OPERATING EXPERIENCE SUMMARY

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EH Publishes "Just-In-Time" Reports

The Office of Environment, Safety and Health publishes a series of Just-In-Time reports on its Lessons Learned and Best Practices web site. These reports are targeted to work planners and workers and discuss safety topics relevant to the work they do. Each report presents examples of problems and mistakes encountered in actual reported cases and offers points to consider to avoid similar mistakes in the future.

EH plans to issue more Just-In-Times soon on other safety issues. All of the Just-In-Times can be accessed at http://www.eh.doe.gov/paa/jit.html.

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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1. DON'T MISUSE THE FIX-IT-NOW WORK PROCESS

The Fix-It-Now (FIN) work process is a best practice whereby special maintenance teams perform minor, unplanned maintenance projects, freeing maintenance departments for more complex corrective and preventive maintenance activities. However, for this best practice to be used effectively and safely, proper screening of work tasks is necessary to ensure they are correctly categorized as "minor" work (i.e., work that does not require rigorous hazards analysis).

Top-performing nuclear utilities have used FIN teams for many years in an effort to become more efficient and cost-competitive. PECO Energy management estimates that they have saved more than 100,800 work-hours (worth $1.39 million) and reduced both backlog and those maintenance tasks that require detailed planning from 75 percent to 25 percent since they initiated FIN teams at their Peach Bottom plant in Pennsylvania. This best practice is also used in the United Kingdom. For example, British Energy FIN teams, called DART (Defect and Rectification Team), were able to significantly reduce the backlog of defects following implementation of the program.

Many sites across the DOE Complex also use the FIN work process or similar processes for minor work activities. For instance, at Los Alamos National Laboratory, the site support services contractor uses FIN when they need to quickly make minor maintenance repairs in non-laboratory and non-hazardous areas like offices. Their goal is have a FIN team complete specific requests, such as re-lamping, plumbing repairs, and minor carpentry that does not require structure penetrations, within 48 hours. Fix-It-Now maintenance repair requests are routed to the area facility manager for prioritization and approval before the work is performed.

It is important to recognize that even though this work practice allows for expedited work approval and completion without detailed planning or scheduling, the tasks should be properly screened to ensure that they clearly fit the criteria for FIN-type work. Although FIN criteria may vary from organization to organization, the following criteria, used at the Savannah River Site, is a typical example.

- The task requires less than $2,000 worth of labor and materials.
- No work is performed on safety class or safety significant equipment unless a pre-approved procedure or model work order exists.
- Either a pre-planned/approved model work order or pre-approved procedure is available or neither is required (skill-of-the-craft).
- The equipment to be worked on has a single-point lockout, a lockout readily available, or a lockout already installed.

Examples of recent events in which the failure to properly screen FIN-type or minor work was a causal factor include the following.

On April 11, 2005, at the Hanford Waste Receiving and Processing Facility, fire system maintenance personnel isolated a fire suppression system riser while the facility was in operational mode to troubleshoot a restriction in the system. This violated the facility technical safety requirements. At the critique, investigators learned that the work was performed under a Minor Work Ticket, which is used only for low-risk activities. The Minor Work Ticket has a checklist of criteria, one of which is that the work cannot involve safety significant systems. (ORPS Report RL--PHMC-WRAP-2005-0003)

On February 2, 2005, at the Pantex Plant, electricians allowed the extended bucket of an aerial truck to rest on a de-energized insulated phase line of a 480-volt lighting circuit while they re-lamped outdoor security lights. Investigators determined that inadequate work package preparation was a factor because a FIN work package was used that relied on the skill-of-the-craft to determine and apply appropriate hazards controls that were outside the scope of minor work. (ORPS Report ALO-AO-BWXP-PANTEX-2005-0019)

On December 8, 2004, at the Savannah River H Tank Farm, a pressure gauge blew off and struck the hardhat of a mechanic who was attempting to replace the gauge on an air system. The mechanic did not know the system was still pressurized. Investigators determined that the standard work release protocol was not followed. A FIN job scope for replacing the gauge was used; therefore, neither a hazards screening nor a lockout screening was performed. (ORPS Report SR--WSRC-HTANK-2004-0038)

Other past events have included performing work on safety-significant equipment without applying the necessary quality assurance checks, failing to include necessary post-maintenance testing that would have been specified in a standard work request, or failing to provide adequate hazards identification and analysis.

