March 19, 2002

The Honorable Jessie Hill Roberson
Assistant Secretary for Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Ms. Roberson:

The Defense Nuclear Facilities Safety Board (Board) has continued to monitor the planning and implementation of deactivation and decommissioning in the Department of Energy's (DOE) defense nuclear complex. In so doing, the Board has noted recent occurrences during dismantlement activities that illustrate the safety hazards associated with certain cutting operations and the need to continue to improve the identification, analysis, and control of such hazards.

During the past few years, DOE has worked to update requirements for facility disposition and develop associated implementation guidance. Currently, several DOE resources provide information on how to approach deactivation and decommissioning, offer lessons learned, and summarize numerous examples of disposition activities and experience. Despite the availability of these resources, preventable mishaps continue to occur during deactivation and decommissioning work.

Given that the scope of deactivation and decommissioning work, experience levels, and the maturity of work planning processes vary across the DOE complex, the Board believes a compendium of good practices would assist in the safe performance of such activities. The primary aim would be to share common and practical experience in the identification and implementation of requisite safety controls for various deactivation and decommissioning methods and technologies. Resources such as the Energy Facilities Contractors Group, the HAMMER Training and Education Center, the ALARA Center of Technology at Hanford, and the Deactivation and Decommissioning Focus Area within DOE's Office of Science and Technology may be helpful in defining and supporting the development of this compendium of good practices for use during deactivation and decommissioning. Providing more specific and detailed information will help support work planning at the activity level (e.g., engineering of work areas, selection of appropriate personal protective equipment for different work environments, and implementation of lessons learned). Such guidance could help preclude duplication of effort and repetition of errors.

The enclosed report on this issue prepared by the Board’s staff is forwarded for your information and use as appropriate.

Sincerely,

John T. Conway
Chairman

c: Mr. Richard B. Provencher
Mr. Keith Klein
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

February 15, 2002

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: J. W. Troan, T. L. Hunt

SUBJECT: Feedback from Deactivation and Decommissioning Activities

This report documents observations from a review by members of the staff of the Defense Nuclear Facilities Safety Board (Board) of the application of lessons learned from deactivation and decommissioning (D&D) activities. To develop these observations, the staff reviewed recent occurrences related to size reduction activities, studied selected D&D technologies, and evaluated various documents that may be used to support the feedback function of Integrated Safety Management.

The scope of work activities, the levels of experience with D&D, and the maturity of work planning vary across the complex, as well as within particular sites. Increased and improved feedback is needed to preclude duplication of effort and repetition of mistakes. Better communication and sharing of information regarding the hazards, controls, and associated good practices for various methods and technologies used in D&D activities could help improve work planning and implementation, and should also aid in increasing productivity, mitigating or eliminating hazards, and establishing more effective controls.

Application of Lessons Learned from D&D Activities. Recent events during dismantlement activities illustrate the hazards associated with certain cutting operations and the need to continue to improve the identification, analysis, and control of those hazards. Equipment used for size reduction of gloveboxes, piping, and tanks includes mechanical cutting machines (e.g., portable bandsaws, metal nibblers) and equipment used for melting metal (e.g., cutting torches, plasma arc cutters, and lasers). Common and unique hazards may be encountered during cutting and are dependent on the method used. Potential hazards include cuts, punctures, heat stress, and radioactive contamination, as well as burns and fire from molten metal debris and exposure to ultraviolet/laser light.

Levels of experience with the different cutting methods vary across the defense nuclear complex. Some off-the-shelf equipment commonly used in commercial industrial settings is being integrated and deployed during disposition activities (e.g., laser cutting at Los Alamos National Laboratory), while other technologies (e.g., plasma arc cutting at Idaho National Engineering and Environmental Laboratory) have been used at certain sites for dismantlement

for several years. Although there are a number of sources of technical information regarding use of the various cutting methods and associated lessons learned, mistakes still occur that could have been avoided had this information been more practical and shared more effectively.

A good example of identification of cause and communication of issues is the Type A accident investigation following a February 1997 accident at the Oak Ridge K-25 Site, Building K-33, in which a welder using a cutting torch suffered fatal burns when his clothing caught fire. The report on this incident issued by the Department of Energy's (DOE) Investigation Board proposes managerial controls and safety measures believed necessary to prevent or minimize such incidents. An overarching issue identified during the investigation was the failure to conduct adequate work planning and hazard analysis. The February 1997 incident received a great deal of attention across the complex, and the staff has seen evidence of action taken to rectify associated problems.

