

Decontamination and Decommissioning of the 2000 Complex Facilities at Oak Ridge National Laboratory - 11199

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ABSTRACT

The 2000 Complex at the Oak Ridge National Laboratory (ORNL) was decontaminated and decommissioned (D&D'd) by UT-Battelle, LLC as an American Recovery and Reinvestment Act (ARRA) activity between spring of 2009 and winter of 2010. The project was conducted as two separate D&D efforts (i.e., 2000 East and 2000 West) based on the complexities and characteristics of the affected facilities. Field work was conducted by a fixed-priced demolition subcontractor to UT-Battelle, with the scope of both efforts including hazardous, asbestos, and radiological material abatement; structural demolition; waste management and disposal; and site restoration. At completion of major field activities in December 2010, eight facilities were demolished (approximately 5,715 m² or 61,500 ft²), generating approximately 7302 m³ (9,550 yd³) of solid waste. Over 62,000 man-hours were expended, and the project is on track to complete well within the allocated budget. Demolition of the 2000 Complex removed what was previously identified as one of the highest risk set of facilities at ORNL.

INTRODUCTION AND BACKGROUND

ORNL has been engaged in developing and operating facilities to support wide ranging research activities for the Department of Energy Office of Science (DOE-SC) and its predecessor organizations since the 1940s. The ORNL 2000 Complex was originally constructed in 1948 as health physics and metallurgical laboratories and underwent changing missions over the next five decades. At final shutdown in 2002, the 2000 Complex consisted of eight facilities; the two largest were steel-framed “Quonset Hut” structures. These structures were identified as one of the highest risk set of facilities at ORNL due to the physical deterioration of the interior facility structures, the lack of an active fire suppression system, the release of polychlorinated biphenyl (PCB)-contaminated paint from the facility exteriors, and the close proximity of the Complex to new development in the Oak Ridge Science and Technology Park.

In the spring of 2009, DOE initiated a Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Time Critical Removal Action (TCRA) to address the imminent potential threat to public health, worker safety, and the environment posed by on-going releases of PCBs from flaking exterior paint, and potential releases of asbestos, beryllium, and radioactive materials from the 2000 Complex. The TCRA was funded by DOE's Office of Environmental Management (DOE-EM) via the ARRA. UT-Battelle, ORNL's management and operations contractor for DOE-SC, was assigned to demolish the 2000 Complex [1].

2000 COMPLEX HISTORY AND DESCRIPTION

The 2000 Complex (Fig. 1) was comprised of four primary research facilities (Buildings 2000, 2001, 2019, and 2024), associated outbuildings (Buildings 2034, 2087, 2088, and 2092), a filter house and stack, and service utilities.



Fig. 1. The ORNL 2000 Complex consisted of eight buildings, including the four identified research facilities.

Building 2000

Building 2000 was a 2,243 m² (24,148 ft²), steel-framed Quonset hut that was constructed in 1948. It was originally developed as a metallurgy laboratory, later used by the Manhattan Research Project in the late 1940s, and then the ORNL Metals and Ceramics Division in the 1950s. The most recent occupants of Building 2000 were the ORNL Solid State Division and Quality Service Division, who occupied the building from 2000 until 2002 when the building was shut down and emptied of loose materials.

The facility contained metal casting and fabrication equipment to produce fuel elements containing highly-enriched uranium, laboratories for testing the mechanical, chemical, and physical properties of uranium and fuel elements, and office space. Aluminum-clad, aluminum-uranium fuel elements were developed in Building 2000 for use in the ORNL Materials Test Reactor (MTR) and the Light Isotope

Test Reactor (LITR). The Building 2000 High Bay contained the metalworking, melting, casting, and heat-treating equipment for uranium and thorium metal processing; beryllium machining work was also performed in the facility. The building's once-through ventilation system removed radioactive materials from the air using a cyclone separator system and absolute filters before release to the environment. Categorized as a radiological facility, the structure had extensive contamination within the air-handling systems and contamination bonded onto many of the building surfaces [1, 2].

