Operating Experience Summary

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Hoisting Cable On Leased Truck Breaks

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On April 9, 2008, at Hanford, a teamster was unloading waste containers from a recently leased shuttle truck with a lift deck when the hoisting cable broke, recoiled toward the windows in the cab of the truck, and broke out about a third of the glass in the upper part of the passenger side rear window (Figure 1-1). The cable also left minor marks on the rubber gasket of the window and on a 1-inch section of plastic molding. The teamster was not injured, and the truck and lift deck were taken out of service. (ORPS Report EM-RL--WCH-REMACT-2008-0004; final report issued May 23, 2008)

The teamster engaged the hydraulic control levers of a Galbreath lift deck to hoist an empty waste container onto the back of the shuttle truck using a roll-on/roll-off process. The bottom of the waste container was pulled along the top of the lift deck rails, as both the container and the lift deck were slowly lowered into traveling position on the back of the truck frame. When the waste container reached the end of the lift deck, it was stopped by mechanical metal stops at the front end of the lift deck guide rails.

As the waste container came to rest against the container stops, the teamster heard a loud bang at the rear of the truck and realized that the cable had broken. The hydraulic rams had continued to apply pressure to the hoist system in excess of cable tensile strength after the container reached the end of the deck, causing the cable to break. Figure 1-2 shows the empty container after it slid off the rails; Figure 1-3 shows the broken cable underneath the truck rails.

Figure 1-1. Passenger side rear window damage

The rented truck had been on site less than 48 hours before this event occurred, and mechanics had inspected it upon receipt. A post-event mechanical inspection determined that the pressure relief valve on the shuttle truck was set to allow a maximum pump pressure of more than 3,000 psi. However, the manufacturer recommends a pump pressure of only 1,850 psi, and the valve is set at that value before shipment. An inspection of other shuttle trucks on site indicated that their hydraulic pressure relief valves were in compliance with manufacturer-recommended settings.

Site records and interviews with site mechanics indicated that all required inspections and maintenance had been performed on both the truck and lift deck system and that both were working properly before the event. The receipt inspection included drawing the cable out to its operating length, inspecting it visually, taking measurements to ensure a consistent diameter along the length, and cycling a waste container through the roll-on/roll-off process numerous times. Inspection of the hydraulic system pressure was not required because the pressure is set by the manufacturer.

Investigators learned that the truck was operated the previous day, apparently also at 3,000 psi. However, on the day of the event, the operator ran the hydraulics for some time with the waste container on the stops, allowing sufficient pressure to build up in the hydraulics to break the cable. Investigators also spoke with the rental vendor and contacted the manufacturer. Both believed that this was an isolated incident and that it was likely that the pressure relief valve was set improperly before the shuttle truck was delivered to the Hanford site.

As result of this event, the hydraulic pressure setting will be verified during initial onsite inspections. Rear cab protection is also being added to shuttle hoist trucks to ensure that the driver is protected if a similar event should occur. A site lessons learned bulletin (Identifier RCCC-08-009) on this event is available at http://www.washingtonclosure.com/about/safety/docs/RCCC-08-009.pdf. The textbox on the following page shows the recommended actions from the bulletin.

A similar event occurred at Hanford on June 13, 2006, when a subcontractor operating a Sterling shuttle truck was loading a full roll-on/roll-off waste container and the hoisting cable broke. The container rolled down the truck rails to the ground, where it hit another container. The cable break was on the underside of the hoist frame, and the cable was contained within the hoist bed. In a post-event inspection, the company that supplied the cable determined that there was a splice in the cable and some cable hardening. The damage was not noticed before shipping,

Figure 1-2. Empty container after sliding off rails

Figure 1-3. Broken cable underneath the truck rails

during the receipt inspection, or during installation and routine maintenance inspections, and no one could explain how or when the cable might have been damaged. The cable service life was lowered as a precautionary action, and maintenance and inspections were scheduled more frequently. In addition, shuttle truck drivers were alerted to the problem and reminded to provide additional safety checks on cables and trucks. (ORPS Report EM-RL--WCH-ERDF-2006-0004)

