Operating Experience Summary

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Three Recent Events Involved Failed Rigging and Lifting Hardware

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In August and September 2008, three events were reported to ORPS in which rigging (slings) and lifting hardware (eye bolts) failed, resulting in dropped loads, near misses, and, in one event, minor injuries to a worker. Each of these events was preventable, and all of them could have had serious consequences.

On September 24, 2008, at the Waste Isolation Pilot Plant, an overloaded synthetic sling failed (Figure 1-1) and struck a waste handling technician across the hand, forearm, and chest. The technician received a minor injury (redness of the skin). (ORPS Report EM-CAFO--WTS-WIPP-2008-0012)

After remote handling personnel loaded an empty shipping cask onto a trailer, an upper (rear) impact limiter was installed using two slings and a 25-ton crane (Figure 1-2). The crane operator was positioned on the northwest end of the trailer in clear view of the operator spotting the impact limiter into position. With the impact limiter in position, two waste handling technicians installed bolts and torqued them, completing installation of the limiter. The crane was maintaining approximately 2,500 pounds tension on the two slings during the installation process. Each synthetic sling was rated at 3,200 pounds and had satisfactorily passed all pre-use inspections.

With the impact limiter installed, the workers positioned themselves to lower the hoist so the rigging equipment could be removed. When the spotter signaled the crane operator to lower the hoist, the operator inadvertently moved the control stick to the hoist (raise) position, instead of the position to lower it, and raised the load higher. A Conduct of Operations mentor positioned at the rear of the trailer noticed that both the cask and trailer were beginning to lift, but before he could call for a stop, the slings broke and struck one of the technicians. Work was stopped and the scene was secured.

Figure 1-1. Worker holding failed synthetic sling

Initial investigation revealed that this event could have been attributed to inattention to detail by the crane operator, an improperly positioned load cell, or the lack of sufficient engineered barriers. The exact causes will not be known until the Root Cause Analysis has been completed.

On September 15, 2008, at the Hanford Solid Waste Facility, a crane was lifting a retrieved waste cask when the slings used to rig the cask to the crane broke. The waste cask dropped approximately 4 inches and landed in an upright position (Figure 1-3). No one was injured, and the cask was not damaged. (ORPS Report EM-RL--PHMC-SOLIDWASTE-2008-0008)

