# OPERATING EXPERIENCE SUMMARY

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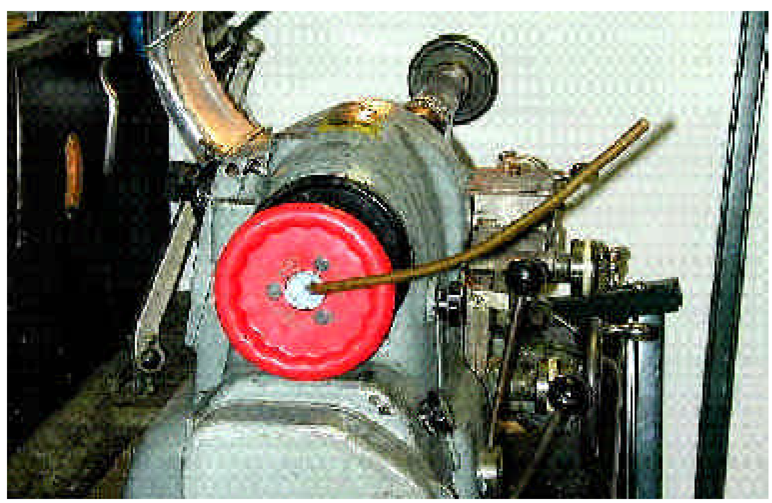


**U.S. Department of Energy**

**Office of Environment, Safety and Health**

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# EVENTS

## 1. NEAR MISS: BREACHED PRESSURIZED FIRE EXTINGUISHER BECOMES A PROJECTILE

On October 13, 2003, at the Paducah Gaseous Diffusion Plant scrap yard, the cutting attachment (shear) on an excavator breached the cylinder wall of a pressurized fire extinguisher while the excavator operator was sorting and segregating debris. Rapid depressurization of the cylinder caused the lower section to become a projectile that arced 250 to 300 feet in the air, flew across a road into another scrap yard a few hundred feet away, and fell to the ground about 60 feet from two scrap yard workers. How the pressurized fire extinguisher got into the scrap pile has not been determined. No injuries resulted from this near-miss incident. (ORPS Report ORO--BJC-PGDPENVRES-2003-0016)

The debris in the scrap pile comprised legacy material that had been in the scrap yard for 15 to 45 years. The operator moved a large piece of metal and noticed some portable fire extinguishers at the base of the pile that had the discharge valves removed, so he knew they were depressurized. Figure 1-1 shows the debris pile and several discarded fire extinguishers. He decided to consolidate the pile and push it away from the roadway to improve access. The operator was pushing the pile, with the shear in the open position, when a fire extinguisher and another piece of metal lodged in the jaws of the shear.

*Figure 1-1. Debris pile with discarded fire extinguishers*

The valve end of the fire extinguisher was obstructed by the piece of metal, so the operator could not see it, but he had no reason to believe that its discharge valve had not been removed as those on the other extinguishers he'd seen had been. When he closed the jaws of the shear to dislodge the debris, the fire extinguisher broke in half and rapidly depressurized. Figure 1-2 shows the portion of the fire extinguisher that became a projectile, and Figure 1-3 shows where it came to rest.

*Figure 1-2. Portion of the fire extinguisher that became a projectile*

*Figure 1-3. Final location of the fire extinguisher projectile*

Corrective actions taken as a result of the incident and implemented before scrap yard operations resumed included the following.

- All personnel attended a safety stand-down meeting that included a detailed presentation on the incident, training on heavy equipment safety, compressed gas cylinder awareness, Integrated Safety Management, and reinforcement of on-the-job safety practices.
- Safety analysts revised the Activity Hazards Analyses for project tasks to specifically address pressurized containers.
- ES&H personnel walked down accessible scrap yard areas to search for any other pressurized containers. (They found a pressurized carbon dioxide cylinder, last hydrotested in 1963, and safely depressurized it.)
- Site management personnel walked down accessible scrap yard areas to identify any other potential safety hazards or concerns.
- Managers reminded site workers of their stop-work authority/responsibility when they identify suspect pressurized containers or other hazardous conditions.

