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 "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.

EVENTS

1. NONCOMPLIANT SCAFFOLD RESULTS IN WORKER INJURY

On June 9, 2004, at the Idaho Test Area North Liquid Waste Treatment Building D&D site, a subcontractor laborer slipped and fell while working on a scaffold. He suffered a bruised shin and sprained ankle. Investigators determined that the scaffolding was not in compliance with OSHA standards. (ORPS Report ID--BBWI-TAN-2004-0002)

The laborer was standing on a 5-foot-high platform, core-drilling a concrete wall of a building that is being demolished (Figure 1-1). When he fell, his right leg slid into a 14-inch gap between the decking and the concrete wall. Initially, medical personnel indicated he had a sprained ankle and bruised shin. However the laborer later consulted with his personal physician, who reported that his right tibia and ankle appeared to be fractured. Further examination and evaluation revealed that the laborer did not have any fractures. Citing the potential for serious injury, the facility manager re-categorized this event to a near miss.

Figure 1-1. Scaffolding used during core drilling

A closer look at the job site shows that the scaffolding was not in compliance with the guidelines specified in OSHA Standard 29 CFR 1926.451, "General Requirements," of Subpart L, *Scaffolds*. Figure 1-2 illustrates the specific

Figure 1-2. Scaffold deficiencies

deficiencies. The deficiencies and how they deviate from the OSHA standard are described below.

- 1926.451(b)(3) states that the front edge of all platforms shall not be more than 14 inches (36 cm) from the face of the work, unless guardrail systems are erected along the front edge and/or personal fall arrest systems are used. As can be seen in Figure 2, the scaffold was between 14 and 18 inches from the face of the concrete wall, and there was no guardrail.

- 1926.451(f)(13) states that debris shall not be allowed to accumulate on platforms. However, as Figure 2 shows, the platform was littered with paper, power cords, and hoses.

- 1926.451(f)(8) states that employees shall be prohibited from working on scaffolds covered with snow, ice, or other slippery material except as necessary for removal of such materials. The scaffold apparently became slippery from core-drilling slurry. The subcontractor's job safety analysis identified the hazard of the wet platform and recommended using a wet-dry vacuum to clean up slurry and housekeeping of hoses lying around.

Following the accident investigation, the facility manager directed drillers to use mats and keep hoses and lines cleared out of the way on working platforms. Subcontractor personnel installed additional railings and leveled the ramped access to the scaffold.

Personnel using scaffolds need to be sure that the scaffold structure and working surface are in compliance with 29 CFR 1926.451 (or 29 CFR 1910.28 for non-construction applications). Working from an elevated surface on a portable structure can pose a number of significant hazards.

KEYWORDS: *Scaffold, OSHA, near-miss, injury*

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

2. UNAUTHORIZED SAFETY SYSTEM MODIFICATIONS

On May 5, 2004, at the Thomas Jefferson National Accelerator Facility, a laboratory worker noticed a metal plate attached to a switch actuator bracket on a Dewar test vessel (Figure 2-1) and realized that someone had performed an unauthorized modification on the Personnel Safety System (PSS) interlock switches, which are designed to protect personnel from exposure to ionizing radiation. She also noticed a similar modification to the shield lid actuator of a second test vessel. Wall-mounted and personnel radiation detectors indicated that there had been

