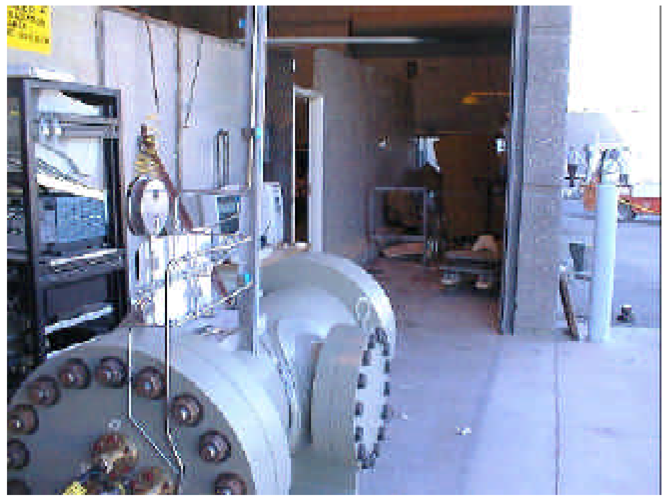
OPERATING EXPERIENCE SUMMARY



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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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EH PUBLISHES A REVIEW OF HOISTING AND RIGGING EVENTS

The Office of Environment, Safety and Health recently published *Department of Energy Hoisting and Rigging Events*. Hoisting and rigging activities typically involve the lifting, moving, and laying down of heavy loads. These tasks require careful planning, preparation, and implementation by a variety of individuals, including managers, work planners, supervisors, riggers, spotters, equipment operators, and maintenance personnel.

The purpose of this report is to describe the commonly made errors in these incidents and to identify the lessons learned and specific actions that should be taken to prevent similar incidents from recurring.

The report can be accessed at the URL **http://www.eh.doe.gov/HR_INPO_Style_FinalDraft_01-20-04.pdf**

EVENTS

1. GAS LINE PUNCTURED DURING UNSCHEDULED EXCAVATION WORK

On November 4, 2003, at the Los Alamos National Laboratory (LANL), a backhoe operator began excavating a trench for electrical lines and punctured a pressurized (80 psi) natural gas line (Figure 1-1). As the tine of the backhoe bucket penetrated the line, a co-worker heard a hissing sound and directed the backhoe operator to stop work. Emergency responders evacuated the area, turned off the gas, and checked for gas concentrations. The leaking gas did not ignite, and there were no injuries. (ORPS Report ALO-LA-LANL-ADOADMIN-2003-0005; final report filed December 22, 2003; SELLS Identifier LANL-ADOADMIN-2003-0010)

The backhoe operator had completed a scheduled excavation and decided to begin digging the trench for the electrical lines, even though that work was had not been scheduled and was not planned. A spotter who was working with him had moved to another area after the operator completed the planned excavation. He did not know that the operator had begun excavating another trench until he heard the hissing sound when the 2-inch gas line was cut.

Figure 1-1. Cut gas line

When the backhoe operator began digging the trench, he apparently was unaware that the utility locator markings had deteriorated since a crew marked them a month earlier. Work planners intended to have the gas line re-marked before scheduling work on the trench. The operator did not realize that performing additional unplanned and unscheduled work posed a hazard, and did not discuss his intention to excavate the trench with anyone.

Investigators determined that work controls were inadequate to ensure that only authorized work was performed and that situations where tasks were completed ahead of time were addressed. Corrective actions for this event included counseling the worker; reviewing the event and excavation requirements with subcontractor construction workers; and incorporating a discussion on safety issues, controls, and the designated work boundary for each task into the subcontractor's plan of the day meeting. In addition, a planned Integrated Work Management Process developed by the LANL Health, Safety, and Radiation Protection Group was quickly implemented, and subcontractors received training on its requirements.

The new Integrated Work Management Interim Process was developed to improve configuration management and to address work control problems that had led to past events. The process applies to all current and future work at LANL that requires Hazard Control Plans, facility work packages, Activity Hazard Analyses, and other activity hazard identification and control documents. The new process was introduced on November 3, 2003, but had not yet been implemented when the November 4th incident occurred.

LANL management developed the Integrated Work Management Interim Process because of the number and frequency of significant events in 2002 and 2003. The following is a brief description of some of the excavation events that suggested improved work control was needed. (ORPS Report ALO-LA-LANL-LANL-2003-0001)

- January 22, 2003 — An exposed 2-inch, 88 psi pressurized gas line was struck and ruptured when an excavator bucket hit the line.

- January 8, 2003 — A 10-inch clay sewer line encased in concrete was struck, releasing approximately 3,600 gallons of raw sewage.