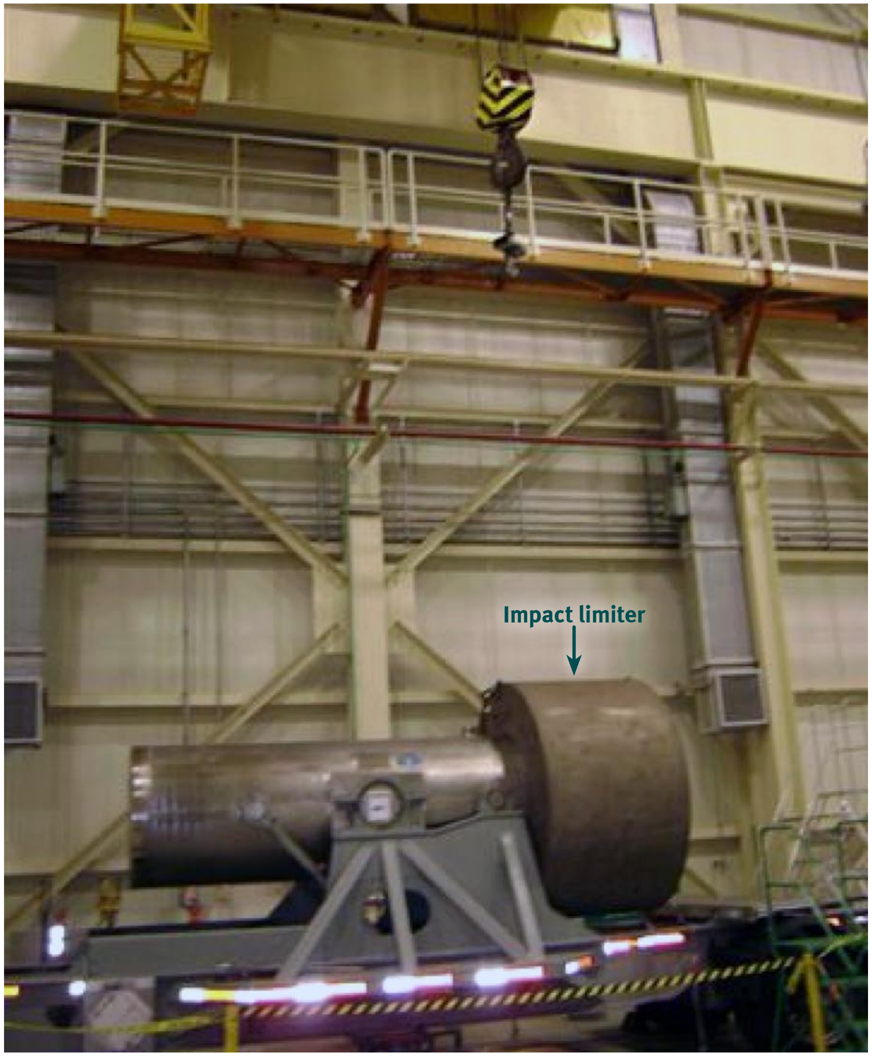

Figure 1-2. Empty cask on trailer with impact limiter installed sitting underneath overhead crane

Figure 1-3. The dropped waste cask

Investigators determined that the synthetic slings selected (Figure 1-4) were inappropriate for the rigging configuration, and softeners had not been used to cushion them. Both conditions increased the potential for the slings to fail.

The load initially was lifted approximately 1 foot to obtain the weight of the cask and was then lifted 3 feet for contamination surveys and removal of dirt. When the surveys were completed, the cask was raised approximately 4 feet to clear the radiological control barrier. During these evolutions, personnel were within 2 to 3 feet of the cask. Fortunately, the slings failed when they did; otherwise, personnel could have been seriously injured.

Investigators determined that the riggers looked at the safe working capacity of the slings in the basket configuration (6,400 pounds), not the choked configuration (2,400 pounds). However, they rigged them in the choked configuration, with a total capacity of 4,800 pounds, even though the cask weighed approximately 6,000 pounds. They did not make a second check of the working capacity of the rigging. In addition, the slings were not protected by softeners at the flange interface, which created a sharp corner.

On August 19, 2008, at the Hanford High Level Waste Facility, a 6,000-pound shield window liner toppled 3 feet to the ground after two lifting eye nut assemblies sheared off from the top of the window liner because of excessive side loading stresses. Iron workers were attempting to lay the liner on its side when the rigging hardware failed (Figure 1-5). (ORPS Report EM-RP--BNRP-RPPWTP-2008-0016; final report issued September 30, 2008)

The shield window liner had to be placed on its side to shorten the legs and jacking bolts had to be added to help with its final positioning in a wall. The drop-forged, heavy-duty eye nuts

Figure 1-4. The cut sling

Figure 1-5. Window liner on its side after eye nut stud failure

(10,600-pound workload rating vertical pull) and threaded studs (116,000 psi tensile strength) were installed according to the manufacturer's drawings and shipping instructions. The lifting eye nut was threaded onto a metal stud that was threaded into a welded flange on the liner.

The rigging for the eye nuts was positioned at approximately a 45-degree angle, and the rigger was using a chain hoist to raise the legs off the ground when the shearing of the two studs occurred. The riggers had successfully performed these side loading lifts in the past on a similar sized window liner with no incident.

Investigators learned that the drawings and specifications provided by Bechtel to the manufacturer lacked the correct rigging configurations and requirements. The drawings did not require the eye nut shoulder to be flush or seated with the flange of the shield window liner. The drawings left a ⅝-inch exposed neck (reveal) on the studs, reducing the overall strength of the eye bolt assembly (Figure 1-6). Figure 1-7 shows one of the failed studs.

Investigators determined that there were no specifications for shear ratings for the studs and that a document review would have identified the lack of lifting or rigging instructions and restrictions. They also determined that there were no material handling directions for the window liners.

Investigators learned that the rigger used a chain hoist with a capacity of 3,000 pounds to lift the window liner assembly, which weighed 6,000 pounds. The rigger should have used a chain hoist with the capacity to match the lift weight. After the configuration of the stud bolts, the chain hoist became the next weakest link in the rigging apparatus. The slings in use for this lift were not an issue.