To find information on other maintenance best practices, go to the Energy Facility Contractors Group (EFCOG) website at http://www.efcog.org/Best%20Practices/Maintenance.htm.

The use of a Fix-It-Now or Minor Work Ticket process is an effective method of streamlining the maintenance process; however, it is important to ensure that the process is used correctly and only on low-risk work activities. This will ensure that work tasks that require detailed work group coordination, hazards analysis, quality controls, and post-maintenance testing are handled through normal work process protocols. The proper use of this maintenance best practice is important to ensure worker and facility safety.

KEYWORDS: *Best practice, FIN, fix-it- now, minor work, work process, maintenance, work order, work request*

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

2. PROTECTIVE EYEWEAR AND EFFECTIVE CONTROLS — ESSENTIAL ELEMENTS OF LASER SAFETY

The Office of Corporate Performance Assessment published *Special Operations Report: Laser Safety* in February 2005 to detail the root causes and corrective actions taken in response to seven laser accidents that occurred across the DOE Complex over the past 5 years. These incidents resulted in eye injuries to five individuals, none of whom was wearing laser eye protection (LEP). The most recent of these events occurred on January 19, 2005, at the National Renewable Energy Laboratory (NREL), where a graduate student sustained significant damage to the vision in his right eye. (ORPS Report GO--NREL-NREL-2005-0001; final report filed March 11, 2005).

The graduate student was working with an NREL researcher testing a new linear antenna design to determine its sensitivity. The task involved testing silicon samples to compare the amplitude of signals produced by the new design antenna versus an existing antenna. Because of the layout of the laboratory and the tasks that needed to be completed, the researcher and the graduate student often could not speak to each other regarding the status of the Class 4 laser during testing and could not always see each other. In addition, the laser emission indicator light was not functioning, so there was no visual indication that the system was on, other than a barely visible beam.

In the course of testing, the graduate student used stainless steel tweezers to remove the Neural Density (ND) filters, so he could check for an observable signal. While the researcher was getting another sample in a different part of the laboratory, the graduate student worked on trying to obtain a better signal, tuning the circuit while observing the signal on an oscilloscope. He was aware that the laser was on during this process because with the laser in standby he would have to monitor the circuit on a voltmeter, rather than on the oscilloscope. At some point, he removed his LEP—most likely because the dark glasses made it difficult to observe the signal on the oscilloscope.

When the researcher returned with the new sample about 5 minutes later, the graduate student used the tweezers to remove the previous sample from the antenna enclosure and observed a multi-colored flash in his right eye. At the time he thought the flash was from the room lights because it was not the deep red color he believed the beam would present. However, investigators believe that the flash was caused by a reflection of the laser beam off the sample or the tweezers.

The researcher told investigators that when he returned with the new sample he noticed that the graduate student was not wearing his LEP and instructed him to put it back on, which the graduate student did immediately. He also stated that he was sure that all of the ND filters were in place at that point and that the previous sample had already been removed from the antenna enclosure.

The graduate student, now wearing his LEP, mounted the new sample and began to monitor the signal. He noticed that the vision in his right eye was slightly fuzzy, and when he looked up to view the signal on the oscilloscope, he saw a dark shadow that obscured the vision in his right eye. He told the researcher that something was wrong, then covered his eye with his hand and exclaimed "Ouch." He then said repeatedly, "I see spots." The researcher realized there was a problem, shut down the laser, and took the student to the site medical clinic. The student was sent to a local eye surgeon and while there he told the researcher that he had removed all of the ND filters while trying to obtain a signal from the second sample and failed to replace them before he removed the sample from the antenna enclosure.