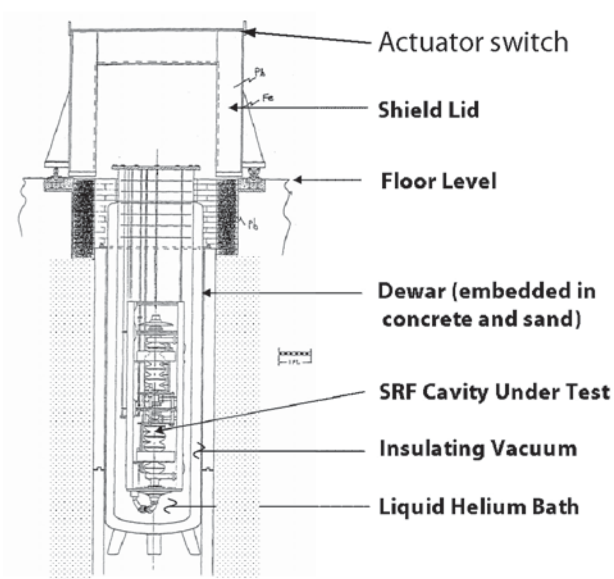

Figure 2-1. Diagram of Dewar test vessel for RF experiment

no identifiable personnel radiation exposures during the 6-month period. (ORPS Report ORO--SURA-TJNAF-2004-0003)

The PSS interlock actuator is attached to the inside of the vessel shield lid, and when the lid is closed a signal is sent to the PSS indicating that it is safe to operate the equipment. The closure signal is one of the conditions that the safety interlock system must detect before it, in turn, signals the radiofrequency (RF) amplifier controller to generate a high-power RF signal.

Investigators determined that a physicist at the laboratory's Institute for Superconducting Radiofrequency Science and Technology made the unauthorized modifications several months earlier. The physicist said that he made the modifications to make the interlock switches function properly so that he could conduct tests.

It is not clear what hazardous conditions might have arisen if the modifications had not been discovered. The high-power RF signal itself is a hazard and it also produces "field-emission" x-rays (i.e., x-rays induced in materials encountered by the RF signal). If a high-power RF signal were generated in the test vessel with the lid unlatched, personnel in the immediate area would be at risk. The RF signal in this hypothetical occurrence would likely be of short duration, however, because several other detectors and interlocks in the control system would quickly shut down the RF signal generator.

Corrective actions resulting from the incident included the following.

- Replace affected interlock switches and test the shield lid interlock functions.
- Evaluate all passive area radiation monitor readings for the past several months to confirm that recorded radiation levels were consistent with normal operations.
- Review personnel radiation badge readings for the past several months to confirm that recorded radiation levels were consistent with normal operations.
- Conduct a safety briefing for all operators before resuming operation to review configuration management/change control

requirements and to identify configuration-controlled systems and equipment.

- Develop maintenance procedures to help ensure reliable operation of the shield lids and address recertification of the PSS components after maintenance activities.

- Design and implement an improved configuration for the shield lid interlock switches that makes alignment less critical while retaining the required reliability.

Guidance on configuration management for DOE facilities is provided in DOE-STD-1073-2003, *Configuration Management,* dated October 2003. This standard defines and addresses the following elements of configuration management.

- Design Requirements
- Work Control
- Change Control
- Document Control
- Assessments

Chapter 5 of the standard, "Change Control," addresses identifying and documenting proposed changes, reviewing and approving changes, implementing changes, documentation, and baseline change control.

A search of the ORPS database for reports involving unauthorized modifications to safety systems revealed several events. On October 4, 2002, at the Brookhaven National Laboratory, a worker's eyes were exposed to a low-power light beam after unauthorized and unreviewed changes were made to light beam controls at the National Synchrotron Light Source Facility. No injury occurred, but a serious eye injury could have been inflicted on the worker if the power level of the light beam had been higher. (ORPS Report CH-BH-BNL-NSLS-2004-0001)

At the Argonne National Laboratory – East, an overheated flask burst during an experiment, spraying water and glass shards that cut a scientist's face and hands. Investigators determined that an unauthorized modification had been made to the safety-related components of the experiment apparatus; specifically, a valve had been installed between the flask and a pressure relief valve. The valve was closed at the time of the accident, which defeated the safety protection provided by the relief valve. (ORPS Report CH-AA-ANLE-1999-0012)

These events underscore the importance of controlling changes to safety-related structures, systems, and components (SSCs). Unauthorized changes to SSCs can degrade systems relied upon for safety and can create hazards for workers and the public. Facility managers should ensure that workers and supervisors know which SSCs cannot be modified without an analysis and should impose penalties on persons who willfully disregard configuration management/change control requirements.