Figure 1-6. Installed eye nut not shouldered to the flange

Figure 1-7. One of the four lifting flanges on the liner with a broken stud

The following guidance is from DOE-STD-1090-07, *Hoisting and Rigging Standard (Formerly Hoisting and Rigging Manual).*

- Guidance for proper care and use of slings can be found in Chapter 11, "Wire Rope and Slings." 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. Section 11.3.5.i states that synthetic web slings can be cut by repeated use around sharp-cornered objects. The Standard identifies several types of protective devices that can be used to prevent sling damage.
- Chapter 12, "Rigging Hardware," provides requirements for inspecting, testing, and using shackles, eyebolts, eye nuts, rings, wire-rope clips, turnbuckles, rigging hooks, and load-indicating devices used in hoisting and rigging. Section 12.5.1 of the Standard states that eye nuts shall only be used for in-line loads.

These events underscore the importance of following an approved lift plan and ensuring that the rigging selection and lifting hardware are correctly and properly configured for the lift. The Person-in-Charge should conduct a physical check of the load to verify its configuration and placement of rigging and should also ensure that the load weight has been correctly calculated.

KEYWORDS: Hoisting and rigging, sling, dropped load, near miss, eyebolt, eye nut

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

Worker's Death Linked to Mesothelioma

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On September 17, 2008, at Sandia National Laboratory (SNL), a millwright craftsperson died of complications associated with mesothelioma. He had been employed at SNL since 1971. When the worker first became ill in January 2008, his personal physician diagnosed pneumonia; however, in July his physician determined that he suffered from mesothelioma. Medical personnel at SNL first became aware of the craftsperson's condition on September 9, 2008, when they learned that he had filed a workers compensation claim. (ORPS Report NA--SS-SNL-NMFAC-2008-0017)

Mesothelioma, a cancer of the mesothelium membrane, which covers and protects the lungs and most of the internal organs of the body, is an invisible killer and is difficult to diagnose. Primarily caused by asbestos exposure, it usually takes up to 20 to 40 years for people to develop mesothelioma, and many people have no symptoms for an extended period of time. Also, symptoms may vary, depending on the stage of the cancer. Mesothelioma generally is treated with chemotherapy, radiation, surgery, or a combination of these. Less than 1 percent of those diagnosed with mesothelioma survive, and the average survival rate is from 4 to 12 months. A video describing the symptoms, diagnosis, and treatment of mesothelioma can be viewed at http://www.youtube.com/watch?v=YLW08jEGqWw.

Asbestos has been mined and used commercially since the late 1800s, and its use greatly increased during the 1940s. Before the 1980s, asbestos-containing materials (ACM) were commonly found in many structural components, including insulation; drywall; and roofing, ceiling, and floor tiles. When these materials are disturbed (for example, during D&D or maintenance activities), the tiny fibers may become dislodged; and, if inhaled, can cling to the pleural lining of the lungs for as long as 50 years before causing symptoms related to mesothelioma.

Millions of Americans, as well as citizens of other countries, have been exposed to asbestos dust, not only in the workplace, but in schools and even in their homes. Approximately 400 cases a year are diagnosed in Canada, and about 3,000 new cases each year are diagnosed in the United States, where fatality totals have risen every year since the U.S. began coding mesothelioma as a cause of death in 1999. New York City rescue workers who responded to the terrorist attack on September 11, 2001, are among those recently exposed to significant amounts of asbestos: many of them have been diagnosed with asbestos-related diseases or have died. In Great Britain someone dies of mesothelioma every 5 hours, according to a video on the "human face of mesothelioma," that features, among others, a British school teacher, plumber, and electrician suffering from the disease. (http://www.youtube.com/watch?v=gLTDknLVm4A)

An article in OE Summary 2006-09*, Work Planning Requires a Thorough Analysis of Respiratory Hazards,* stated that a review of ORPS reports between January 1, 2004, and publication of the issue (July 21, 2006) showed that asbestos was the most common non-radiological respiratory hazard reported to ORPS, with 22 reports filed during that timeframe. More recently, the following asbestos-related events were reported to ORPS.