A team of investigators that included laser subject matter experts and the Laser Safety Officer (LSO) investigated this event. They determined that multiple causal factors led to unsafe practices that allowed the exposure to occur. The graduate student removed his LEP while the laser was operating, violating an explicit requirement that required everyone in the room to wear protective eyewear when Class 3b or Class 4 lasers were being operated.

The investigative team also determined that work planning for this task was inadequate. A verbal plan was in place, but the planning process was not carried far enough, was not documented, and did not establish what to do if the activity did not produce the expected results (e.g., shutting everything down if the new testing apparatus did not function). The team also learned that the researcher, as a matter of practice, required less experienced workers to wear LEP that provides a higher level of protection than is strictly required. In this case, the resulting reduction in visibility was incompatible with the graduate student's ability to see the instrumentation, which led him to remove his laser eyewear.

The team identified nine corrective actions to address this event, including the following.

- Improve the engineering controls for laser operations to reduce reliance on laser eye protection and other administrative controls. Controls such as full or partial enclosure of laser beams, interlocks on beam enclosures, use of diffusive surfaces to minimize beam reflections, use of beam blocks for direct and reflected beams, and selection of appropriate hand tools for laser operations should be implemented.

- Revise the format and content of laser operation procedures to specifically address the hazards presented by both routine and non-routine operations. Explanations of the hazards, controls, and step-by step procedures for conducting routine operations should be included, as should thresholds for determining when a non-routine operation achieves a hazard level that requires additional risk assessment.

- Improve the supervisory/mentoring process with particular emphasis on activities involving less experienced workers and non-routine tasks.

- Perform a comprehensive assessment of the laser safety program and revise the program based on the results. Special emphasis should be placed on the roles and responsibilities of line management, mentors, and the LSO.

- Improve the quality and quantity of LSO resources and ensure that they are commensurate with the number, type, and complexity of laser operations. Establish training and certification requirements for both the LSO and the alternate LSO.

A similar event occurred at Los Alamos National Laboratory (LANL) on July 14, 2004, where an undergraduate student sustained an eye injury that resulted in loss of central vision in her left eye while working with a LANL scientist on a new experiment that involved use of a Class 4 laser. (ORPS Report ALO-LA-LANL-CHEMLASER-2004-0001; final report issued December 23, 2004)

The scientist and student had set up a laser experiment designed to suspend and analyze particles inside a vacuum target chamber, using a configuration that was not described or analyzed in work control documents. Figure 2-1 shows the setup for the experiment.

Figure 2-1. Laser experiment setup

The experiment involved using a Particle Generating (PG) laser to suspend the particles and a Laser Induced Breakdown Spectroscopy (LIBS) laser to vaporize them. After the scientist had fired the laser, secured it, and observed the suspended particles, he told the student she could view the particles. As the student looked into the chamber, she saw a flash and noticed a reddish brown substance floating in her left eye. She was later diagnosed with a retinal lesion and associated hemorrhage in the eye. Neither the student nor the scientist was wearing LEP because they needed to see the small amount of visible light from the laser while they were aligning the mirror.

Investigators determined that the laser exposure resulted from improper or no use of engineering controls and the lack of personal protection equipment. The work was poorly planned, hazards were not identified, controls were not put in place before work began, and the performance of workers was poorly monitored. In addition, the scientist did not adhere to documented requirements for Class 4 laser operations and failed to practice, model, and enforce safe behavior, which directly influenced the student's behavior in the laboratory.

OE Summary 2004-06 discusses a March 14, 2003, incident in which a graduate student at UC-Berkeley suffered a temporary eye injury while manipulating a power meter in the path of a pulsed infrared laser beam. The student believed the alignment task was completed and had already removed his LEP when a stray beam reflected into his eyes. The article includes a listing of techniques for performing laser alignments safely, as well as a figure (shown here as Figure 2-2) depicting various types of protective eyewear.