- November 8, 2003 — An abandoned 1-inch cable was struck. The cable was within about 2 inches of a main water line and within feet of other utility lines, including sewer gas, and telephone lines.

- November 5, 2002 — A 10-inch water line was struck after it had been fully exposed, releasing nearly 100,000 gallons of water from a fire suppression water tank.

- September 24, 2002 — A gas line was cut through a 6-inch-wide plastic marking tape and a tracer wire.

- August 29, 2002 — An exposed water line was struck and cut, releasing 15,000 gallons of water into the environment.

- August 19, 2002 — A gas line was cut during excavation for a manhole.

In most cases, it is subcontractors who perform trenching and excavating activities. This makes it important to have good communication and ensure subcontractor control. If subcontractors are responsible for locating utilities before digging, they should demonstrate to facility management that underground utilities have been located, identified, and marked before excavation begins. All construction work performed at LANL must now incorporate the requirements of the work management process, and all work control documents for new work must be provided to LANL managers before work begins.

Requirements in OSHA 29 CFR 1926, *Safety and Health Regulations for Construction,* subparts 651(b) and 651(a)(3), hold employers responsible for identifying underground hazards near a work area. Subpart .965(c) requires work to be conducted in a manner that avoids damage to underground facilities.

A lessons-learned report (SELLS Identifier LANL-ADOADMIN-2003-0010) on the LANL event is available on the SELLS website, http://tis.eh.doe.gov/ll/listdb.html.

An institutional process for configuration management is essential to ensuring that construction workers can perform work safely. Excavation crews must have accurate, up-to date information to ensure that they know the locations of all utility lines in the work area. Workers should never perform tasks outside the authorized work scope and should consult their supervisors before beginning any task that has not been scheduled for completion.

KEYWORDS: *Conduct of operations, configuration management, work controls, hazard controls*

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

2. GOOD PRACTICE: IMPOUND SALVAGED SUSPECT/ COUNTERFEIT BOLTS TO PREVENT REUSE

With implementation of the suspect/counterfeit and defective items program in 1991, site management became responsible for ensuring facilities were inspected to identify and remove suspect, counterfeit, or defective items. This process involves recognizing suspect, counterfeit, or defective components and being vigilant in identifying them. Often, these items, particularly fasteners, have been in service for a number of years and may be difficult to readily detect. When such items are identified, it is essential that they be removed from service or from storage containers where they could be reused in a future application.

The Specific Manufacturing Capability (SMC) at the Idaho National Environmental and Engineering Laboratory has an ongoing program of conducting facility sweeps to locate suspect/ counterfeit bolts that have been recovered from dismantled equipment. Facility personnel, recognizing the potential for these bolts to be reused in a load-bearing or high-consequence application, developed a system for tracking, reporting, and impounding the bolts to preclude their inadvertent reuse. (ORPS Reports ID--BBWI-SMC-2003-0004, –0006 through –0008, –0010)

On November 17, 2003, SMC reported that facility personnel had found low-strength, Grade 2 (Figure 2-1) and suspect/counterfeit bolts installed by the original manufacturer in custom-built shipping containers. Following this discovery, an engineering evaluation indicated that the bolts were not used in a load-bearing or high-consequence application.

Figure 2-1. Grade 2 bolt with no manufacturer's headmark

When workers dismantled the containers, they did not recognize the bolts as potentially suspect or counterfeit and placed them in tool containers. When the bolts were later found and identified as suspect/counterfeit during a facility sweep, they were removed from the tool containers and impounded.

The corrective actions taken in response to this and similar previous events consisted of the following actions.

- Revise awareness training.
- Add training requirements.
- Modify work order templates to include a suspect fastener reminder.
- Extend the facility-wide search for suspect/ counterfeit items.
- Incorporate the revised awareness training into employee qualification requirements.

Facility managers acknowledge that they cannot prevent legacy suspect/counterfeit items entirely, but they can prevent the items from being reused.

The sweeps for suspect/counterfeit bolts at SMC may have contributed to worker awareness that led to the discovery of installed suspect/counterfeit bolts. In one case, on November 18, 2003, a construction worker noticed suspect bolts in overhead beams in the work area (ORPS Report ID--BBWI-SMC-2003-0009). He reported this finding to his supervisor. Engineers consulted the DOE Suspect/Counterfeit Headmark List and verified that the bolts in question were indeed counterfeit. A cause analyst determined that the bolts had originally been installed in 1986, 5 years before the DOE Suspect/Counterfeit and Defective Items Program was instituted.