**GOOD PRACTICES FOR WORKING WITH DEMOLITION DEBRIS**

- Survey for and analyze potential hazards in advance of performing work to the extent practicable.
- Watch carefully for hazardous materials/ conditions at all times.
- Use a spotter to assist the heavy equipment operator in watching for hazards associated with what is being moved.
- Be aware of the potential hazards associated with the work (e.g., mechanical hazards, stored energy, radiological contamination, flammable materials, and hazardous chemicals).
- Be prepared to exercise stop work authority if unsafe conditions are encountered.

A search of the ORPS database for other events where hazardous conditions developed when working with facility demolition waste materials in scrap yards revealed several occurrences. On September 9, 2003, at the Portsmouth Gaseous Diffusion Plant, scrap yard workers were potentially exposed to extremely toxic gaseous hydrofluoric acid (HF) when the copper tubing they were size-reducing was breached, began to smoke, and released gaseous uranium hexafluoride ($UF_6$). HF is a product of the instantaneous chemical reaction of $UF_6$ with water vapor in the air. The $UF_6$ was supposed to have been removed from all piping before it was discarded into the scrap yard. No injuries resulted from this occurrence. (ORPS Report ORO--BJC-PORTENVRES-2003-0017)

On October 25, 2002, at the RMI Decommissioning Project in Ashtabula, Ohio, a 25-pound angle iron was ejected from an intermodal shipping container as it was being loaded with discarded metal debris. The angle iron struck the window frame of an occupied excavator being used in the operation, breaking but not penetrating, the window. This near-miss incident resulted in no injuries to personnel. (ORPS Report OH-AB-RMI-RMIDP-2002-0006)

*As more DOE facilities are decommissioned and demolished, scrap yard work (e.g., handling and size-reducing demolition debris) will become more common. The hazards associated with scrap yard and debris-handling operations can be substantial, and they need to be identified and analyzed in advance, so that incidents like those discussed above do not recur. In addition to the mechanical and stored energy hazards addressed in the cited occurrences, other possible hazards in scrap yard operations include radiological contamination, flammable substances, and hazardous chemicals. Workers must be alert for hazardous or off-normal conditions in scrap yard operations and must be prepared to exercise their authority and responsibility to stop work if they suspect or observe unsafe conditions.*

***KEYWORDS:*** *Pressurized container, scrap yard operations, debris pile, demolition, projectile, near miss*

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

## 2. *MANAGEMENT AND CONTROL OF SHOCK-SENSITIVE CHEMICALS*

Shock-sensitive chemicals (i.e., chemicals that may explode with movement, friction, or heat) are used in laboratories across the DOE complex. Some of these chemicals are shock-sensitive by nature; others become shock-sensitive through drying, decomposition, or reactions with oxygen, nitrogen, or the container. Many are so sensitive that the mere scraping of a spatula on the side of the container is sufficient to initiate an explosion. Several incidents reported to ORPS indicate the need for better management and control of these chemicals in DOE laboratories.

On June 21, 2003, at the Oak Ridge National Laboratory, a researcher learned that the 5 grams of silver azide he had stored in a locked cabinet nearly 10 years before were shock-sensitive and should have been stored in an explosives magazine. The researcher immediately contacted a laboratory supervisor, who had the site Hazardous Materials Response team transfer the material to an explosives magazine for proper storage. Although the potential for an explosion existed, no injuries or other damage occurred as a result of this incident. (ORO--ORNL-X10CENTRAL-2003-0006)

The researcher had synthesized the silver azide for an experiment in 1994, but did not use all of it. Because silver azide is not commercially manufactured, there was no Material Safety Data Sheet (MSDS) describing how to store it properly. However, based on what he knew about the material, the researcher stored it in glass vials wrapped with black electrical tape to minimize light exposure and added a top layer of water to stabilize the material. He locked the vials in metal cabinet to limit access to them but did not label the cabinet to indicate that it contained a "special hazard." When he began searching for information about disposing of the material, the researcher learned that the silver azide was considered shock-sensitive and notified the laboratory supervisor so the correct steps could be taken to secure and dispose of the material.

Investigators believe that if the cabinet had been labeled as required, someone with more current information about the hazards of silver azide probably would have taken measures to store it properly. They also determined that work planners for the experiment should have contacted a subject matter expert to obtain information about the potential hazards of the material since they had no MSDS for reference.