Building 2001

Building 2001, constructed in 1948, was a 2,409 m² (25,925 ft²) steel-framed Quonset hut with a single-story, concrete block addition on the east side. It was originally used as health physics laboratories for the development of health physics instrumentation and subsequently used by the ORNL Environmental Sciences Division for basic research until the late 1970s. The facility was remodeled and used as office space by the ORNL Information Division Complex from early 1980 until 1992. During remodeling the laboratories were converted to office space, slab process drains were covered with vinyl floor tile, and fume hoods were removed, however, the fume hood ductwork and ventilation equipment remained in place. From 1992 until the facility was shut down 2002, Building 2001 was used for temporary offices. Building 2001 exhibited low levels of radioactive contamination, primarily in the interior portions of the air-handling units and process drains [1, 3].

Building 2019

Building 2019 was constructed in 1951, south of Building 2000. This small single-story, light steel frame was 76 m² (815 ft²). This facility was first operated by the ORNL Environmental Sciences Division as the original "Mouse House" and later was used for laser research by the Thin Film Nanostructure and Materials Physics Group [1, 2].

Building 2024

Building 2024 was constructed in 1959 between the Buildings 2000 and 2001 Quonset huts, and expanded in 1969 to its final configuration as a two-story concrete block structure totaling 957 m² (10,296 ft²). It originally served as an annex to Building 2000, providing additional office and laboratory space to support early radiological operations. Later, the ORNL Solid State Division performed research in the laboratories, and multiple divisions have used the office space. The facility was shutdown in 2002, and emptied of loose material, equipment, and furniture in 2002 and 2003. Radiological contamination was generally limited to the process drains, hoods, and associated ductwork [1, 2].

2000 Complex Outbuildings

There were four small outbuildings, with a maximum size of 17 m² (182 ft²), associated with the 2000 Complex (i.e., Buildings 2087, 2088, 2092 and 2034). These structures were free of radiological contamination or had limited radiological contamination that was easily abated prior to demolition [1, 2, 3].

REMOVAL ACTION APPROACH

During the period prior to approval and execution of the CERCLA TCRA, UT-Battelle implemented several activities at the 2000 Complex to stabilize and reduce risks associated with the site hazards in

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preparation for final D&D of the facilities. Building inspections and “condition assessment” walk-downs focused on gaining an understanding of structural, industrial hygiene (IH), and radiological concerns within the facilities that would ultimately drive the stabilization and D&D efforts. A dedicated characterization campaign provided quality data sufficient to demonstrate that the radiologically-contaminated elements of the complex would meet the waste acceptance requirements of the Oak Ridge Reservation’s (ORR) Environmental Management Waste Management Facility (EMWMF), the identified disposal facility for radiologically contaminated demolition debris. Several fixative agents were applied, tested, and evaluated on the peeling PCB-containing paint that covered the exterior surface of Buildings 2000 and 2001 to minimize paint flaking from the structures while awaiting demolition, and to identify a candidate fixative to control the loss of paint during demolition. UT-Battelle also remediated a small area of beryllium contamination in the 2000 Complex to eliminate beryllium as an IH concern during subsequent D&D work. Additionally, all utilities were isolated to remove hazardous energy sources, rendering the complex “cold and dark.”

Final demolition of the facilities in the 2000 Complex was divided into two separate activities based primarily on:

- the extent of radiological contamination expected to be encountered within the buildings;
- the ultimate disposal location of the bulk of the demolition waste; and
- the physical arrangement of the facilities at the site.

Structures with discrete locations of contamination that could be readily abated prior to demolition were packaged as the 2000 Complex East D&D Project; the first of two fixed-price, competitively-bid subcontracts. This subcontract included Buildings 2001, 2019, 2024, and three of the four outbuildings. With removal of the contaminated materials, the balance of the demolition of these structures would be handled as a non-radiological activity, thus allowing waste disposal at the DOE ORR Sanitary/Industrial Landfill.

Building 2000, identified as containing extensive radiological contamination, and Building 2034, a small enclosure over a process waste sampling station were included in the 2000 Complex West D&D Project. The intent of this project was to stabilize radiologically-contaminated systems and equipment in-place, and manage the final facility demolition and the subsequent debris as radiologically contaminated. Demolition waste would be destined for disposal at the EMWMF, the ORR’s CERCLA disposal cell, and would also include the abated radiological waste from the 2000 East D&D Project.