Figure 2-2. Protective eyewear

The unprotected human eye is extremely sensitive to laser radiation and can be permanently damaged from direct or reflected beams. Protective eyewear in the form of goggles, glasses, and shields must be worn at all times during laser operations. Each type of laser requires a specific type of protective eyewear that must be considered in the selection process. It is important to specifically check both the wavelength and the optical density imprinted on LEP before using a laser, especially in multi-wavelength facilities where more than one laser may be located in the same room. In addition, it is important to ensure that area lighting is adequate to allow sufficient visibility to observe instruments even while wearing LEP.

Appropriate control measures should also be taken to ensure worker safety during laser operation. The Laser Institute of America provides a complete list of laser safety control measures (both engineering and administrative) for all classes of lasers on their website. The recommended engineering controls for a Class 4 laser include protective housing, interlocks on removable parts of the housing, and a key-controlled master switch. Recommended administrative controls include requiring eye protection; providing education and training for operators, maintenance, and service personnel; and developing approved, written standard operating procedures. Additional information on laser control measures is also provided in American National Standards Institute Standard, ANSI Z136.1-2000, *Safe Use of Lasers.*

These events clearly show the importance of wearing the appropriate laser eye protection when working with lasers. As noted in the Special Operations Report on laser safety, each laboratory across the complex must implement mandatory use of LEP (exceptions may be granted by the LSO with proper hazard evaluation). These events also demonstrate the need for proper supervision and training of students working on laser experiments with experienced researchers. It is essential for managers and supervisors to ensure that all required safety practices are implemented and that all changes in work configuration are both authorized and addressed in work control documents. Workers, whether experienced or novice, should know the hazards involved in experiments, wear the specified laser eye protection while engaged in laser experiments, and question anything that appears to be unsafe before performing a task.

KEYWORDS: *Laser, eye injury, laser eye protection*

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

3. INADVERTENT LIQUID TRANSFERS VIOLATE CONDUCT OF OPERATIONS PRINCIPLES

Four events involving inadvertent liquid transfers at the Savannah River Site were reported to ORPS in the first quarter of 2005. Ten similar events occurred across the Complex in 2004, and 7 additional events occurred during calendar year 2003. Primarily, these events involved waste water, but the circumstances surrounding them were similar to those that have led to more serious problems (e.g., criticalities) in the United States and abroad. A review of these events indicates that operators at some DOE sites are not adhering to the Conduct of Operations principles of DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities.*

The following summarizes the events that occurred at the Savannah River Site this year.

- On March 10, 2005, at the H-Tank Farm, operators were flushing transfer lines after a tank transfer operation. During the flush, the control room operator noticed a level increase in the wrong tank and shut down the flush. However 1,400 gallons of flush water had already been inadvertently transferred to the wrong tank. Operators conducted a field verification of the transfer route and discovered that valve positions were not in accordance with the system alignment checklist. (ORPS Report SR--WSRC-HTANK-2005-0004)

- On February 23, 2005, at the Laboratory Technical Area, an operator noticed that the wrong transfer light was illuminated when he was transferring waste water from one tank to another. He stopped the transfer, but not before 100 gallons of waste water had been transferred to a previously empty tank. (ORPS Report SR--WSRC-LTA-2005-0003)

- On January 27, 2005, at the F-Canyon Plutonium Processing Facility, someone noticed a mass balance transfer discrepancy during the transfer of process liquid between two tanks, and the transfer was stopped. When valve positioning was re-verified, an operator noticed that an isolation valve to a third tank was locked closed, but the stem was still visible (i.e., the valve was not fully closed/ seated). Subsequent inspection revealed liquid in a tank that should have been empty. (ORPS Report SR--WSRC-FCAN-2005-0001)

- On January 12, 2005, during a tank transfer of waste water at the H-Tank Farm, control room operators noticed an increase in the level of the tank that was not to receive any of the solution. The shift manager and first line manager checked the valve alignment and discovered that a tank isolation valve was not closed as required. (ORPS Report SR--WSRC-HTANK-2005-0001)

A review of 30 inadvertent transfer events reported since 2000 for all DOE sites revealed problematic noncompliance with transfer control procedures and a breakdown in operator attention to detail when performing valve lineups. The following five issues provide examples of commonly made errors.