- On May 1, 2008, at Brookhaven National Laboratory, three workers were preparing to start ACM abatement on newly exposed plumbing pipe fittings when one of the workers noticed that the ACM on the piping was significantly damaged. The workers left the area, the building was posted "Danger Asbestos Hazard," and the doors were locked. Area sampling indicated that it was unlikely that the workers were overexposed to asbestos fibers. (SC--BHS-BNL-BNL-2008-0006)

- On July 23, 2007, at Y-12, a subcontractor employee notified the subcontractor that its workers had removed pipe insulation material that potentially contained asbestos during demolition activities. Investigators determined that the pipe insulation did contain asbestos and that, although it was marked as "asbestos" on a drawing dated December 8, 1990, the drawing was not included in the documents provided to the contractor. (NA--YSO-BWXT-Y12CM-2007-0004)
- On May 31, 2007, at Los Alamos National Laboratory, workers cleaning dirt and debris from three steam pits encountered what they believed to be asbestos behind piping. They did not disturb the asbestos debris and immediately reported it to their supervisor. The workers were not wearing respirators because they did not expect to encounter asbestos. Initial sampling indicated that debris in the steam pit where the work was being performed contained 1 percent to 5 percent asbestos; however, a second steam pit in the area contained 15 percent to 25 percent asbestos. Cleanout operations were stopped in all steam pits so they could be re-evaluated for asbestos. Investigators learned that the workers had identified the asbestos based on what they had learned in training. (NA--LASO-LANL-BOP-2007-0011)

An Asbestos Awareness Bulletin issued by the Office of Environment, Safety and Health in December 2005 (DOE/EH-0697) indicated that about 20 percent of 40 incidents involving ACM that occurred between 2000 and 2005 involved releases to the environment and disposal issues. The remaining cases consisted of handling and removal deficiencies that had the potential for releases and exposures. The text box shows a number of methods for controlling asbestos hazards that were included in the Bulletin. (http://www.hss.energy.gov/csa/csp/safety_bulletins/2005-13.pdf)

The only known way to prevent mesothelioma is to avoid asbestos exposure. According to NIOSH, "all levels of asbestos exposures studied…have demonstrated asbestos-related disease," and "there is no level of exposure below which clinical effects do not occur." Workers should use all protective equipment provided by their employers, should follow recommended work practices and safety procedures, and should use properly fitting respirators as required.

Controlling Asbestos Hazards

- Ensure that effective work controls are in place in buildings with ACM.
- Avoid disturbances that can generate dust during routine maintenance and cleaning near ACM.
- Wear the proper respiratory equipment and clothing.
- Work in controlled areas that are clearly marked by asbestos warning signs and barricaded to prevent unauthorized entry.
- Provide appropriate dust controls, including water management with a wetting agent, before and during ACM removal.
- Use negative-pressure enclosures with transparent view ports when required.
- Do not drop, throw, slide, or damage ACM during removal.
- Seal wastes in leak-tight, labeled containers and store them in controlled areas.

DOE mandates that its contractors comply with all Federal, State, and local regulations and standards relating to asbestos. In 2007, the Department issued 10 CFR 851, *Worker Safety and Health Program* (http://www.hss.energy.gov/HealthSafety/WSHP/rule851/rule.pdf), which incorporates the OSHA requirements in 29 CFR 1910.1001 and 29 CFR 1926.1101. The requirements in 1910.1001 state that the employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter of air as an 8-hour time-weighted average (TWA) and that each person entering a regulated area shall be supplied with and required to use a respirator. (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9995)

OSHA divides construction and asbestos abatement work into categories based upon the threat of exposure and provides work procedures for each category. When a high asbestos exposure danger exists, the safety requirements are most stringent. For construction work, OSHA requires using vacuum cleaners with HEPA filters to collect asbestos-containing debris and wet methods during mixing and handling to minimize dust. At a minimum, employers must provide either local exhaust ventilation equipped with HEPA filter dust collection systems, enclosures for processes producing asbestos dust, or ventilation of regulated areas to move contaminated air away from the employee's breathing zone to a filtration or collection device. These requirements are found in 29 CFR 1926.1101. (http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10862)

To learn more about mesothelioma, contact your Safety and Health Office or access information online using the following links.