In a second instance, on December 2, 2003, a mechanic performing maintenance on a Tiger manlift noticed approximately 30 bolts installed in the equipment that appeared to be suspect. The machine was tagged out of service pending resolution of the issue. (ORPS Report ID--BBWI-SMC-2003-0010)

Hanford Site management has also taken steps to identify and remove suspect/counterfeit bolts from service or reuse. During an inspection on July 24, 2003, a quality assurance engineer discovered 79 suspect/counterfeit fasteners of various grades, sizes, and headmarks in a storage bin. On July 29, 2003, a quality assurance engineer found another eight suspect/counterfeit fasteners in a storage bin. All of the fasteners were immediately removed and replaced with new fasteners. (ORPS Report RL--PHMC-ANALLAB-2003-0006)

WHERE TO FIND INFORMATION ON SUSPECT/COUNTERFEIT ITEMS

- The EH Suspect/Counterfeit and Defective Items web site: http://www.eh.tis.doe.gov/paa/sci
- DOE O 414.1A, *Quality Assurance* and DOE G 414.1-2, *Quality Assurance Management System Guide,* which can be accessed at http://www.directives.doe.gov
- Government-Industry Data Exchange Program (GIDEP) (http://www.gidep.org)
- Institute of Nuclear Power Operators (INPO)

Suspect, counterfeit, and defective items must be removed from service as soon as possible. One removed, they cannot be salvaged for reuse. When sites identify these items, they need to notify the local Inspector General's office (in the event the items will be needed for evidence) and then impound or destroy them.

KEYWORDS: *Suspect/counterfeit, bolt, load-bearing*

ISM CORE FUNCTION: *Provide Feedback and Improvement*

3. *NEAR MISSES AND ADVERSE EVENTS ARE PRECURSORS TO SEVERE ACCIDENTS*

On September 18, 2003, at the Nevada Site Office North Las Vegas facility, an experimentation support engineer increased the pressure to an experimental pressure vessel from 1,000 psig to 1,100 psig, and eight socket-head cap screws connecting an electrical terminator housing to the chamber failed. The terminator was propelled about 60 feet (Figure 3-1), damaging a flammable storage cabinet (Figure 3-2), fire protection equipment, and a roll-up door. No one was injured, but the engineer and a principal investigator stood within 5 feet of the vessel, and two maintenance mechanics stood outside the roll-up door about 10 feet away (Figure 3-3). Had they been in the path of the component, they could have

Figure 3-1. The terminator assembly was forcibly ejected

been severely injured or killed. (ORPS Report NVOO--BN-NLV-2003-0001; final report issued January 22, 2004; SELLS Identifier 2004-NV-NLVBN-005)

As a precaution, nonessential personnel were evacuated from the building for about 2 hours until the fire suppression system could be verified operable. An accident investigation team determined that an inadequate hazard assessment and design review, coupled with work control deficiencies, caused this near-miss event. Because organizational processes for design were not followed, the screws used to secure the component

Figure 3-2. The damage to the flammable materials storage cabinet

were not adequate for the experiment. Further details can be found in the lessons-learned entry

Figure 3-3. The projectile path from the vessel to the rollup door

submitted to the SELLS website (http://www.eh.doe.gov/ll).

At Argonne National Laboratory–West on February 9, 2003, a pressure excursion occurred in a water wash vessel where sodium was being processed. The technicians had moved out of the processing area to observe the process remotely, so there was no possibility of injury. (ORPS Report CH-AA-ANLW-ANLW-2003-0001; final report issued December 24, 2003)

Processing the sodium involves introducing steam and nitrogen at a very low flow rate into a steel tank containing sodium that has low levels of radioactivity and mercury. The resulting sodium hydroxide solution is pumped to a tote for further processing and ultimate disposal. The tank is vented to the water wash vessel, which is vented to the atmosphere through a chemical scrubber and a HEPA filter.

The technicians made an engineering-approved adjustment to the system steam flow that increased the hydrogen gas generation rate. When the hydrogen level reached the 2.5 percent setpoint, the steam flow tripped off-line.

The technicians had left the room, but they noticed that the reaction in the tank rapidly increased. A pressure transient resulted, releasing pressure and cooling the temperature. The technicians re-entered the area to survey the damage. They found a small amount of radioactive contamination inside the immediate area around the damaged tent that was contained in a former radioactive material area. Following the excursion, an engineer reviewed the automatically recorded data and determined that the pressure in the tank did not exceed the 25-psig design pressure. A thermocouple on the tank wall momentarily reached a maximum temperature of 578°F, which exceeded the tank's 500°F engineered design temperature.