Conducting a thorough safety inspection of leased or loaned equipment is extremely important as evidenced in a recent near-miss event at the Idaho Cleanup Project. On April 21, 2008, the driver of an articulated dump truck noticed unusual movement on the back end of the truck while carrying a full load of material to a landfill. The driver stopped and discovered that only 5 of the 21 lug nuts were still attached to the rear wheel. The dump truck was on loan to the landfill organization and had transported 14 loads before the operator noticed the missing lug nuts. Investigators discovered that scheduled maintenance on dump trucks did not include a torque check of the lug nuts. (ORPS Report EM-ID--CWI-BIC-2008-0005)

These events demonstrate the importance of thorough inspections of equipment, particularly leased equipment, before use. In the case of roll-on/roll-off trucks that depend on a hydraulic pressure relief valve to avoid overcoming the rated capacity of the hoist cable, the valve should be tested before placing the truck into service to ensure that the manufacturer's recommended setting has not been compromised. In addition, a rear window shield should be installed in these trucks to protect the driver in the event of a cable break. Drivers should always perform safety checks on both cables and trucks before use.

Recommended Actions from Hanford Lessons Learned Bulletin

- Because the pressure relief valve is also a safety system, any incoming shuttle truck should have the pressure settings checked and compared to the service manual before acceptance or prior to field service. A pressure setting check should also be included in annual (periodic) inspections.
- If not addressed in the service manual, the manufacturer should be contacted before setting or resetting any pressure relief valves to confirm if field readjustment is allowed and to confirm the correct setting.
- A rear window shield should be installed to provide an increased level of protection for the driver in case of cable failure.

KEYWORDS: Cable break, shuttle truck, lift deck, waste container, leased equipment

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

Radio Frequency Interference Triggers Nuclear Plant Shutdown

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The increasing use of advanced analog- and microprocessor-based instrument and control systems in reactor protection and other safety-related systems has introduced concerns about creating additional noise sources. Equipment in such systems is very susceptible to both electrical noise and Radio Frequency Interference (RFI). The most recent example of RFI-related issues is the March 23, 2008, event in which a digital camera triggered a shutdown at Indian Point Nuclear Power Plant in Buchanan, New York (Figure 2-1).

On March 23, 2008, signals from a worker's digital camera caused an emergency shutdown of the reactor at the Indian Point Power Plant just 2 days before a scheduled refueling shutdown. When the camera was turned on too close to a control panel, RFI interfered with a boiler pump that provided water to four steam generators, causing the water levels to drop, thus resulting in an emergency shutdown. No radiation was released, but the 2-day work stoppage cost Entergy Nuclear (Entergy), the licensee, approximately $2 million. (www.wabc.com, June 25, 2008)

Entergy uses cameras to document equipment. The worker was taking photographs with the digital camera to prepare for the scheduled outage when the event occurred. A spokesperson for the NRC stated that troubleshooting after the event indicated that the direct cause was RFI from the camera and that "all that had to happen was for the camera to be on." Entergy sent the camera to the Electric Power Research Institute (EPRI) for evaluation. Entergy will also review their photography procedures because of the incident, and the NRC will relay information about the camera incident to other nuclear plant licensees.

NRC issued Information Notices (IN) in 1997 and in 1983 concerning similar events at Haddam Neck Nuclear Plant (1997); Grand Gulf Nuclear Plant (1983); Three Mile Island (1982); Sequoyah Nuclear Plant, Unit 1 (1979); and Farley Nuclear Plant (1975). These INs are summarized below.

- IN 97-82, *Inadvertent Control Room Halon Actuation due to a Camera Flash* — On August 7, 1997, during tests of the fire detection system (FDS) panel at Haddam Neck Nuclear Plant, a training representative took a flash photograph of the alarm reset pushbuttons inside the FDS control panel and caused an annunciator inside the panel to alarm. No lock-in alarm indication was seen, so a second flash photograph was taken, which caused another alarm indicating imminent system actuation. A few seconds later, Halon discharged from the overhead nozzles. The discharge scattered papers around the room and dislodged ceiling tiles, one of which hit a worker, but he sustained no injuries. Investigators determined that light from the camera flash affected an electronic programmable microprocessor inside the FDS control panel, causing the incident.