In the fall of 2009, UT-Battelle conducted an evaluated procurement, and subsequently awarded the 2000 Complex East D&D Project to the Safety and Ecology Corporation (SEC). The evaluation team determined that SEC offered DOE and UT-Battelle the best value in terms of experience, technical approach, and cost for the subcontract scope of work. SEC’s team for the 2000 Complex East D&D included E. Luke Greene for asbestos abatement, and Washington Safety Management Solutions LLC (WSMS) for waste transportation.

Concurrent with the field work for the 2000 Complex East D&D Project, UT-Battelle pursued procurement of a subcontractor for the second fixed-price work package, the 2000 Complex West D&D Project. This effort was timed to minimize the delay between completion of the 2000 Complex East D&D Project site work and field mobilization for the 2000 Complex West D&D Project work. In the spring of 2010, the SEC team performing the 2000 Complex East D&D Project was also awarded the subcontract for the 2000 Complex West D&D scope, based on a best-value evaluation of bids.

FIXED PRICE SUBCONTRACT DEMOLITION

The two demolition subcontracts tasked the SEC team to perform all activities needed to safely and compliantly demolish the structures. Major elements of this work included hazardous material abatement, asbestos abatement, radiological material abatement, structural demolition, waste disposal, and site restoration.

Hazardous Material Abatement

Initial field activities for both subcontracts consisted of identification and removal of hazardous materials from the facilities. Chemicals, oils and lubricants, lead, and universal wastes were collected, consolidated, and packaged under the guidance and direction of UT-Battelle personnel for disposal by UT-Battelle's Laboratory Waste Services Group. Additionally, other items prohibited from disposal at the ORR EMWMF and Sanitary/Industrial Landfill were identified and segregated. In Building 2000, shielding in the form of lead sheet was identified with spray paint and recovered following demolition of the building to minimize the physical and potential exposure hazards posed by pre-demolition manual removal inside of the building. The lead sheet was containerized and arrangements made for reconfiguring this material for use as shield blocks.

Asbestos Abatement

The use of asbestos-containing materials (ACM) was standard practice at the time the 2000 Complex was constructed. A significant abatement phase was required to remove friable and selected non-friable ACM from the buildings. Thermal system insulation (TSI), transite items, and some floor tiles and mastic were systematically removed, packaged, and shipped to the appropriate DOE-ORO disposal facility. Some Category I and Category II non-friable ACM materials were left in the buildings after a qualified asbestos inspector determined that these items were not in poor condition and not likely to become friable during demolition. One area of Building 2000 was structurally compromised to the extent that access for friable ACM abatement was not feasible. A small quantity of friable ACM was left in this area and demolished with the structure. This material was recovered intact and segregated from the balance of the debris following demolition.

Radiological Material Abatement

The facilities associated with the 2000 East D&D Project were radiologically "clean" with the exception of several fans, air handling units, lab hoods, and some associated ventilation ducts. Radiologically contaminated items were removed and packaged prior to building demolitions for disposal at the EMWMF with the 2000 West D&D Project waste. This allowed the balance of the structures included in the 2000 East D&D Project to be disposed at the ORR Sanitary/Industrial Landfill following demolition. Several sections of original Building 2000 ventilation system duct that exhibited levels of radiological activity substantially higher than the rest of the contaminated systems were removed from Building 2000 prior to demolition. This activity was performed as an additional contamination control measure to address concerns that radioactive contamination could become loose (due to the overall deteriorated condition of the duct) during demolition and size reduction. No abatement of the remaining radiological material from facilities included in the 2000 West D&D Project was attempted; all materials, including abated asbestos, was managed as radiologically contaminated following the application a fixative to known contaminated systems within the structure.

Structure Demolition

Following completion of the abatement phases of the projects, each facility was safely demolished to slab using a trackhoe (Fig. 2) outfitted with appropriate demolition tools (e.g., grapple, hammer, shear), with the exception of Building 2034, which was disassembled manually. Prior to demolition, the metal skin of Buildings 2000 and 2001 was covered with a sprayed-on elastomeric coating to minimize the flaking of PCB-contaminated paint during demolition and subsequent size-reduction. Non-amended water was used for dust control during trackhoe operations. The project conducted continuous perimeter air monitoring for airborne asbestos and radiological contaminants throughout the demolition process.