Contamination events and personal injuries during size reduction activities continue to occur and are indicative of the need to improve work planning, hazard identification, and controls. For example:

- In February 2001, a worker at the Miamisburg Environmental Management Project (MEMP) became contaminated while using a plasma arc cutter to disassemble a highly contaminated walk-in fumehood. This contamination event was believed to have been caused by metal slag melting through the worker's plastic shoecovers and into his shoe. In response to this occurrence, workers involved in cutting were outfitted with heavy rubber boots. Subsequently, however, another contamination occurred, this time involving a worker stationed as a fire watch outside the immediate cutting area. This worker had not been given similar upgraded boots, and the breach of personal protective equipment was attributed to a piece of sharp metal slag cutting through his shoecovers. Lessons learned at MEMP, as well as experiences from other sites, had not been effectively applied.

- In November 2001, a worker was injured while using a portable bandsaw to cut pipe in the process hood at Hanford's 233-S Plutonium Concentration Facility. Small-diameter piping (e.g., diameter of 0.5 to 0.75 inch) had been removed from a vertical installation and was being cut into small pieces. The worker was supporting the pipe with one hand and was using the other to operate a portable bandsaw to cut the pipe. The blade cut through the pipe and cut the worker's index finger on the hand that was holding the pipe assembly. This injury might have been prevented or mitigated had better controls been identified and implemented. Corrective actions, such as the use of cut-resistant gloves, had been taken in 1999 at the Rocky Flats Environmental Technology Site after a worker was cut while using a portable bandsaw during D&D work. The layout of the work area and physical controls for size reduction activities were contributing factors to both of these occurrences.

The attachment to this report describes these events in greater detail and provides additional examples of related occurrences.

Feedback on D&D Technology. The D&D Focus Area was established by DOE's Environmental Management program through its Office of Science and Technology (EM-50). One of the missions of this focus area is to demonstrate and deploy improved D&D technologies to reduce cost, minimize risk, and accelerate D&D of radiologically contaminated surplus facilities. Large-scale demonstration and deployment projects (LSDDPs) are used to demonstrate individual technologies alongside competing baseline technologies within ongoing site D&D projects. Project personnel then have the responsibility of communicating the results of the technology demonstrations, including both cost and other factors (e.g., radiation dose, safety features, schedule impact, and regulatory and stakeholder acceptance). Upon completion of each LSDDP, a final project report is issued that provides, among other things, recommendations and lessons learned from the project.

In general, lessons learned from subsequent deployment of demonstrated technologies have not been communicated to EM-50 for incorporation into revised technology fact sheets or reports for consolidation and dissemination. Instead, any promulgation of lessons learned from using D&D technologies occurs via the Internet through use of the lessons learned program of DOE's Office of Technical Program Integration (EM-22), in a miscellany of DOE-generated documents, or informally through distribution by site lessons learned coordinators or interested parties.

As an example, the staff recently received new lessons learned on the use of the oxy-gasoline cutting torch at the West Valley Demonstration Project. EM-50 demonstrated this technology several years ago at the Fernald Environmental Management Project and issued a summary report including lessons learned. The new lessons learned, gathered during deployment at West Valley and eventually disseminated through the Hanford ALARA Center of Technology and the *DOE Occupational Radiation Exposure Report, 2000,* were not transmitted through EM-50 to close the feedback loop. The lessons learned at West Valley included the fact that by working with the vendor, the site was able to obtain a custom-made 13-foot-long torch that allowed workers to operate from a lower-dose area. Cutting with an oxy-gasoline torch does not require tight control of the distance between the torch and the piece being cut, making this technique better suited for use with long-handled tooling than methods such as plasma arc cutting. Such lessons learned would be more accessible if captured in EM-50 documentation to ensure that all information relevant to a particular technology was consolidated within a single source.