GOOD PRACTICES FOR CONFIGURATION MANAGEMENT/CHANGE CONTROL OF SAFETY SYSTEMS

- Ensure that workers and first-level supervisors know which facility structures, systems, and components (SSCs) are included in the configuration management (CM) program

- Label safety-related SSCs included in the CM program to alert workers that proposed modifications must be analyzed before they are implemented.

- Perform regular inspections of safety-related SSCs in the CM program to ensure early identification of unauthorized modifications.

- Include CM program change control process requirements in worker training courses.

- Penalize persons who willfully disregard the established requirements of change control and configuration management.

- Include CM program and change control process performance as part of the performance evaluations for both workers and supervisors.

KEYWORDS: *Unauthorized modification, safety systems, configuration control, interlock switches, personnel safety*

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

3. *FIELD-MODIFIED EQUIPMENT OVERTURN*

On two separate occasions within a week at the Savannah River Site, there have been accidents involving field-modified portable water hauling tanks that overturned. (ORPS Report SR--WSRC-CMD-2004-0002; final report filed June 22, 2004)

The first event occurred on April 23, 2004, at the Pond B dam. Dry weather conditions necessitated spraying water on the earthwork dam to control dust. The subcontractor provided a dump truck with a 1,000-gallon, skid-mounted water tank secured in the truck bed with a nylon strap. When he reached the area that needed to be sprayed, the driver started to turn the truck around to move it into position and backed onto an adjacent slope. The truck became unstable and then rolled over onto the passenger side. The driver, who was not wearing a seatbelt, braced himself in the truck during the rollover and was not injured. No one else was in the area.

A site superintendent uprighted the truck with a forklift and excavated the soil contaminated with diesel fuel and oil that had spilled from the truck. All work was stopped, and a preliminary investigation ensued. Investigators determined that one causal factor was that the water tank assembly was secured only with the nylon strap to prevent rearward shifting. The skid assembly was not blocked or otherwise secured to prevent potential lateral shifting inside the dump body. When the truck encountered the uneven grade, the tank skid assembly shifted toward the passenger side of the vehicle.

The second event occurred 3 days later, on April 26, 2004, at a different facility at the site. Another subcontractor was executing a flow test for a sewer lift station. Contractor personnel modified the trailer system before the test by removing a substantial mass (a pump) from the tongue (ahead of the axle) of the trailer. They did not realize that removing the mass caused a shift in the effective center of gravity, changing the operational characteristics. The driver backed the 500 gallon tank of water close to the lift station and began to detach it from the hauler. As the tongue latch was released, the trailer auto-rotated, the trailer/tank system tipped backward, and the tank landed in an upright position on the ground. The water valving broke when the tank hit the ground, causing a slow, controlled release of water. The driver reported the incident, and the facility manager initiated an investigation. Preliminary results indicate that the trailer was field-fabricated without proper engineering considerations.

The common thread between these two events was poor work planning and a lack of engineering controls (i.e., a failure to understand and establish responsible limits for skill of the craft activities). In the first event, the subcontractor "jury-rigged" a dump truck with a water tank; in the second, the subcontractor failed to consider the operational differences that would result when the pump was removed from the total mass mounted on the trailer.

Site management realizes that contractor management personnel need to control how subcontractors declare equipment to be used onsite, how they convey expectations that the subcontractor will do the job safely, and how subcontractors develop engineering controls for the work they perform.

In addition, the construction subcontractor technical representatives reviewed their active subcontracts to verify that any outstanding contracts clearly identify their declared equipment and its intended use (especially if the equipment is being used for several tasks). All subcontractors were furnished with general rules for securing cargo, and construction management disseminated lessons learned on these events to all construction forces involved in hauling, towing, and heavy equipment operations.