Figure 2-1. Indian Point Power Plant

- IN 83-83, *Use of Portable Radio Transmitters inside Nuclear Power Plants* — On July 25, 1983, at Grand Gulf Nuclear Plant, a spurious isolation trip caused by keying a walkie-talkie resulted in the loss of a shutdown cooling loop for 30 minutes. The walkie-talkie operated in the frequency range of 451 to 456 MHz, and the resulting RFI caused the trip.
- A 1979 incident at Sequoyah also resulted from use of a walkie-talkie. A health physics technician used his walkie-talkie to communicate with the control room and initiated a safety injection when there was a spurious signal to all four channels of pressurizer pressure. The event was later initiated intentionally in the same way and with the same results, to verify that RFI from the walkie-talkie had caused the incident.
- At Three Mile Island, in February 1982, workers entering containment noticed that the combustible gas monitors they were carrying indicated the presence of hydrogen and low levels of oxygen. They realized that the readers varied with the use of their face mask radios. Gas sampling outside of containment verified that the face mask radios caused false readings on the combustible gas monitors because of RFI.
- The Farley incident (1975) involved a solid-state differential relay that was sensitive to radio frequency and apparently picked up signals from a transceiver and fed it to the relay amplifier, resulting in false operation of the relay.

Numerous RFI-related events across the DOE Complex were reported to ORPS throughout the 1990s. At the Savannah River Site, for example, there were six spurious alarm activations of a high-range alpha monitor over a 6-week period in 1994. Investigation revealed that the monitor's output signal momentarily went to zero, causing the failure alarm to actuate, but there was no equipment failure. Investigators believed that a possible reason for signal disturbance was RFI caused by two-way radios. (ORPS Report DP-SR--WSRC-LTA-1994-0137)

At Hanford, in 1995, a laboratory was evacuated when a fire alarm sounded. The false alarm occurred while personnel performing equipment testing activities were attempting to establish radio communication in the vicinity of a detector that tripped. Investigators believed RFI caused the false alarm. (ORPS Report EM-RL--WHC-ANALLAB-1995-0007)

RFI occurs when a signal radiated by a transmitter is picked up by an electronic device in such a manner that it prevents the clear reception of another, desired signal or causes malfunction of some other electronic device. With the advent of digital technology and investigation of events similar to those that occurred in the 1980s and 1990s, regulations to address such events were implemented. However, technology is constantly evolving, and manufacturers of digital systems are incorporating increasingly higher clock frequencies, faster operating speeds, and lower logic-level voltages into their designs. Unfortunately, these advances may have an adverse impact on the operation of digital systems with respect to RFI and power surges because of the increased likelihood of extraneous noise being misinterpreted as legitimate logic signals.

With so many wireless electronic devices (cell phones, wireless phones, digital cameras, blackberries, global positioning systems, etc.) in use today, RFI is a concern that must be addressed, particularly in areas where safety equipment may be affected. Title 47, Part 18, of the Code of Federal Regulations, *Industrial, Scientific, and Medical* [ISM] *Equipment,* requires ISM equipment to be designed and constructed in accordance with good engineering practice and with sufficient shielding and filtering to provide adequate suppression of emissions.

The regulations also require that the following information be provided to users of such equipment.

- The interference potential of the device or system;
- Maintenance of the system; and
- Simple measures that can be taken by the user to correct interference.

The recent shutdown at Indian Point Nuclear Plant illustrates the importance of understanding and taking precautions against RFI, particularly with regard to safety equipment. If items such as digital cameras, cell phones, blackberries, and other wireless electronic devices are permitted in areas where safety systems are installed (e.g., control rooms), it is essential that adequate shielding is in place to suppress random emissions. Consideration should be given to banning wireless items in areas where critical safety equipment is installed, if possible.

KEYWORDS: Radio frequency interference, RFI, digital camera, NRC, Indian Point Nuclear Plant

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

Preliminary Notice of Violation Issued for Violations Related to Y-12 Uranium Chip Fire

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On June 13, 2008, the Department issued a Preliminary Notice of Violation (PNOV) and levied a $123,750 civil penalty against Babcock and Wilcox Technical Services Y-12, LLC (B&W Y-12) for a March 15, 2007, uranium machine turnings (chips) fire at the Y-12 Plant. More than 100 workers received radiation doses from smoke inhalation and airborne material from the fire.