Improving Hazard Identification and Control Through Better Feedback. Disposition activities are currently addressed by requirements in DOE Order 430.1A, *Life Cycle Asset Management*, and various subordinate implementation guides provide acceptable methods for meeting these requirements. Further guidance for integrating and enhancing the protection of workers, the public, and the environment during facility disposition activities is given in DOE Standard 1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*. In addition, DOE provides other resources containing information on how to approach D&D, lessons learned, and numerous examples of disposition activities and experiences. Among these resources are the following, which are available on the Internet: *DOE Office of Environmental Management Decommissioning Handbook—Procedures and Practices for Decommissioning*; *Office of Environmental Management, Lessons Learned Program*; *Excess Facility Transition to Deactivation and Decommissioning: Methods and Practices Handbook*; *Innovative Technology Summary Report*; and *Decommissioning Preferred Alternatives Matrices*. These resources provide a wealth of information that can aid in implementing the facility disposition program. However, some of the information that is useful for identification of hazards and selection of controls is difficult to assimilate. Information has not yet been developed to the point where it effectively provides practical and consolidated guidance in sufficient detail to help prevent some of the problems experienced during work activities in the complex. Many of the lessons learned are presented as anecdotes, and one must search and evaluate the information to arrive at practical solutions for a particular application. The staff believes better integration and consolidation of existing information, along with supplemental guidance, could help planners, supervisors, and workers create a safer work environment.

The staff concludes there is a need for enhanced guidance regarding the safe implementation of practical methods and technologies used in disposition activities. The following specific topics might be addressed:

- Cutting devices (e.g., plasma arc, laser, oxy-gasoline, and oxyacetylene cutting devices; saws, nibblers, and grinders)
- Engineered controls (containment, capture ventilation)
- Specifications for personal protective equipment
- Actions/techniques/equipment to prevent electric shock
- Fire safety
- Waste-handling methods
- Use of automated and remotely operated equipment

In some cases (e.g., cutting devices), it may be appropriate to include in the guidance topical discussion of various disposition methods/techniques, their selection and use, and associated hazards and controls. For each method, the discussion ought to address capabilities, application, availability, cost-benefit comparison, hazard-risk comparison, requirements for infrastructure and ancillary equipment, and hazards and typical controls, thus facilitating informed decision making and planning for disposition activities. Other guidance might be tailored to be more specific and address how to do a particular task, such as designing, installing, and operating capture ventilation, or procuring, installing, and operating a size reduction system such as the Inner Tent Chamber used at the Rocky Flats Environmental Technology Site. The *Radiological Containment Guide,* WHC-EP-0749, Rev. 1, prepared by Lockheed Martin Hanford Corporation in November 1996, is an example that might be helpful in the development or elaboration of such guidance.

Attachment

Examples of Occurrences During Deactivation and Decommissioning Activities

1. Contamination of Personnel Clothing Results from Plasma Arc Torch Cutting: Miamisburg Environmental Management Project

February 15, 2001—Contamination of personnel resulted from a demolition activity in the Semi-Works Building, Room 208. This work involved the use of a plasma arc torch to disassemble a highly contaminated walk-in fumehood. This area was posted as a high-contamination area (HCA). Contamination was found on a worker's shoes. A critique was held, and it was determined that the contamination had likely come from metal slag melting through the worker's plastic shoecovers and into the rubber soles at the toes of the shoe. Work was suspended until a heavy rubber boot suitable for use as personal protective equipment (PPE) was obtained.

February 27, 2001—Contamination of personnel occurred as a result of demolition activity involving the use of a plasma arc torch to disassemble a walk-in fumehood in the Semi-Works Building, Room 208. A worker performing fire watch duty, who was standing outside the immediate cutting area, noted a black spot on the bottom of the three layers of shoecovers he was wearing. Personnel performing cutting operations were wearing heavy rubber boots, but the fire watch was not wearing similar PPE. The fire watch was allowed to stay in the area until the work and fire watch were over. Upon doffing his anticontamination clothing, he found contamination on his shoe. Following a critique of this occurrence, it was decided that all personnel entering the HCA during plasma arc torch cutting would be required to wear heavy rubber boots in addition to shoecovers.