Fig. 2. Building 2024 demolition using a trackhoe with an attached shear.

Waste Disposal

Approximately 153 m³ (200 yd³) of abated radiological waste from the 2000 East D&D Project were packaged in intermodal containers and disposed at the EMWMF. The 2000 West D&D Project generated approximately 2,725 m³ (3,560 yd³) of demolition debris that was disposed at the EMWMF under a separate waste profile. Approximately 4,380 m³ (approximately 5,730 yd³) of demolition debris from the 2000 East D&D Project and Building 2034 from the 2000 West D&D Project, was disposed at the ORR

Sanitary/Industrial Landfill. In addition, approximately 46 m³ (60 yd³) of low-volume waste streams, including universal and mixed wastes, were disposed at commercial treatment and disposal facilities.

Site Restoration

Little site restoration beyond repairing and re-vegetating small areas of disturbed soil around the former footprint of the large structures was required, as plans for follow-on slab removal, scheduled for 2011, are well underway. Temporary safety barriers were installed around the perimeter of the remaining slabs where the potential for fall hazards existed (Fig. 3). Known areas of fixed radiological contamination in/on the slabs were identified with yellow and magenta paint and affixed with appropriate signage.



Fig. 3. 2000 Complex slabs following demolition.

CHALLENGES

Demolition of the 2000 Complex was the second of two major CERCLA TCRAs executed by UT-Battelle funded under the ARRA. While the facilities demolished in the 2000 Complex were structurally and operationally different, many of challenges to safe and compliant demolition and waste management were similar. Several of the more significant issues encountered during the 2000 Complex D&D are summarized in the following sections.

Degraded Structural Conditions

The buildings in the 2000 Complex were experiencing the effects of age even as the last occupants of the facilities were being vacated. The intervening years of sitting empty with no utilities or regular maintenance accelerated the degradation of the structures (Fig.4). The resultant continuous water leakage further damaged ACM insulation on piping and ductwork, making abatement work more problematic. Additionally, several areas were structurally compromised to the extent that personnel access was prohibited.



Fig. 4. Sample of interior deterioration in Building 2000.

Extensive Fall Hazards in Attics

The attic areas of Buildings 2000 and 2001 contained the majority of the friable asbestos, which was abated prior to demolition. Walkways and working surfaces in attics, where they existed, were not compliant with current standards for personnel protection and presented significant fall hazards. An extensive effort was required to install acceptable temporary planking and guardrails to protect workers during abatement efforts. Since attic access was limited to several fixed ladders, a number of holes were cut into the attic in Building 2000 from the first floor ceiling to provide access for personnel and material via scissor lifts.

Heat Stress

Interior abatement work in Building 2000 commenced in July 2010 presenting the challenge of heat and high humidity. At the beginning of abatement, a heat stress monitoring program was implemented that included physiological monitoring of personnel to manage what was arguably the biggest challenge of the project. Early on, a “cool down” room was constructed in the building to afford abatement workers an air-conditioned break area where they could remove their respirators, allowing an opportunity to take more frequent, but shorter breaks during the work cycle. However, with daytime ambient temperatures exceeding 32.2 degrees Celsius (90 degrees Fahrenheit) daily, heat indices over 60 degrees Celsius (140 degrees Fahrenheit) were routinely reached in the attic. The work schedule was changed to a night shift in August and September in an effort to minimize the potential for heat-related injuries and illnesses, while maintaining productivity.

CONCLUSION

The 2000 Complex at ORNL was demolished between spring of 2009 and winter of 2010 by UT-Battelle using two fixed-price subcontracts to SEC. At completion of major field activities in December 2010, eight facilities were demolished (approximately 61,500 ft²), generating approximately 9,550 yd³ of solid waste. Over 62,000 man-hours were expended, and the project is on track to complete well within the allocated budget of \$11.7M. Successful completion of the project removed what was previously identified as one of the highest risk set of facilities at ORNL.

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