This event resulted from a number of factors, including an incomplete and inadequate design review, deviations from procedure, and a procedure that did not clearly address when to stop work for new, experimental, or nonroutine procedures. The engineer-approved adjustments that led to the excursion actually accelerated the reaction. The post-event interview revealed that the technicians viewed excursions as normal even though their mitigative actions did little to arrest them. Argonne–West managers rigorously investigated this event and developed corrective actions that will prevent recurrence; for example, they revised the facility conduct of operations procedure, retrained affected personnel to the procedure, developed a lessons-learned document on the causal analysis, and briefed personnel. Corrective actions still underway include developing formal hazardous process guidance to define technical processes, hazards identification and mitigation, testing guidance, appropriate reviews and approvals, and actions required for unexpected results at each level of testing. This guidance will be formally administered to the appropriate personnel. In addition, the engineering analysis procedure will be revised to ensure a balanced and methodical approach to engineering design review that includes reviews by subject matter experts, technical peers, and technical managers.

Near misses and adverse events are often precursors to more severe accidents, like the one that occurred on March 13, 2001, at BP Amoco Polymers (now Solvay Advanced Polymers LLC) in Augusta, Georgia. Three people were killed when they opened a process vessel (Figure 3-4) containing hot plastic, unaware that the vessel was pressurized at about 80 psi. One worker, who had performed this type of work for over 10 years, was killed when the 2,000-pound, partially unbolted cover struck him (Figure 3-5). The hot plastic that killed the other two workers was propelled with great force throughout the room, causing some nearby tubing to break. Hot fluid from the tubing ignited, resulting in a fire and second explosion minutes later. The U.S. Chemical Safety and Hazard Investigation Board investigated the accident. Their detailed report is

Figure 3-4. The opened process vessel

Figure 3-5. The vessel cover

available on the Internet at http://www.csb.gov under Completed Investigations.

Twelve hours before the accident, workers had attempted to restart the production unit. They stopped because of problems with the extruder downstream of the reactor, but not before an unusually large amount of partially reacted material had been sent to the polymer catch tank. Hot molten plastic inside the polymer catch tank continued to react and began to slowly decompose, generating gases and foaming the contents. The material expanded as foaming continued, and eventually the entire tank was filled. The material then forced its way into connecting pipes, including the normal and emergency vents.

Once in the pipes, the plastic solidified as it cooled (Figure 3-6). A hardened layer of plastic 3 to 5 inches thick also formed around the entire inner wall of the tank. However, the core of the plastic mass remained hot and molten, and probably continued to decompose over several hours, generating gases that pressurized the vessel. Before attempting to open the polymer catch tank, the workers may have relied on a pressure gauge and a transmitter on the vent piping from the vessel to ascertain whether it was under pressure. However, any reading from the pressure gauge would likely have been unreliable because plastic had entered the vent line and solidified (Figure 3-7). The workers also knew that the process was shut down, which may have led them to believe they could safely open the vessel.

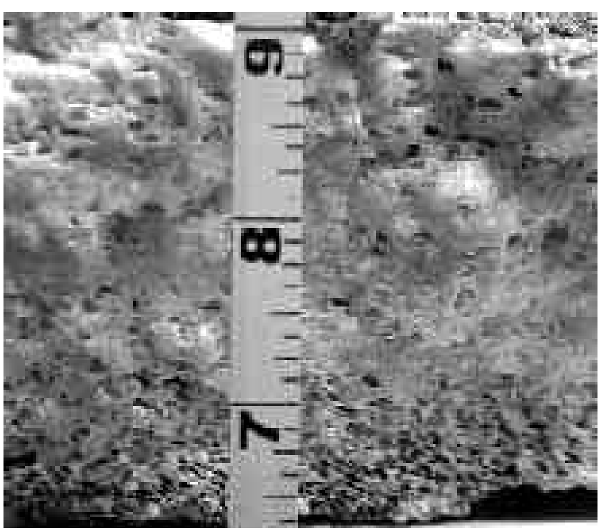

Figure 3-6. Hardened polymer taken from the perimeter of the catch tank

Figure 3-7. The vent pipes were plugged with hardened material

The ensuing investigation disclosed a number of deficiencies in design review, work planning, and hazard analysis. Previous adverse events and near misses were dealt with reactively rather than used as a means to take corrective actions that would have prevented this accident. Reporting adverse events was discouraged, thereby eliminating the opportunity for others to learn from them as well.

Workers all over the DOE Complex routinely perform hazardous work, and can lose the necessary perspective to focus on safety, particularly where there are relatively few workplace injuries. It is important that we learn from our mistakes and take steps to prevent future events that can be even more costly.