These events illustrate the importance of using the appropriate equipment for the job instead of a makeshift substitute. Subcontractor personnel should not modify equipment without having *modifications approved by a professional engineer. In addition, subcontractors should clearly identify the equipment they bring onsite to perform a task so that any concerns over its safety can be raised before work begins.*

KEYWORDS: *Dump truck, overturned, near miss, water tank, subcontractor*

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

4. COMPRESSED GAS CYLINDER SAFETY

Cylinders containing compressed gas are used routinely throughout DOE without incident, but these gas cylinders can easily become a hazard if they are mishandled. Because compressed gases are commonly used, workers tend to overlook the hazards. Most events involving cylinders are avoidable and are caused by unsafe acts or unsafe conditions, rather than equipment failures.

Some of the more common hazards that workers need to be aware of when handling or using compressed gas cylinders are the following.

- Most gases, including inert gases, can act as simple asphyxiants by displacing oxygen in the air. Other gases can be toxic to the human system either through inhalation or contact with the skin or eyes.
- Flammable gases present the potential for fire or explosion.
- Ruptured cylinders can result in injury or damage by becoming missiles or forcefully ejecting the contents. Cylinders can be pressurized to 2,200 pounds per square inch.
- Many cylinders are heavy, bulky, and difficult to handle and can cause injury by falling or rolling on personnel. A cylinder, 57-inches high and 9-inches in diameter, can weigh as much as 155 pounds when filled. The majority of injuries occur during lifting or moving cylinders.

Cylinder Handling

It is extremely important to move compressed gas cylinders safely and secure them properly to ensure that they do not fall over during use or sustain damage during transport. The required method for moving gas bottles is to use a bottle cart. Because of their small footprint in the upright position, cylinders can be toppled easily; therefore, they should be secured at all times with chains or straps.

On February 27, 2001, at the Hanford Central Plateau Remediation Project, a subcontractor tried to lift and move a cylinder of acetylene by hand, using only the protective cap. The threaded cap, which was cracked along the side, came off and hit him in the chin, leaving the bottle uncontrolled. The subcontractor believed he could control the cylinder by hand because it only needed to be moved a short distance. (ORPS Report RL--BHI-CENTPLAT-2001-0020)

On March 8, 2000, at the Rocky Flats Environmental Technology Site, a cylinder of compressed argon gas fell out of a welding cart and hit the floor, breaking off the stem connection to the regulator and venting 800-psi gas to the air until the isolation valve could be closed. A construction worker was trying to reposition the welding hoses and pulled on the hose connected to the argon cylinder causing it to tip over. The chain/hooking device either was not properly secured or was not adequate to hold the cylinder in place in the cart. If the isolation valve had broken off, the cylinder could have become a dangerous missile. (ORPS Report RFO--KHLL-WSTMGTOPS-2000-0004)

At the Oak Ridge National Laboratory, a nitrogen cylinder rolled down a flight of stairs, injuring a pipefitter and damaging the cylinder. Two pipefitters were attempting to slide the cylinder, bottom first, down a stairwell when they lost control. The cylinder slid down 16 steps, knocking one pipefitter backwards down 4 steps, injuring his back. The protective cap over the cylinder valve was knocked off and the valve stem was sheared at the packing nut. (ORPS Report ORO--LMES-X10PLEQUIP-1996-0001)

Cylinder Transportation

When transporting cylinders by vehicle, it is important to chain or strap the cylinders down to prevent movement in any direction.

On June 14, 2002, at the Nevada Test Site Tunnel Complex, receiving personnel discovered that a cylinder of sulfur hexafluoride (SF_6) had fallen off a truck while a shipment of cylinders was en route. Investigators determined that the cylinders (seven in all) were not sufficiently strapped down. Straps were placed so as to prevent side-to-side movement, but not forward and backward movement. (ORPS Report NVOO--DTRA-TUNNELS-2002-0001)

A similar event was reported in OE Summary 2003-06. Two compressed gas cylinders slid forward through the rear window of a pickup truck (Figure 4-1) when the driver came to a sudden stop. The cylinders were unsecured and stacked too high.