On January 30, 2003, at the Ames Laboratory, inspectors from the DOE Inspector General's Office conducted an inspection of the management of shock-sensitive chemicals at the Laboratory and found evidence that some chemicals were being kept past their recommended shelf life. In particular, two bottles of peroxide-forming chemicals had not been disposed of within the limits of their storage/disposal dates. The inspectors reported that the proper requirements were in place, training seemed adequate, and research staff understood the special precautions for handling and storage of shock-sensitive chemicals. However, they identified a need for additional mechanisms to identify, track, and monitor the use and storage of these chemicals. (CH--AMES-AMES-2003-0001)

Corrective actions implemented to provide additional assurance that hazards associated with shock-sensitive chemicals would be managed appropriately included a review to identify all such chemicals stored throughout the Laboratory. The chemicals were then removed, disposed of, or identified with warning labels, as appropriate. A protocol for the review of peroxide-forming and other sensitive chemicals is also being developed to ensure that all hazards are identified and addressed.

On June 21, 2000, at the Oak Ridge National Laboratory X-10 site, a hazardous materials coordinator entering data on chemicals into the Hazardous Materials System noticed an entry for picric acid and requested a search of a laboratory, where a safety officer found the picric acid stored in a reagent cabinet. Personnel confirmed that the picric acid was dry and potentially unstable/shock-sensitive, locked the room, and restricted access to the building. They later found a second, 1-lb container of the chemical in a refrigerator in another laboratory. Although a researcher had prepared and submitted a mandatory chemical inventory, he apparently did not consider the condition and storage status of items on the list. (ORO--ORNL-X10ATY12-2000-0003)

Investigators determined that although personnel and management deficiencies contributed to this event, the root cause was that the controls in place to administer and direct the documentation, review, and management of chemical inventories within individual site laboratories were inadequate. The system allowed work to be done in a compliant but superficial manner, and generated delays in implementing systems that would have improved the management of shock-sensitive chemicals.

## Potentially Shock-Sensitive Compounds

- Acetylenic compounds
- Acyl nitrates
- Alkyl nitrates
- Alkyl and acyl nitrites
- Alkyl perchlorates
- Amine metal oxosalts
- Azides
- Chlorite salts of metals
- Diazo compounds
- Diazonium salts when dry
- Fulminates
- Hydrogen peroxide in concentrations above 30%
- N-halogen compounds
- N-nitro compounds
- Oxosalts of nitrogenous bases
- Perchlorate salts
- Peroxides and hydroperoxides
- Picrates, especially picric acid when dry (creatine picric reagent or trinitrile phenol)
- Polynitroalkyl compounds
- Polynitroaromatic compounds

The Department's Office of Worker Protection, Policy and Programs recently published a *Safety and Health Bulletin*, "Safe Management of Shock-Sensitive Chemicals" (DOE/EH-0197, Issue No. 2003-02, September 2003), that provides information on controlling the hazards associated with these chemicals and strategies for managing them.

The Bulletin includes guidance for developing an effective life-cycle management system from acquisition control through disposal and stresses the importance of establishing the appropriate criteria for identifying these chemicals as well as developing procedures for their safe and timely disposal (see textbox). For additional information about this Bulletin, contact Bill McArthur, Director of the Office of Worker Protection, Policy and Programs (301/903-9674 or Bill.Mcarthur @eh.doe.gov)

OSHA regulation 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, can be accessed at www.osha.gov. This regulation provides direction on the use of chemicals, including signs and labels; spills and accidents; basic rules and procedures; and training and information. The DOE *Explosive Safety Manual* (DOE M 440.1-1) also provides general laboratory safety guidance.

*These events illustrate the challenge of managing and controlling shock-sensitive chemicals. It is important to maintain an accurate inventory of these chemicals that is consistent with their rate of use. It is also important to inventory and dispose of chemicals that tend to form unstable materials with age or materials that become dangerous when they become dehydrated (e.g., picric acid). Shock-sensitive materials should be stored in a cool, dry area and protected from heat and shock. During storage, the materials should be segregated from incompatible materials including flammables and corrosives. Materials which are used specifically because of their explosive properties should be treated as explosives of the appropriate class and*