Valve Lineup Issues

– Operators placed valves in the wrong position.
– Operators failed to ensure valves were closed.
– Independent verification of valves and valve positions was less than adequate.
– Operators were not familiar with the correct techniques for manipulating chain-operated valves or verifying proper valve positions (e.g., lack of tags on three-way valves).
– Operators had difficulty seeing valve or valve position indication (i.e., they made assumptions or relied on recollection).

Procedure Issues

– Procedure steps were missed or not completed.
– Control room operators failed to have the procedure open for reference, or field operators did not have a procedure copy.
– Working copies of procedures did not identify solution to be transferred.
– Work instructions did not include formal valve lineup or verification.
– Unused procedure sections were not marked as N/A (not applicable), or the wrong procedure steps were marked as N/A.
– Data sheets were misplaced, or the wrong transfer sheets were used.
– Infrequently performed steps were performed incorrectly.

Job Planning Issues

– Pre-job briefings were not performed or were less than adequate.
– Review of the transfer evolution was less than adequate.
– Not all participants in the evolution attended the pre-job briefing.
– System walk downs were not performed.
– The transfer evolution was considered routine and not discussed.
– The transfer evolution was infrequent and not discussed.
– All potential transfer paths were not identified or discussed regarding consequences of valve misalignment.

Communication Issues

– Communication was less than adequate (i.e., valve positions not repeated back).
– Supervisor or control room operator gave wrong valve information or wrong valve position to field operator (Reader-Worker method).
– Turnover was less than adequate to relief operator who was not at pre-job briefing.

Maintenance Issues

– Issues with mechanical binding of valves.
– Chain operators for valves were not functioning properly.

– There was no program for lubricating valve chain operators.

Inadvertent transfers can cause problems. Solutions containing fissile materials can experience inadvertent criticality. For many solutions, reactions between incompatible chemicals can produce explosive, corrosive, or gas-generating mixtures. There is also the potential for off-site release of hazardous chemicals. It must be acknowledged that operators across the Complex routinely manipulate hundreds of valves a day without incident. However, under the right circumstances, even one misalignment can result in an incident.

The following recommendations can help prevent or mitigate inadvertent liquid transfers.

1. **Use Procedures** —Proper use of procedures reduces the chance of unexpected results. Proper communication plays an important role in directing the evolution from a remote location. The "Reader-Worker" method requires the controlling operator to read the procedure verbatim to the local operator who repeats back the step, reports completion of the step, and is acknowledged by the controlling operator.

2. **Verify Valve Lineups** — Checking system alignment should guarantee that the solution goes to the expected location. All lineups should be physically walked down and checked against facility documentation. Valve and switch lineups should be independently verified.

3. **Conduct Detailed Briefings** — Conduct detailed briefings with all parties involved in the transfer, ensuring that each one understands what is expected and what actions are to be taken if something unexpected happens. Briefings should identify all possible transfer paths, as wells as the important parameters and instrumentation to be monitored.

4. **One Task at a Time** — Ensure that each evolution is complete and parameters have stabilized before beginning another task. Where multiple evolutions must be performed, ensure adequate supervision of each.

CONDUCT OF OPERATIONS PRINCIPLES

A high level of performance can be achieved when operators follow Conduct of Operations principles, some of which are listed below.

- Adhere to industrial safety requirements.
- Perform adequate shift turnover using log books, round sheets, status boards, checklists to convey an accurate status to the oncoming crew.
- Ensure that procedures are technically accurate and written so that operators can use them without making mistakes.
- Do not permit shift turnover until both the oncoming and offgoing personnel have a high degree of confidence that an appropriate information transfer has taken place.
- Monitor process parameters, recognize out-of-specification conditions, and promptly take appropriate action.
- Align components (or check for alignment) using alignment checklists or procedures prior to operation.
- Maintain exposure ALARA through use of PPE and monitoring instruments; follow Radiological Work Permits and postings; know your exposure level.
- Believe your readings/indicators and treat them as accurate until **proven** otherwise.
- Use the latest revision of drawings and procedures.
- Apply and document lockout/tagout in accordance with procedures.
- Independently verify components in systems with safety-related functions or others that could lead to unplanned shutdowns or toxic or radioactive material release.

DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities

5. **Prepare Contingency Plans** — When preparing for an evolution, think about what may go wrong and for each possible event ensure that guidance is provided to mitigate it. Include parameters and instrumentation that would indicate an unusual event is occurring.

6. **Practice Self-Checking** — Use the STAR principle: Stop, Think, Act, and Review. Pause before acting and think about what you are about to do. What responses do you expect? Have you selected the correct component? Carry out the action and then review the results. Is the result what you expected? In the case of liquid transfers, is the level of the intended source decreasing and is the level of the intended receiver increasing?

7. **Exercise Stop-Work Authority** — Stop work immediately, restore to safe conditions, and report condition that is abnormal or unexpected.

These events are a reminder of how easily inadvertent liquid transfers can occur when procedures lack rigor or are not followed to the letter; when personnel do not perform pre-evolution steps completely and correctly – such as ensuring that valves are in the EXACT position required; when review is less than adequate; and when sufficient controls are not in place to prevent inadvertent transfers. Disciplined conduct of operations and procedural compliance is important to facility safety.

KEYWORDS: *Conduct of operations, inadvertent transfer, liquid transfer, valve, tank, flush*

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

4. KEEP BODY PARTS OUT FROM UNDER SUPPORTED LOADS

On April 14, 2005, at the Fernald Closure Project, a DOE facility representative saw a radiological control technician (RCT) reach underneath a waste hopper supported on the tines of a forklift to swipe the bottom of the hopper. Concerned, the facility representative spoke to the RCT's supervisor and the project manager. The project manager suspended work. (ORPS Report OH-FN-FFI-FEMP-2005-0011)

The forklift operator had raised the hopper (Figure 4-1) about 12 inches from the ground and left the forklift's engine running. After swiping the sides of the hopper, the RCT reached under it and swiped the bottom of the hopper. The forklift operator did not maintain a clear view of the RCT while he was surveying the hopper, because he was waiting for the RCT's signal that the survey was complete and that the hopper could be transported away.

Figure 4-1. Waste hopper

Fernald, like some other sites across the DOE Complex, trains its RCTs to use a standard long-handled mop with cloth affixed to the head when swiping the tops and sides of tall or large objects. Very large objects such as metal boxes or Sealand® containers are normally placed on blocks so that RCTs can survey the underside.

Good Practice: Use a long-handled mop to perform radiological swipes on inaccessible or potentially unstable objects.

Fernald's forklift procedures state that workers are not to stand under a raised load, but do not specify that workers should not extend body parts under a load. These procedures are based on the OSHA Standard, 29 CFR 1910. Section 178, *Powered industrial trucks*, states in paragraph (m)(2), that "No person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty."

Fernald is in the process of clarifying its procedures to prohibit RCTs from reaching under (or placing any body part under) a supported load unless it is absolutely necessary, in which case safety and health organization staff will first evaluate the situation.

On March 24, 2005, 3 weeks before the Fernald event occurred, an RCT at the East Tennessee Technology Park reached under a 200-pound Super Sack® containing wooden pallets to swipe it. The Super Sack was sitting on the tines of a parked forklift. The RCT's supervisor directed him to move out from under the load. No other corrective actions were specified. (ORPS Report ORO--BJC-K25ENVRES-2005-0007)

These events illustrate that it is prudent for RCTs to take advantage of an active engineering control (e.g. a long-handled tool) to reach under a supported load or to reach a tall object rather than relying on the device supporting the load to remain stable. Using this type of tool workers can avoid positioning themselves underneath supported loads or climbing a ladder to reach the top of an object.

KEYWORDS: *Hopper, RCT, forklift, elevated load, near miss*

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

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
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
MSDS	Material Safety Data Sheet
ORPS	Occurrence Reporting and Processing System
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control