Cylinder Labeling and Identification

The contents of a compressed gas cylinder must be clearly identified and stenciled or stamped on the cylinder or an affixed label. Commercially available three-part tag systems may also be used for identification and inventory. Compressed gas cylinders should not be accepted for use if the contents are not legibly identified. If the labeling on a cylinder is not clear or an attached tag is defaced to the point the contents cannot be identified, the cylinder should be marked "contents unknown" and returned to the supplier. The color of the cylinder should never be relied on for identification because cylinder colors may vary with the supplier. Additionally, labels on caps have little value because caps are interchangeable.

Figure 4-1. Unsecured cylinders during transport

On August 11, 2003, at Argonne National Laboratory–West, a health physics technician connected the wrong gas cylinder to a personnel contamination monitor. The monitor requires a mixture of methane-argon (P-10 gas) for operation, but the technician connected a cylinder of hydrogen instead. The technician failed to read the label, which correctly identified the contents of the cylinder; instead he relied on the color of the cylinder. (ORPS Report CH-AA-ANLW-FASB-2003-0001)

A similar event occurred at Oak Ridge National Laboratory on November 1, 2001, when someone connected a cylinder of flammable gas (95 percent hydrogen) to an anaerobic chamber instead of a cylinder containing 95 percent nitrogen. The installer failed to read the label on the cylinder as required. (ORPS Report ORO-ORNL-X10WEST-2001-0015)

Flammable, Corrosive, and Special Gases

Some special gases require particular handling and precautions. Compressed oxygen, while not combustible itself, will cause some materials to burn violently. Grease, cleaning solvents, or other flammable material should never be used on an oxygen valve, regulator, or piping. Figure 4-2 shows an oxygen cylinder that was involved in an explosion and fire at a shipyard when oxygen came in contact with a lubricant used on the threaded connection at the cylinder valve.

Systems carrying acetylene gas should be made only of steel or wrought iron pipe because, under certain conditions, acetylene forms explosive acetylide compounds when in contact with copper, silver, or mercury.

Cylinders containing corrosive or toxic gases should be evaluated regarding the safety of long-term storage and manufacturer's shelf life recommendations. Also, components in corrosive or toxic gas systems should be inspected at regular intervals as determined by analysis and service use.

Figure 4-2. Oxygen cylinder burned during fire

On November 6, 2003, at the Oak Ridge National Laboratory, two lecture bottles were discovered to be leaking, resulting in HAZMAT team response. One cylinder contained tungsten hexafluoride (WF_6) and the other contained hydrogen fluoride (HF). The bottles had been stored for a long period of time, and the seals had deteriorated. (ORPS Report ORO--ORNL-X10CENTRAL-2003-0010)

Facilities that store or use cylinders containing toxic, corrosive, or highly toxic gases should have an emergency response plan.

Cylinder Discharge and Leaks

The accidental discharge of gas from a cylinder can propel it with great force, resulting in injury and facility damage. Leaking cylinders can be dangerous, especially if they contain flammable and hazardous gases.

At Brookhaven National Laboratory, two firefighters were slightly injured when one of them accidentally discharged an 800-psi carbon dioxide (CO_2) cylinder. The discharge propelled the cylinder from a cart, and it spun out of control and struck one of the firefighters. The other firefighter fell while trying to avoid the spinning cylinder. (ORPS Report CH-BH-BNL-BNL-1998-0041)

A similar event occurred at the Oak Ridge Y-12 Site, where a fire department worker narrowly escaped injury when he accidentally actuated a CO_2 cylinder. The discharge propelled the cylinder from a storage building, spinning it 30 feet into a parking area before it came to rest against a concrete ramp. (ORPS Report ORO--MMES-Y12SITE-1995-0025)

A non-DOE accident in September 2003 resulted in an explosion when a leaking cylinder of acetylene was left in a pickup truck (Figure 4-3). The cylinder valve was not fully closed allowing acetylene to accumulate and ignite when the truck door was opened. A pipefitter suffered facial injuries and damaged ear drums.

