DECOMMISSIONING OF HOT CELL FACILITIES AT THE BATTELLE COLUMBUS LABORATORIES

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ABSTRACT

Battelle Columbus Laboratories (BCL), located in Columbus, Ohio, must complete decontamination and decommissioning activities for nuclear research buildings and grounds at its West Jefferson Facilities by 2006, as mandated by Congress. This effort includes decommissioning several hot cells located in the Hot Cell Laboratory (Building JN-1). JN-1 was originally constructed in 1955, and a hot cell/high bay addition was built in the mid 1970s. For over 30 years, BCL used these hot cell facilities to conduct research for the nuclear power industry and several government agencies, including the U.S. Navy, U.S. Army, U.S. Air Force, and the U.S. Department of Energy. As a result of this research, the JN-1 hot cells became highly contaminated with mixed fission and activation products, as well as fuel residues.

In 1998, the Battelle Columbus Laboratories Decommissioning Project (BCLDP) began efforts to decommission JN-1 with the goal of remediating the site to levels of residual contamination allowing future use without radiological restrictions. This goal requires that each hot cell be decommissioned to a state where it can be safely demolished and transported to an off-site disposal facility. To achieve this, the BCLDP uses a four-step process for decommissioning each hot cell: (1) Source Term Removal; (2) Initial (i.e., remote) Decontamination; (3) Utility Removal; and (4) Final (i.e., manual) Decontamination/Stabilization. To date, this process has been successfully utilized on 13 hot cells within JN-1, with one hot cell remaining to be decommissioned.

This paper will provide a case study of the hot cell decommissioning being conducted by the BCLDP. Discussed will be the methods used to achieve the goals of each of the hot cell decommissioning stages and the lessons learned that could be applied at other sites where hot cells need to be decommissioned.

INTRODUCTION

In 1943, the Battelle Memorial Institute (BMI), a private research and development corporation, entered into a contract with the Manhattan Engineering District to perform atomic energy research and development activities. In support of this contract, nuclear research facilities were constructed at BMI's West Jefferson site in West Jefferson, Ohio. The initial building constructed, JN-1, contained two hot cell facilities designed for work with nuclear fuels. JN-1 was twice modified by adding more hot cell facilities, up to a total of 14 operating hot cells. For over 30 years, these hot cell facilities were used to conduct nuclear research for private industry and numerous government agencies, including the U.S. Navy, U.S. Army, U.S. Air Force, and the U.S. Department of Energy (DOE) and its predecessors. As a result of BMI's participation in this research, the hot cell facilities became highly contaminated.

In 1989, the Battelle Columbus Laboratories Decommissioning Project (BCLDP) was formed to address nuclear contamination in fifteen (15) Battelle-owned buildings, including JN-1. The objective of the project is to clean up the buildings and grounds and prepare them for future use without radiological restrictions. As a result of both government and industry research conducted in the buildings, Battelle entered into a cost share agreement with the DOE. The DOE Ohio Field Office-Columbus Environmental Management Project is overseeing the BCLDP.

To achieve unrestricted future use of the site, the BCLDP has made plans to demolish JN-1, including each of the hot cell facilities. These plans require that each of the hot cells be cleaned and stabilized to allow demolition to occur without exposing workers to excessive levels of radiation and without spreading radioactive contamination. To accomplish this, the BCLDP uses a four-step process for decommissioning each hot cell: (1) Source Term Removal; (2) Initial (i.e., remote) Decontamination; (3) Utility Removal; and (4) Final (i.e., manual) Decontamination/Stabilization.

SOURCE TERM REMOVAL

The research conducted in the hot cell facilities left each of the cells full of contaminated equipment and research residues. This material resulted in a source term within the cells estimated at over 4,000 curies combined. The goal of the source term removal stage of the decommissioning activity was to remove all research residues, examination equipment, and non-essential systems from the hot cell. This stage allowed decontamination efforts to be focused on the hot cell surfaces and operating equipment.

The initial step in the source term removal process was to complete a waste management assessment of the materials in the cell. Prior to initiating work in a hot cell, historical records were reviewed to identify any potential for chemical contamination, which might result in generating a mixed waste. Any identified chemical contamination was isolated as early in the removal process as possible to minimize mixed waste.

In addition to chemical characterization, cell material was also subjected to a radiological characterization process. The radiological characterization was conducted using a dose-to-curie model developed for the JN-1 building. Historical records, in conjunction with smear sampling throughout the building, were used to create a "standard mix" on a per curie basis. This normalized curie mix was then computer modeled to provide the dose-to-curie program. As each item was removed from the hot cell, it was dose rated and characterized based on the program results. This characterization allowed the material to be sorted by waste category (i.e., transuranic [TRU], Low Level Waste [LLW]-Class A, LLW-Class C) and packaged for disposal.

In preparation for removal from the hot cell, each item was evaluated for disposal based on its characterization data, dose rate, and physical size. This information was used to determine the operating restrictions that needed to be overcome to remove the item from the cell. Size reduction, stabilization, and shielding were completed, as necessary, to meet the operating restrictions.