2. Hot Slag Melts into Sole of Worker's Boot: Portsmouth Gaseous Diffusion Plant

February 2001—A welder cutting a metal converter ring stood on hot slag, which partially melted through a small area of his anticontamination bootie and into the sole of his steel-toed work boot. The welder was not aware of the slag melting into the sole of the boot until he left the work area to doff his PPE. A fire watch was present and saw nothing out of the ordinary. A small area of the bootie and sole of the boot melted, but did not burn or smolder. The employee was not injured.

3. Worker Burned by Plasma Arc Cutter: Hanford Site

January 2001—A crew in the T-Plant Canyon was preparing to cut equipment into smaller pieces with a plasma arc cutter. The fire watch on the job set up the work area for cutting, including attaching the ground clamp to the piece to be cut and energizing the cutter.
A rigger positioning the material to be cut removed the grounding clamp from the material and placed it on a metal cabinet where the energized cutter gun was resting. He turned and looked up to locate the crane hook, took a step back, and contacted the box and the cutter gun. The

worker experienced a slight shock as the cutter fired. He had apparently trapped the gun between the box and his thigh and depressed the trigger, causing a prespark. The prespark burned a hole through his outer and inner PPE and burned his leg.

4. Contamination Control Ventilation System Lost as a Result of Fire: Building K-33, Oak Ridge National Laboratory

November 1999—Ignition of an oak timber being used as wood cribbing during plasma arc cutting caused a high-efficiency particulate air filter to catch on fire.

5. Protective Clothing Burned: Hanford Site

November 1999—In H-Area, a Bechtel Hanford Incorporated subcontractor was cutting up a half-buried, large-diameter contaminated pipe from the inside with a slice torch—a heavy-duty torch similar to an arc welder, but much hotter than an oxyacetylene torch and able to slice through concrete and dirt. There was a fire watch, but he was outside the end of the pipe (to avoid airborne contamination), and his view was obstructed by the smoke. The worker was wearing fire-retardant anticontamination clothing. Leather covered everything except the bottoms of his feet and his back. However, he was wearing rubber boots on top of his fire-retardant booties to provide traction. The worker stepped on some slag and ignited his rubber boots. The flame from the boots scorched his fire-retardant shoecovers and burned several holes through them. (Fire-retardant clothing will burn if exposed to a steady flame.) The worker extinguished the fire with his welding glove. Although contamination was found on his rubber boot, he suffered neither skin contamination nor burns. Corrective actions involved using heavy-duty firemen's boots, placing the fire watch inside the pipe, and providing training on cutting techniques.

6. Fire Occurs in Building 324 B-Cell: Hanford Site

January 1999—A small fire occurred in B-Cell of Building 324 at Hanford during operations involving cutting with a plasma arc torch. The fire occurred when molten metal from the cutting process ignited combustible materials in a waste container in the corner of B-Cell. During a critique following the fire, it was suggested that covers be placed over waste containers in the cell during such operations.

7. Worker Injured During Band Saw Cutting: Rocky Flats Environmental Technology Site

February 1999—On February 2, 1999, a worker was performing size reduction activities in a glovebox located in Building 779. Cuts were being made on an interior piece of a furnace with a portable band saw. While moving the saw into position for the next cut, the worker held the saw with his right hand on the handle that contained the trigger and placed his left hand on the other end of the saw, where a wheel-type mechanism that turns the blade is located. The worker accidently hit the trigger, and the moving blade caught the top of his left index finger and cut it. The root cause of this occurrence was determined to be personnel error—inattention to detail. A contributing cause was a design problem—inadequate man-machine interface. The job hazard analysis was revised to include requirements for appropriate hand protection for all size reduction activities; in addition, cut-resistant gloves were purchased and it is now the practice at RFETS to use such gloves when performing cutting operations.

8. Pipefitter Cuts Finger with Saw While in High-Contamination Area: Hanford Site

November 2001—A pipefitter from the crew of the 233-S Decommissioning Project was using a portable bandsaw to remove a bundle of small-diameter piping in an HCA on the second floor of the process hood. The pipefitter was wearing two sets of anticontamination coveralls, three sets of surgeon's gloves, shoulder-length veterinarian sleeves and gloves, and one pair of canvas outer gloves. While the pipefitter was cutting through a pipe bundle, the saw blade contacted his left index finger, causing a laceration with low levels of plutonium and americium contamination. The pipefitter received sutures and was released back to work with restrictions.