On March 15, 1999, at the Oak Ridge East Tennessee Technology Park, a 150 pound propane cylinder was leaking in an open storage shed. A hazardous materials response team used leak-patching equipment to seal the cylinder valve and valve cap. Investigators determined that personnel had damaged the cylinder valve when they inserted a lever through the valve cap ports to loosen an over-tightened cap. (ORPS Report ORO--BJC-K25GENLAN-1999-0005)

Hazards associated with compressed gas cylinders at DOE facilities are similar to those encountered in industrial plants. However, because many DOE facilities contain radioactive material, there is an extra concern that the cylinders do not become a secondary radiological hazard.

DOE O 420.1A, *Facility Safety*, and DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, require compliance with National Fire Protection Association Standard 55*, Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers,*

Figure 4-3. Acetylene cylinder explosion

GOOD PRACTICES FOR GAS CYLINDER STORAGE

- Store cylinders in dry, well-ventilated, and fire-resistant areas.
- Do not store cylinders where other objects could strike or fall on them or near high-ignition substances, such as gasoline.
- Use storage areas with adequate spacing to allow cylinders to be grouped by the hazard class of the contents.
- Store liquefied-gas cylinders with the valve end up, so the pressure relief device remains in contact with the gas phase.
- Acetylene cylinders must remain upright because they are packed with porous rock that is saturated with acetone.
- Do not place cylinders where they could contact energized equipment/circuits.
- Segregate empty cylinders from full ones.
- Do not expose cylinders to extreme temperatures or corrosive chemicals.
- Secure cylinders at all times to prevent falling, using items such as chains, plastic-coated wire cable, and commercial cylinder straps.
- Equip areas where corrosive gases are filled or used with emergency showers and eye-wash stations.
- Place "No Smoking" signs near flammable gas cylinders and ensure the availability of carbon dioxide or dry chemical fire suppression equipment.

Cylinders and Tanks. Additionally, these DOE Orders require compliance with NFPA Standard 1, *Fire Prevention Code*, which includes additional precautions regarding sources of ignition.

The requirements of 29 CFR 1910.101, *Compressed Gases*, state that in-plant handling, storage, and use of compressed gasses in cylinders shall comply with Compressed Gas Association Pamphlet P-1-1965. Additional information on compressed gas cylinder safety can be found in, (1) the *Handbook of Compressed Gases* (Compressed Gas Association) and (2) the *Guide to Safe Handling of Compressed Gases* (Matheson Products, Inc.).

Compressed gas cylinder safety should be an integral part of a facility safety program and should be discussed in the safety manual. Personnel who use, manipulate, or transport cylinders should be trained in cylinder safety and operation. Potential industrial, process, or operational hazards associated with compressed gas cylinders should be analyzed to define the risks posed to personnel and the environment. Personnel should contact the cognizant fire protection engineer or fire department representative with questions or concerns regarding the use of compressed gases within their facility.

KEYWORDS: *Compressed gas, cylinder, bottle, regulator, flammable gas*

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

GOOD PRACTICES FOR GAS CYLINDER USE

- Identify cylinder contents by reading the label—not by the color of the cylinder. Report any unlabeled cylinders.
- Do not use cylinders that are dented, cracked, or have other visible damage.
- Open cylinder valves slowly. Do not force valves that are hard to open or frozen from corrosion. Keep cylinder valves closed when not in use.
- Allow only trained personnel to handle compressed gases.
- Retest cylinders in accordance with the requirements of 49 CFR 173.34, *Qualification, Maintenance and Use of Cylinders*. Never accept cylinders that have an expired hydrostatic pressure test date.
- Keep valve protection caps on cylinders except when they are connected to dispensing equipment.
- Never roll or "walk" cylinders. Transport large cylinders on a cylinder hand-truck and ensure that the protection cap is installed.
- Use non-sparking tools when working with flammable gas cylinders.
- Never use grease or oil on oxygen cylinders.
- Remove contaminated cylinders from service and identify them as contaminated. Inform the vendor of the problem.
- Always ensure that regulator and valve fittings are compatible. Regulators are gas-specific and not necessarily interchangeable.

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