The fire at Y-12 occurred during an open-air dry-chip transfer operation, as operations personnel transferred glovebox materials from a container to a dolly. The work was being performed outside the glovebox, and the fire resulted from a chemical reaction that occurred when dry uranium chips were exposed to air. The fire was small, self-extinguished, and did not activate fire alarms. However, the resulting smoke prompted evacuation of three assembly operators and their supervisor, who were involved in the transfer operation, as well as support personnel and other building occupants. Initial testing detected no external personnel contamination. Radiological control (RadCon) dose modeling indicated no impact outside the building, as did air sampling. (ORPS Report NA--YSO-BWXT-Y12NUCLEAR-2007-0012; final report issued February 11, 2008)

Follow-up testing to evaluate possible internal doses took several months to process. The results of those tests indicated that 111 out of 159 workers had received some radiation exposure from inhaling airborne material. Most of the workers received doses of 10 millirems or less, but some received doses closer to 100 millirems. These doses are not expected to create health problems for any of the workers. However, even though the doses are low, they could have been significantly higher had more material ignited.

The issuing letter for the PNOV cited B&W Y-12 for violations of the Code of Federal Regulations, Section 10, Part 830 (10 CFR 830), *Nuclear Safety Management*, and 10 CFR 835, *Occupational Radiation Protection*, and a finding of three Severity Level II violations and one Severity Level III violation. Violations were identified in adequacy of training, adequacy and implementation of work controls and radiological procedures, and effectiveness of independent and management assessment programs. The specific findings are summarized below.

Severity Level II Violation—Personnel Training and Qualification: *DOE contractors are to train and qualify personnel to be capable of performing their assigned work. [10 CFR 830.122(b)(1)]*

B&W Y-12 training failed to ensure that workers were fully capable of performing their assigned tasks. Training did not fully inform workers about specific hazards and did not ensure that emergency response actions and responsibilities were implemented effectively.

Investigators determined that training given to glovebox operators did not adequately inform them of the fire hazards associated with uranium chips, dry chip transfers outside the glovebox, or the increased risks from uranium hydride. Operator training included only general information (e.g., fire suppression methods, the effect of fire on glovebox materials, large fires inside gloveboxes). Deficiencies in emergency response training that impeded the evacuation were also identified. Investigators learned that not all of the personnel in the facility were familiar with necessary actions to evacuate the facility. Although the building emergency plan does not include any direction for an "orderly" evacuation, facility personnel were directed to make an orderly evacuation, rather than an "immediate" evacuation during the event. In addition, some personnel did not initially evacuate to the designated assembly station, while others were held at a loading dock by security personnel, which kept them from going to their designated assembly area.

Severity Level II Violation—Work Processes: *DOE contractors are to perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means. [10 CFR 830.122(e)(1)]*

Approved work control procedures were inadequate to control and limit the pyrophoric hazards associated with specific disassembly and handling operations. Investigators determined that there was no approved procedure in place to effectively control transfer, handling, and disposition of uranium chips generated during disassembly operations. Consequently, effective evaluations of the hazards posed by these activities were not performed. This resulted in the controls (e.g., respiratory protection and walk-in hoods) for chip transfers (required in other work areas) being neither required nor used during the transfer operations that resulted in this event. In addition, although there were procedures in place to control operations inside the glovebox and provide general criticality safety control for material operations, they did not include material handling and disposition activities outside the glovebox or explicitly discuss pyrophoric concerns with uranium chips or the precautions to take in the presence of uranium hydride.

Investigators reviewed operation and disassembly procedures and found that they lacked adequate detail about pyrophoric concerns or appropriate controls for chip handling operations. They also found that accompanying hazard analyses did not explicitly address either pyrophoric concerns specific to uranium chips or the hazards of uranium hydride. A B&W Y-12 investigation team also reviewed procedures after the event and found that the disassembly procedures did not include specific instructions, did not specifically evaluate chip transfers for fire potential, and did not identify specific controls other than the initial containerization of chips in the glove box.