KEYWORDS: *Pressurized, vessel, excursion, near miss, adverse event*

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

4. PRESSURIZED AIR LINE CUT DURING D&D ACTIVITIES

On December 23, 2003, at the Rocky Flats Environmental Technology Site, a construction foreman partially cut a pressurized 125-psig air line. The line was not labeled to identify its operational status, and the foreman believed it was abandoned. He notified the Configuration Control Authority, who suspended all D&D activities in the facility and initiated a lockout/tagout to fully isolate the air line. No injuries or equipment damage resulted from this event. (ORPS Report RFO--KHLL-PUFAB-2003-0019)

The foreman decided to remove the air line because it interfered with removing mechanical equipment in a machine shop. Because he had been temporarily assigned to supervise the work while the regular foreman was on vacation, the interim foreman did not participate in the work-package walkdown. He assumed the line was abandoned and could be safely removed. After the foreman cut into the line, he taped the breach while another worker located and closed a system isolation valve.

Kaiser Hill Construction (KHC) managers convened a fact-finding/corrective action meeting on December 24, 2003. They determined that a generic work package prepared for another facility had been used for the work. Although workers had walked down the job the previous week, engineering staff was not asked to participate in the walkdown, and no one verified whether the piping was actually abandoned and depressurized. Managers also learned that the construction crew did not specifically discuss which systems were abandoned and which might contain stored energy during a pre-job briefing. In addition, piping and components were not labeled to indicate their status (i.e., in-service or abandoned).

KHC managers found that the interim foreman might not have received an adequate turnover

WHAT CAUSED THIS EVENT?

- The work package was inadequate for the intended work scope.
- Specific job hazards were not properly analyzed for the scope of work.
- Piping and equipment were not identified or labeled regarding in-service or abandoned status.
- The interim foreman received inadequate turnover.

before assuming his supervisory role. They also learned that the workers mistakenly believed that all of the systems in the machine shop were abandoned and the work package allowed them to remove all piping below a height of 8 feet. Corrective actions to address this event included the following.

- Review all craft work packages to verify that they adequately identify the scope of work and the associated job hazards. Cancel, rework, or release for work (as appropriate) all reviewed packages.
- Review job hazard analyses for craft work packages that are released for work and amend them as necessary.
- Brief all D&D managers on this event and discuss the causes and corrective actions.
- Include engineering staff in the development of all craft work packages.
- Conduct engineering reviews of all open work packages before restarting D&D activities. Update the work packages as necessary.
- Brief all KHC workers on changes in scope, proper turnover with foremen (including the general foreman), the process for removing hindrances and interferences, and the requirements for isolating and abandoning system piping and equipment.

A similar event occurred on December 15, 2003, at another facility, where KHC workers inadvertently cut a differential pressure instrument reference leg pipe during D&D equipment removal activities. Workers removed the pipe because it hindered their accessibility to other piping tagged for removal. Although the workers thought the reference leg was an abandoned pipe, it was not labeled and they did not verify its function or status with system engineers before removing it.

At a December 16 meeting to critique the event, managers determined that it was not enough to simply flag the non-abandoned piping. Workers should have verified the status of the piping with a package engineer before cutting it. KHC implemented several corrective actions including requiring facility in-service systems and components to be identified and labeled and briefing facility superintendents and crew leaders on the proper methods for verifying abandoned piping and equipment before removing it.

These events illustrate the need for rigorous work planning and job hazard analysis when working on abandoned systems during D&D activities. Both of these events could have been avoided if workers had used job-specific work packages, performed detailed system walkdowns, conducted comprehensive pre-job briefings, and labeled and identified abandoned system piping and components. If the lessons learned and corrective actions prepared after the December 15 event had been shared and implemented throughout Rocky Flats, the December 23 event might have been avoided.

KEYWORDS: *Cut air line, abandoned systems, equipment removal, pipe cutting; air line*

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

GOOD PRACTICES WHEN CUTTING PIPING DURING D&D ACTIVITIES

- Use an approved work package that is specific to the task at hand.
- Conduct system walkdowns and engineering evaluations before working on abandoned systems.
- Identify the specific piping to be cut during pre-job briefings.
- Clearly mark where piping cuts are to be made.
- Clearly label all piping and equipment as in-service or abandoned.
- Isolate and remove all energy sources. Use lockouts and tagouts.
- Conduct a supervisory review before starting the work.
- Verify that all energy has been removed before making the cut.

Agencies/Organizations	
ACGIH	American Conference of Governmental Industrial Hygienists
ANSI	American National Standards Institute
BLS	Bureau of Labor Statistics
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

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

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	Radiation Equivalent Man
v/kv	volt/kilovolt

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

Job Titles/Positions	
RCT	Radiological Control Technician