- http://www.epa.gov/asbestos
- http://www.asbestosnetwork.com/exposure/ex_safety.htm
- http://www.icdri.org/Medical/Mesotheli.htm
- http://www.cancer.gov/cancertopics/factsheet/Risk/asbestos

As these events demonstrate, mesothelioma is a deadly disease, and workers across the Complex may be exposed to asbestos while performing work tasks during D&D, maintenance, or other cleanup. The use of proper safety equipment (e.g., respirators) is the most important safeguard for ensuring that workers are not exposed to asbestos. It is also essential that all workers are trained in recognizing asbestos and are aware of the consequences of asbestos exposure so that they can take appropriate actions and report the potential for exposure immediately. Risk assessments to identify potential hazards and ensure that proper controls are in place should be performed prior to any work being performed in areas where there may be asbestos hazards.

KEYWORDS: Fatality, mesothelioma, asbestos, industrial hygiene exposure

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

Time to Take Cold Weather Protection Measures

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It has already snowed in Idaho this year (Figure 3-1). In early October, 1.7 inches of snow fell in Boise—the earliest measurable snow since recordkeeping began in 1898—so winter is on its way, and it is time for sites across the Complex to begin taking steps to protect piping, water lines, sprinkler heads, and other essential systems during inclement weather. It is also a good time to remind employees that they need to be wary while walking on icy sidewalks and in parking lots, as well as when driving in hazardous conditions. The following winter weather-related events are among those reported to ORPS during the winter of 2007/2008.

Frozen Sprinklers/Burst Pipes

On January 21, 2008, at Fermi National Accelerator Laboratory, personnel responding to alarms and indications of equipment failure found that water from sprinkler piping and the hot water heating system was leaking onto building equipment. The outside temperature on the previous day had dropped to minus 7°F, and the temperature inside the building was only 28°F because a supply valve for the hot water heating system had been closed the previous day when employees complained of excessive heat in the building. The leak damaged ceiling tiles and equipment and shorted-out electrical receptacles. Investigators found that frozen sprinkler pipes in the automatic wet-pipe fire protection system resulted in the leak from the hot water heating system. Clean-up and repairs cost approximately $100,000. (ORPS Report SC--FSO-FNAL-FERMILAB-2008-0001)

On January 4, 2008, at Y-12, personnel discovered that piping in a dry-pipe system broke because of ice build-up in the piping. The temperature had dropped below freezing the previous night and had remained below freezing on the day of the occurrence. Investigators determined that condensate had collected in the piping over time and froze, breaking a pipe and discharging water from the sprinkler system through a ball drip valve. (ORPS Report NA--YSO-BWXT-Y12NUCLEAR-2008-0001)

Slip/Fall Injuries

On December 28, 2007, at the National Renewable Energy Laboratory, a subcontractor slipped on ice in the Visitor Center parking lot while walking to his car, fell, and fractured his wrist. Snow had fallen the previous day, and the lot had been

Figure 3-1. The October 12, 2008, snowfall in Boise, Idaho

cleared, but residual snow had melted and frozen. The lot was sanded after the subcontractor's fall, and in the future sanding will be performed on an "as needed" basis. In addition, containers of sand were placed near the parking lots so that workers could immediately apply sand to small patches of ice. (ORPS Report EE-GO--NREL-NREL-2007-0004)

On February 25, 2008, at Los Alamos National Laboratory, an employee walking on a paved road on Laboratory grounds slipped on ice, fell, and struck his head on the ground. That evening he experienced flashes of light and "floaters" in his right eye and went to a local emergency room, where he was diagnosed with a detached retina. Following two unsuccessful laser treatments on his eye, the employee underwent eye surgery (vitrectomy). Investigators learned that the worker had chosen to walk in an area that had a layer of snow covering the road to obtain better traction and was unaware that there was ice beneath the snow. Following this event, managers met with their employees and emphasized that they should take a longer, safer path rather than the shorter, quicker path when walking in icy conditions. (ORPS Report NA--LASO-LANL-PHYSTECH-2008-0006)