## STRATEGIES FOR IMPROVING SHOCK-SENSITIVE CHEMICALS MANAGEMENT AND CONTROL

- **Acquisition Control –** Limit procurement to the quantity that can be used before shelf life is reached and determine disposal path; follow criteria for identifying shock-sensitive chemicals; ensure facilities are rated for explosives work and receivers are properly authorized and trained.
- **MSDS/Labels –** Incorporate MSDS/label hazard and safe handling information into work procedures; add labeling that includes the date received, date opened, expiration date, responsible person, and MSDS/other applicable information.
- **Use –** Define the parameters for testing and safe usage.
- **Storage –** Adhere to manufacturer's recom-mendations; ensure implementation of systems for inspecting, testing, and solvating the chemicals
- **Tracking –** Maintain a current inventory that tracks locations, inspection dates, etc., from procurement through disposal; provide for notification if threshold quantities are exceeded.
- **Training –** Ensure that personnel are trained on hazards, safe working methods, and emergency procedures for shock-sensitive chemicals.
- **Disposal –** Establish criteria and procedures for safe and timely disposal.
- **Review/Verification –** Develop a system to evaluate and verify the effectiveness of the shock-sensitive chemical management program.

*kept in an explosive-proof locker or the equivalent storage area.*

***KEYWORDS:*** *Shock-sensitive, chemical hazards, explosive, management and control*

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

## 3. THREE MACHINE SHOP ACCIDENTS RESULT IN TWO WORKER INJURIES AND A NEAR MISS

Recently, three separate incidents at two DOE facilities involving metal lathes and a milling machine resulted in injuries to two workers and a near miss for another. Two events occurred after operators inadvertently started a metal-working lathe at too high of a speed. The third event occurred when an operator started a computer-controlled milling machine that was incorrectly programmed, causing it to overspeed. The following is a summary of the events.

On September 4, 2003, at Brookhaven National Laboratory (BNL) a worker injured his hand when he inadvertently started a metal-working lathe at high speed, causing an extended portion of brass tubing to bend 90° from centerline. As he attempted to shift to a lower speed, his hand slipped from the control lever and was struck by a portion of the rotating tubing. Following the accident, the machine shop supervisor locked out the lathe. (ORPS Report CH-BH-BNL-NSLS-2003-0002)

The operator was trained and designated for independent lathe operation. He had set up the lathe (Figure 3-1) to machine a 38-inch length of 3/8-inch brass tubing, with the machine shop supervisor observing. A critique committee determined that three factors contributed to the accident.

1. The tubing extended approximately 13 inches beyond the collet drawer bar take-up wheel and was not supported (Figure 3-2). Although the job requirement was to machine a bushing no longer than 1 inch, the operator chose not to cut the stock to the proper length before machining.

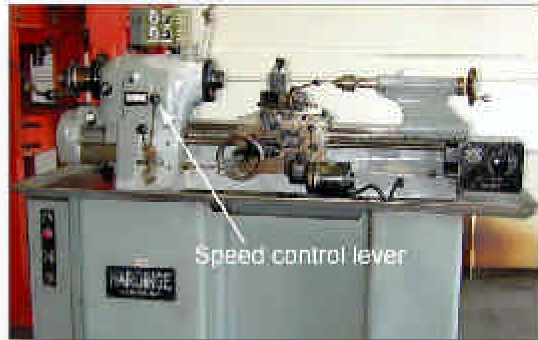


*Figure 3-1. Hardinge Brothers lathe*

2. A single speed control lever is used to start the lathe in low or high speed and to stop the lathe. Before machining the tubing, the operator determined that the low speed setting of 900 revolutions per minute (rpm) was satisfactory for the job, but he did not consider that the high-speed setting was 2,700 rpm.

3. When the operator set up the lathe, he inadvertently started it at high speed. This caused the extended portion of the tubing to bend from the force of the higher rotational speed.

The critique committee recommended that operators perform the following actions when setting up a lathe to machine metal stock.

- Do not permit metal stock to extend beyond the collet take-up wheel of the headstock. If the metal stock must extend beyond the collet take-up wheel, support the extended material.

- When machining material in low speed, adjust the high speed setting to the low setpoint to avoid inadvertently over-speeding the lathe.