Security Level III Violation—Written Procedures (Worker Radiological Protection): *Written procedures shall be developed and implemented as necessary to ensure compliance with this part, commensurate with the radiological hazards created by the activity and consistent with the education, training, and skills of the individuals exposed to those hazards. [10 CFR 835.104]*

Written procedures commensurate with the radiological hazards of uranium chip transfer activities were not implemented. Investigators determined that a B&W Y-12 procedure on radiological posting and entry control specified that any area where the concentration exceeds the derived air concentration (DAC) values in 10 CFR 835 must be posted as an airborne activity area. B&W Y-12 estimated that uranium airborne radioactivity concentrations exceeded 10,000 DAC as a result of the chip fire, but the work area was not posted as required and no additional controls were in place to limit airborne activity. The requirements in the procedure for radiological work permits state that "the user is to be familiar with the radiological conditions and/or review available attached surveys…."

However, investigators learned that the radiological work permit for glovebox operations in the facility where the chip fire occurred did not list specific work area radiological conditions and did not include statements directing that users were to be familiar with radiological conditions or should review the radiological surveys.

Severity Level II Violation—Management and Independent Assessment: *DOE contractors are required to ensure that managers assess their managerial processes and identify and correct problems that hinder the organization from achieving its objectives. [10 CFR 830.122(i)] Contractors are required to plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement. [10 CFR 830.122(j)(1)]*

Assessments performed by B&W Y-12, which included a formal readiness review, were not effective in identifying and correcting significant problems or in measuring the adequacy of work performance. For example, the assessments did not identify that dry chip transfer operations were being conducted without a controlling procedure or controls consistent with the hazard. Investigators determined that the scope of the readiness review for glovebox operations related to this event did not include material handling and disposal activities outside the glovebox. Since these activities were not evaluated, the absence of a procedure controlling them was not identified. Evaluations also neglected to identify the lack of a disposition procedure. When the question of where the dry chip transfer should be made was raised, it was resolved informally, and there was no recognition that the activity was not covered by a procedure. When a later evaluation indicated that there was no specific procedure for handling the chip operation, a modification request was initiated, but no action was taken to stop work until the modified procedure was in place.

Another glovebox fire occurred at the Nevada Test Site on June 9, 2005. The fire started when an operator used the edge of a glovebox tray to open a tube full of unidentified gray powder, then shook the contents of the tube into the glovebox tray. The material emitted sparks (described as similar to firework sparklers), and the operator tried to put them out by patting them with his heavy leather welders' gloves. However, the sparks spread, igniting nearby combustibles, so the operator activated the fire suppression system and evacuated the area. (ORPS Report NA--NVSO-BN-NTS-2005-0011)

Following a critique and root cause analysis of the event, Bechtel Nevada Nuclear Operations management issued a lessons learned bulletin (Lesson ID: USER-3-2005-NV-NTSBN-058). Critique members determined that a summary report that was required reading for personnel involved in glovebox operations and which personnel relied upon for guidance stated that reactive materials were expected to be reacted before disposal. They also learned that training based on the summary report did not specifically warn that waste streams could contain reactive constituents.

DOE Standard 1066-99, *Fire Protection Design Criteria,* Section 15, "Glovebox Fire Protection," includes requirements and guidance for glovebox design and addresses extinguishing methods, ventilation protection features, and general operating safeguards. In 2007, the American Glovebox Society issued a third edition of *Guideline for Gloveboxes* (AGS-G001-07), which also provides guidance for fire protection and training. The document is available for purchase from the Society.

When working with pyrophoric materials in gloveboxes, it is essential that all hazards are addressed in procedures and that all necessary work controls are in place. Personnel must be appropriately trained to ensure that they are aware of all potential hazards and know how to properly implement emergency actions. Management must take responsibility for identifying and correcting any problems that could arise during site operations and ensuring that all necessary procedures are in place. Management reviews (e.g., readiness reviews) must not only identify problems or measure adequacy of work performance, but should ensure that all elements of work tasks are evaluated, all necessary procedures are in place, and all identified problems are formally addressed and resolved.

KEYWORDS: PNOV, uranium chip fire, radiation, evacuation, inhalation dose, glovebox

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

The Office of Health, Safety and Security (HSS), Office of Analysis publishes the Operating Experience Summary to promote safety throughout the Department of Energy (DOE) complex by encouraging the exchange of lessons-learned information among DOE facilities.

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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