grounded welding table to weld had become a commonly accepted work practice and that there was no clear management direction regarding this practice. Investigators also determined that the workpiece included components for which the insulating quality was not known to the welder. This information was not obtained from the customer requesting the welding work.

Although there were several probable causes, objective evidence led investigators to conclude that the shock occurred because the welder did not properly ground the work assembly before initiating the weld. Central Shops personnel also conducted a study under controlled conditions to determine the exact nature of the shock. They determined that the welder received a shock from the RF energy of the arc initiation circuit because welding current could not have conducted through his welding gloves.

Regardless of the type of electrical energy involved in this event, investigators determined that the following improvements in the welding process will be implemented.

- Review best practices with welders and supervisors for securing work pieces in a holder and applying a positive grounding conductor in the welding circuit.
- Develop an annual technical refresher training session for welders to ensure skills of the trade are met and that work is performed in accordance with appropriate standards and requirements.
- Revise the process by which materials are received from welding customers to ensure that information is adequate to determine job scope and perform a hazards analysis.

A similar event occurred at Rocky Flats where a welder sustained a minor electrical shock while performing a welding operation. Investigators believe the shock resulted from the high frequency voltage used to initiate ionization for the welding arc coupled with a marginal ground connection from the welder. (ORPS report RFO--EGGR-NONPUOPS1-1993-0001)

Arc welding is a safe process when welders use proper welding practices that incorporate measures to protect them from the hazards of fumes and gases, welding sparks (fires and skin burns), arc rays (eye burns), and electrical shock. The hazard of electrical shock is the most serious risk because contact with energized equipment or parts can result in a serious electrical shock or death. Primary voltages within the welder can be 230 to 460 volts, while the secondary voltage can be 60 to 100 volts. The shock from the secondary voltage can occur from touching part of the welding circuit (e.g., electrode) while also touching the grounded workpiece.

OSHA Standard 29 CFR 1910.254, *Arc Welding and Cutting*, provides information on properly installing and grounding welding equipment. The standard states that the "workmen designated to operate arc welding equipment shall have been properly instructed and qualified to operate such equipment." Section 254(d) states that grounding of the welding machine must be checked, with special attention given to safety ground connections of portable machines, and that manufacturer instructions covering operation of equipment must be strictly followed and the work lead shall be firmly attached to the work. ANSI Standard, Z-49.1, *Safety in Welding and Cutting*, addresses requirements for protective clothing, including the use of welders' gloves, to help prevent injury from electrical shock.

These events point out the importance of following safe work practices and procedures when performing routine tasks. Workers should analyze hazards associated with a job each time they perform it, asking themselves "what could go wrong?" Refresher training should be provided at least yearly to ensure that safety requirements are well understood and to serve as a reminder of the need to follow proper procedures even when performing routine work.

KEYWORDS: *Welding, electrical shock, PPE, grounding*

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

Commonly Used Acronyms and Initialisms

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
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 Requirement
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 reasonably 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