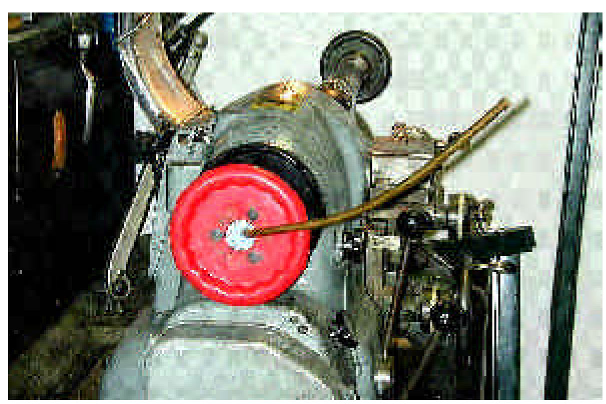

*Figure 3-2. Lathe with bent tube extension*

Caution signs have been posted on all lathes warning operators to support all work piece extensions, and operators will receive new, written guidance for safe lathe setup and operation that incorporates the recommendations of the critique committee.

On August 8, 2003, at the BNL heavy machine shop, the night shift supervisor incorrectly programmed a horizontal milling machine, causing it to overspeed and break the tool arbor. A piece of the arbor flew up and struck an I-beam, a horizontal structural member, and the milling machine electrical panel before falling to the floor. No one was injured, and only the tool arbor was damaged. (ORPS Report CH-BH-BNL-BNL-2003-0012)

Shop personnel designed and fabricated the tool arbor specifically for use with a Haas Model HS-6R horizontal milling machine (Figure 3-3) that would be used to machine 40 pieces in 10 batches. Because each batch would be cut differently, the night shift supervisor prepared a new machine program for each batch. During pre-job testing, the supervisor and a machinist determined that the optimum pro-grammed spindle speed was 750 rpm. Machinists completed work on seven batches between August 4 and August 7 without incident. On August 8, a machinist began loading the eighth batch into the milling machine. He started the program without verifying the spindle speed, and the machine accelerated toward 7,500 rpm emitting a high-speed sound that led the machinist to push the Emergency Stop button. As the spindle was braking, the tool arbor started to bend from decelerating forces and broke at the point where it was clamped into the tool holder. Figure 3-4 shows the arbor and cutting blades after the accident.

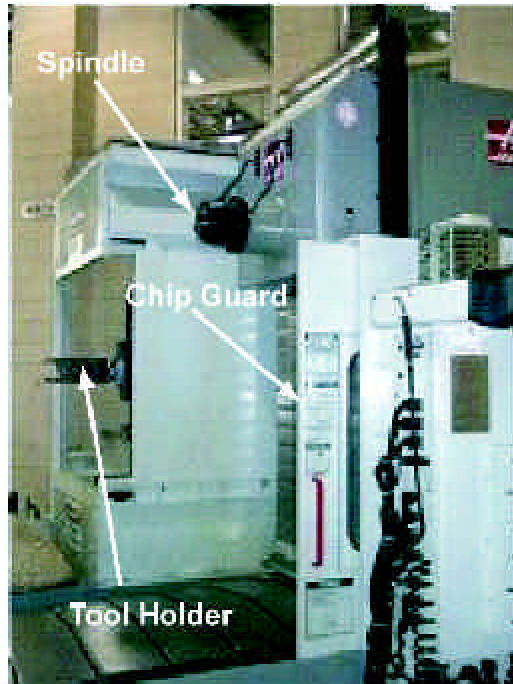


*Figure 3-3. Haas milling machine*

BNL personnel conducted an investigation and determined that the following factors contributed to this accident.

- The night shift supervisor erroneously entered a spindle speed of 7,500 rpm instead of 750 rpm into the machine program, which caused the spindle to rotate at speeds greater than the critical speed for the arbor.
- There was no procedure or requirement for the machinist to verify the programmed spindle speed before running the milling machine.
- The night shift supervisor proposed an arbor 2 inches in diameter with a 1-inch end-step for attaching the cutting saws. However, the day shift supervisor fabricated a 1-inch arbor with a 2-inch collar because this material was more readily available.
- Because BNL considered the tooling job as "skill of the craft," they performed no work planning or safety review before fabricating the tool arbor. The arbor configuration may have contributed to its failure when decelerating from 7,500 rpm.
- No physical barriers were in place to protect personnel and equipment.

The following list includes six of the eight corrective actions that BNL is implementing in response to the event investigation.