The final consideration during the source term removal stage was the minimization of TRU waste. Due to the lack of a disposal path for TRU waste and the limited storage space available on-site, it was very important to generate as little TRU waste as possible. This minimization was accomplished using sorting/segregating techniques and frequently involved decontaminating equipment to below TRU limits.

INITIAL DECONTAMINATION

At the completion of the source term removal stage, the hot cells remained highly contaminated with dose rates preventing manned entry. The goal of the initial decontamination stage was to reduce the dose rates and airborne contamination levels within the hot cell to levels permitting manned entry for future decommissioning efforts. To gain access into the cell to remove utilities, remote decontamination techniques were utilized. The major concerns during this stage were to manage secondary wastes and to achieve a sufficient decontamination factor to meet the target contamination levels.

Decontamination efforts began by using "dry" methods with in-cell manipulators to concentrate on visible dirt and debris. Dry decontamination methods were chosen because they are effective at gross decontamination while generating only limited amounts of secondary wastes. The goal for this initial stage of decontamination was to collect all visible debris and eliminate any identifiable "hot spots." HEPA-filtered vacuums and small hand tools were modified for use with the manipulators. Operators "dry" wiped and vacuumed all accessible hot cell surfaces and monitored progress using an in-cell dose rate meter. Hot spots identified during decontamination efforts were marked for additional cleaning.

When dose rate monitoring determined that dry decontamination techniques were no longer effective, operators used more aggressive wet techniques to further decontaminate the hot cell. Pressure washing tools and scrub brushes were fitted for use with manipulators, and all hot cell surfaces were cleaned. After all manipulator reachable surfaces had been cleaned, additional remote decontamination was completed using "reach-in" techniques. Long-handled tools (e.g., brushes and pressure wash wands) were used from the hot cell door to complete this stage of the decontamination effort. Adding water into the hot cell required deploying a system to manage the secondary waste. Wet vacuums and a water filtration system collected the wash water and removed solids in preparation for evaporation.

UTILITY REMOVAL

The utility removal stage of the hot cell decommissioning effort addressed removing the hot operating equipment, including in-cell cranes, shielding plugs/windows/doors, manipulators, and service lines (e.g., electrical, air, plumbing). Work on this stage was often complicated by the interface between radiation protection and industrial safety controls. Very close interaction between Health Physics and Safety staff was required to ensure that work progressed safely. Much of this stage was completed using in-house staff, with specialty contractors being used for the more hazardous and/or technically challenging work. Of special concern was removing large overhead items such as the in-cell cranes.

Operating systems on the inside of the hot cell presented unique radiological challenges, including airborne contamination and elevated dose rates. Despite the initial decontamination efforts, dose rates and airborne contamination levels remained over 100 mR/hr and 1,000 DAC, respectively, inside the hot cell. Prior to manned entries, the hot cell was fogged with an aerosol to hold down airborne contamination; then all hot cell surfaces were painted with a strippable coating. The strippable coating was removed and reapplied, reducing the in-cell dose rates to below 100 mR/hr and airborne contamination levels to less than 1,000 DAC. After the radiological conditions inside the hot cell were stabilized, the remaining hot cell operating systems were removed by manned entries.

With the remote decontamination stage completed, the hot cell operating systems represented the largest source term remaining in the cell. Manipulator and shielding plug removal activities did not require any manned entry into the cell. As a result, no unique radiological challenges needed to be overcome. These systems were removed by in-house staff using bag-out techniques when necessary and packaged for disposal. Specialty contractors were used to remove and size reduce the higher hazard hot cell systems such as the in-cell cranes and lead glass shielding windows.

FINAL DECONTAMINATION

The final decontamination/stabilization stage of the hot cell decommissioning effort focused on leaving the hot cell in a condition conducive to demolishing the hot cell and transporting the resulting waste to an off-site disposal facility. This focus required further lowering the general area dose rates and fixing residual contamination in place (i.e., eliminating airborne contamination).

The final decontamination activity began by removing the strippable coating applied during the utility removal activities. A dose rate map of the hot cell was generated to identify any areas requiring further decontamination. Areas identified were cleaned using a portable de-surfacing tool. The final decontamination step consisted of applying a polyurea coating to all hot cell surfaces. This coating will hold contamination in place during hot cell demolition.

LESSONS LEARNED

During the course of the hot cell decontamination activities, management staff paid close attention to how the work progressed as compared with the decontamination work plan. This observation allowed lessons learned to be identified and applied to future decontamination efforts. The major lessons learned during the hot cell decontamination are to

- Understand the limitations of new technologies fully to deploy them effectively.
- Ensure close interaction between operations/radiation protection/waste management/health and safety; it is critical to maintaining work schedules.
- Invest in operational systems (e.g., staff and equipment) to reap large benefits during the course of the activity.

REFERENCES

1. Battelle Columbus Laboratories Decommissioning Project Baseline, Revision 3, Battelle Columbus Laboratories Decommissioning Project (2002).