Vehicle Fatality

On January 22, 2008, at Oak Ridge National Laboratory, a UT-Battelle employee left the site in his personal vehicle to attend an offsite meeting, and a few minutes later his pickup truck slid off the road and hit a tree, resulting in the employee's death. A sudden drop in temperature in conjunction with light rain resulted in black ice accumulating on the road. Weather conditions also resulted in other vehicle accidents and numerous slips, trips, and falls at about the time of the fatal accident. Following this accident additional communications were set up to warn Laboratory employees of potentially changing weather conditions and an infrared thermography sensor was implemented to measure ground temperatures. (ORPS Report SC-ORO--ORNL-X10BOPLANT-2008-0001)

A number of actions can be taken to establish effective freeze protection procedures, and the time to begin taking them is before inclement weather arrives. These actions, along with contingency plans for especially severe weather, should be incorporated into written procedures that are reviewed and updated periodically. Some measures that can be taken to avoid weather-related events include the following.

- Establish a schedule for preparing a facility before the cold weather season and develop a cold weather checklist.
- Increase surveillance of building pipelines, flowlines, and safety-related equipment during periods of extreme cold. Provide sufficient watch service to ensure that all plant areas can be visited each hour.
- Check heating systems to ensure that sufficient heat is delivered to keep sprinkler piping from freezing, especially during idle periods when temperatures are extremely cold.
- Install temperature alarms or automatic backup heat sources on vulnerable systems that require special protection because of the hazards or costs associated with freeze damage.
- Develop procedures that detail when and how to alert management and maintenance personnel of cold weather problems and appropriate steps for repairing, replacing, and safely restoring damaged equipment to service.
- Secure and post any areas where accumulated ice could create a dangerous situation for workers or could damage buildings and equipment if the ice fell.

Facility maintenance personnel can find guidance about establishing and updating seasonal maintenance programs in section 4.18 of DOE G 433.1-1, *Seasonal/Severe Weather and Adverse Environmental Conditions Maintenance*. (http://www.directives.doe.gov/pdfs/doe/doetext/neword/433/g4331-1.pdf) In addition, OE Summary 2004-19 includes an example of the cold weather checklist provided in that guide.

A review of ORPS reports for the winter of 2007/2008 identified many additional weather-related slip and fall injuries, as well as accidents involving treacherous driving conditions. It is essential to remind employees of the risks involved when traversing sidewalks and parking lots in snow, ice, and freezing rain or driving in inclement weather. Communications about the hazards of winter weather should be disseminated to all employees well before inclement weather arrives. The textbox provides some helpful tips for preventing slips and falls.

Winter safety tips for driving, work, and home can be found at the websites of the American Automobile Association (www.aaamidatlantic.com), the National Safety Council (www.nsc.org), the Federal Emergency Management Agency (FEMA) (www.fema.gov), and the American Red Cross (www.redcross.org).

These events illustrate winter weather hazards: snow, ice, and freezing temperatures that result in frozen pipes and sprinkler heads, as well as employee injuries and even fatalities. Freeze protection plans must be initiated before the onset of winter weather and employees should be reminded to be wary when walking or driving on snow- and ice-covered parking areas, sidewalks, and roads.

Tips to Help Prevent Slips and Falls

- Wear the proper footgear (e.g., shoes, boots, or overshoes with anti-slip soles).
- Keep both hands free for balance, rather than in your pockets.
- Be careful of wet shoes on a dry floor; they can be just as slippery as dry shoes on a wet floor.
- Keep walkways and parking lots clear of water, snow, and ice.

From Prince Edward Island Workers Compensation Board
Winter Alert, October 2005

KEYWORDS: Freeze protection, snow, ice, slips and falls, injuries, fatality

ISM CORE FUNCTIONS: Analyze the Hazards, Develop and Implement Hazard Controls

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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

Units of Measure	
AC	alternating current
DC	direct current
mg	milligram (1/1000th of a gram)
kg	kilogram (1000 grams)
psi (a)(d)(g)	pounds per square inch (absolute) (differential) (gauge)
RAD	Radiation Absorbed Dose
REM	Roentgen Equivalent Man
TWA	Time Weighted Average
v/kv	volt/kilovolt

Job Titles/Positions	
RCT	Radiological Control Technician

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

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

Miscellaneous	
ALARA	As low as reasonably achievable
HEPA	High Efficiency Particulate Air
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
SME	Subject Matter Expert