*Figure 3-4. Broken tool arbor and cutting blades*

1. Rewrite the machine program to display a text message directing the machinist to verify the programmed speed before starting the machine.

2. Test the programmed speed of the machine arbor behind protective barriers before starting a job.

3. Establish exclusionary zones around the machine in accordance with the manufacturer's recommendations.

4. Revise the work planning procedure to require a safety review and work planning meeting before fabricating special tools for the milling machine.

5. Conduct toolbox talks with heavy machine shop personnel to discuss good practices and the lessons learned from this event.

6. Review and evaluate other BNL machine shops for safe operations and work practices.

On April 8, 2003, at the Oak Ridge Y-12 site, a mechanic was adjusting the chuck on a metal lathe when it began to rotate unexpectedly. The mechanic's left hand was caught between the rotating chuck key and a sharp edge of the lathe. He suffered bruises and several cuts that required 10 stitches to close. (ORPS Report ORO--BWXT-Y12SITE-2003-0015)

Although the mechanic does not know why the lathe began to rotate, Y-12 investigators determined that several factors contributed to this event.

- The mechanic had placed the speed control lever in the neutral position but failed to turn off the lathe before adjusting the chuck.

- Pushbutton controls are illuminated by light bulbs to indicate the operating status of the lathe. The light bulb indicating that the lathe was in "ready" status was burned out.

- There was no safety interlock to prevent lathe startup when the chuck key is removed from its holder.

- Shop administrative controls were not adequate to ensure that mechanics safely operate the lathes.

Y-12 managers have implemented corrective actions to replace the burned-out light bulb, install safety interlocks on all lathes, and revise machine shop administrative work control procedures.

*These events illustrate the importance of observing safe work practices and implementing proper work controls when operating machine shop equipment. Workers must always be aware of the hazards associated with machine tools and not place themselves at risk by overlooking safety practices, taking shortcuts, or being inattentive. Shop managers should employ all available resources to ensure the safety of their workers. These include equipment and safety training, warning signs and labels, work control procedures, job plans and hazard analyses, safety reviews, and safety assessments. Workers need to communicate with each other and to their managers when they observe needed repairs, unsafe work practices, or potentially hazardous situations.*

***KEYWORDS**: Lathe, milling machine, machine tools, overspeed*

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

## *4. ANNUAL FREEZE PROTECTION AND WINTERIZATION REMINDER*

With the onset of winter, it is time to review and implement freeze protection plans at all DOE facilities. Two cold-weather-related incidents recently occurred at Rocky Flats, where freeze protection measures are already in place. On October 30, 2003, operations were suspended in a Rocky Flats facility when the ventilation system automatically cycled to a minimum vent condition because the system controller detected cold incoming air below the freeze protection setpoint. The same day, freezing rain caused an ice buildup on power lines, resulting in loss of power to a building where transuranic waste had been left in a glovebox at the end of day-shift operations. (RFO--KHLL-ANALYTOPS-2003-0004; RFO--KHLL-WSTMGTOPS-2003-0024)

Two cold-weather-related events involving fire protection systems were reported to ORPS in November last year: one at Rocky Flats; the other at Idaho National Laboratory. On November 4, 2002, at Rocky Flats, approximately 1,000 gallons of water discharged into a room when a sprinkler line froze during an extended period of cold weather. A pipe elbow broke and began to leak when the line thawed. Following the incident, portable heaters were installed, and the sprinkler lines were isolated and drained to eliminate freeze-protection issues. (RFO--KHLL-771OPS-2002-0003) On November 3, 2002, at the Idaho Nuclear Technology and Engineering Center, a firewater sprinkler system for an office annex froze, breaking a pipe tee, discharging water into the office building, and causing considerable water damage. Investigators determined that managers had failed to ensure that appropriate mitigation actions (office doors open, heaters running, and more frequent freeze protection surveillances) had been implemented. (ID--BBWI-FUELRCSTR-2002-0012)

Other typical winter weather events at DOE sites during the winter of 2002-2003 included the following.

- On January 20, 2003, at the Oak Ridge Y-12 site, a winter storm followed by several days of subfreezing temperatures resulted in a ruptured chilled water line for a rooftop HVAC system and extensive water damage. Repairs and cleanup costs were over $300,000. Similarly, at the Savannah River Site, on January 27, 2003, a number of incidents, including the rupture of two process water lines for a general purpose evaporator, a cooling water line valve, and two domestic water lines resulted from freeze damage. The estimated cost to repair and return the equipment to an operable status exceeded $10,000. (ORO--BWXT-Y12SITE-2003-0005; SR--WSRC-FCAN-2003-0001)

- On January 25, 2003, at Oak Ridge National Laboratory, a sprinkler head "popped" during severely cold temperatures (–4°), resulting in a sprinkler pipe leak that caused the electrical capacitor bank to fault. An Operations Manager said that the building was colder than normal and a louvered door in the room did not restrict the flow of cold air. The sprinkler system was not in the site freeze protection program because it was no longer needed, but had not been removed. (ORO--ORNL-X10EAST-2003-0001)

- On February 1, 2003, at the West Valley Site, engineering personnel discovered that a large ice mass had fallen from a roof scupper and damaged the roof 30 feet below. A rise in temperatures caused the ice mass to break free from the building. The ice mass had been identified several days earlier, and the area had been secured, monitored, and posted "Do Not Enter – Falling Ice." (OH-WV-WVNS-CF-2003-0002)

Two winter-related accidents at Oak Ridge Y-12 site involved injuries to personnel. On January 24, 2003, an operator working outside at a dock area slipped and fell on the ice, damaging the ligament in his left knee. A similar accident had occurred on January 17, when an employee slipped on ice leaving a building, twisted her left foot, and broke her leg above the ankle. In both cases, snow treated with a melting agent refroze, causing icy conditions. Site managers disseminated a "winter weather safety" reminder to all site employees. (ORO--BWXT-Y12NUCLEAR-2003-0003; ORO--BWXT-Y12SITE-2003-0016)

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 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 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 it fell.

Site personnel are also at risk during periods when snow and ice can cause falls and result in injuries. A policy should be in place that provides supervisors with guidance on making the decision to cancel outside work

## PROTECTING STANDPIPES/ SPRINKLER PIPING

***Where standpipes/sprinkler piping is subject to freezing, the piping systems must be protected by reliable means. Electric heat trace cables are considered acceptable for providing reliable freeze protection if the following conditions are met.***

1. The heating cable is specifically approved for the purpose and is capable of maintaining the piping system at a temperature of 4°C, minimum.

2. The installation of the piping system is fully completed and tested before installing the heating cable.

3. The manufacturer's installation and testing instructions are followed exactly and a copy of the instructions is posted in the sprinkler valve room.

4. Heating cable installation is performed by a Registered Electrical Contractor under a valid electrical permit and inspections are completed before any portion of the piping system is insulated.

5. The heating cable system is continuously monitored through the building fire alarm system to ensure trouble indication.

tasks during periods of inclement weather. Notices about the slipping hazards during snowy, icy weather should be issued to all site employees reminding them to be cautious when walking outdoors in treacherous conditions.

Section 4.8 of DOE G 433.1-1, *Seasonal/Severe Weather and Adverse Environmental Conditions Maintenance*, provides guidance to assist facility maintenance organizations in establishing and updating a seasonal maintenance program. Section 4.1.8.3.2 of the guide includes cold weather preparation information; section 4.18.37 provides an example of a cold weather checklist. The guide can be accessed at www.directives.doe.gov/serieslist.html.

A lessons-learned report (SELLS Identifier 1996-RL-WHC-0026), "Freeze Protection during Extreme Temperature Excursions," also contains useful information. Recommendations include factoring experiences from previous winters into checklists and procedures and setting "triggers" to start specific precautionary actions to prepare for inclement weather and incorporating them into cold weather checklists. The lessons-learned report can be accessed at http://tis.eh.doe.gov/ll/listdb.html.

*These events illustrate the importance of preparing for cold weather before its onset. Managers should evaluate the maintenance histories of systems and equipment, as well as ensure that current policies, procedures, and work planning efforts reflect the lessons learned from previous inclement weather. In addition to taking precautions to ensure that buildings and equipment are not negatively impacted by extremely low temperatures, snow, and ice, managers should remind employees to take the appropriate precautions to avoid injuries from slips and falls in treacherous walking conditions.*

***KEYWORDS:*** *Freeze protection, maintenance, winterize, ice*

***ISM CORE FUNCTION:*** *Develop and Implement Hazard Controls*