D&D of the Radioisotope Development Laboratory (3026 Complex) and the Quonset Huts (2000 Complex) at Oak Ridge National Laboratory Funded by the American Recovery and Reinvestment Act - 10255

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ABSTRACT

The Oak Ridge National Laboratory (ORNL) has operated numerous facilities to research and produce a wide variety of radioisotopes, to investigate uranium and thorium energy production, and understand the environmental impacts of energy production for the Department of Energy (DOE) and its predecessor organizations since the 1940s. Two of the ORNL building complexes engaged in this Manhattan Project-era and early Atomic Energy Commission (AEC) research, the 3026 complex and the 2000 complex, are currently undergoing demolition at ORNL by the University of Tennessee - Battelle (UT-Battelle), the current management and operations (M&O) contractor of ORNL for DOE's Office of Science (DOE-SC). The two complexes encompass a total of five major facilities and multiple ancillary facilities (e.g., storage buildings, filter houses, cooling tower, etc.) and present a wide variety of challenges due to known past uses, uncertainties associated with historical process knowledge, physical deterioration of the facilities to the point of unsafe structural conditions, and the conduct of radiological demolition activities in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in the middle of an active "World Class" research laboratory campus. Funding for demolition of the facilities became available from the American Recovery and Reinvestment Act (ARRA) through DOE's Office of Environmental Management (DOE-EM) in Fiscal Year (FY) 2009, allowing an acceleration of disposition plans for the structures.

This paper discusses the two ARRA-funded projects (Decommission and Demolition (D&D) of the 3026 Complex Wooden Structure and D&D of the 2000 Complex) being conducted as CERCLA Time-Critical Removal Actions, including implementation of the CERCLA process, operational history, challenges, planned approach, necessary stabilization and risk reduction activities, characterization and waste disposal strategies, demolition by fixed-price subcontracts, and lessons learned.

INTRODUCTION

The 3026 Complex and 2000 Complex of buildings at ORNL comprise two sets of high-risk facilities. The two Complexes are comprised of multiple facilities with a variety of operating histories, methods of construction, and current physical conditions. The Radioisotope Development Laboratory (i.e., Facility 3026C&D) is one of the original Manhattan Project buildings at ORNL and contained several hot cells that began operation in 1943. The Quonset Huts (i.e., Facility 2000, 2001, and ancillary buildings) at ORNL were built in 1948 to perform development of uranium and thorium fuel materials and housed the earliest ORNL environmental research organization. These two sets of facilities are considered two of the highest risk facilities at ORNL due to the physical deterioration of the interior and exterior facility structures; the presence of loose radioactive contamination; the lack of active fire suppression systems; as well as the close proximity of the facilities to Nuclear Category 2 and 3 facilities and privately funded facilities. Figure 1 shows the location of the facilities within ORNL.

Shutdown operationally years ago, the facilities were not maintained and the structures experienced physical deterioration to the point of structural failure. The facilities presented a variety of challenges to the conduct of characterization, stabilization, demolition, and waste disposal activities. These challenges were amplified by the need to conduct these operations in the middle of the ORNL Central Campus area and in close proximity of new "third-party" building developments in the Oak Ridge Science and Technology Park.

Fig. 1. Location of the 2000 and 3026 Complexes on the ORNL Central Campus

The facilities were planned for out-year demolition under the DOE-Oak Ridge Operations (ORO) Integrated Facilities Disposition Program (IFDP), when ARRA funding became available. UT-Battelle, the ORNL M&O contractor, proposed the two projects for ARRA funding based on the ability to quickly initiate and implement subcontracts for characterization and demolition. UT-Battelle was funded by DOE-EM in May of 2009 to implement the D&D of the 3026 and 2000 Complexes. The projects were initiated in FY2009 and are scheduled for completion in FY2010 (3026 Complex) and FY2011 (2000 Complex).

CERCLA PROCESS

DOE-ORO CERCLA projects are subject to a regulatory review process outlined in the *Federal Facilities Agreement for the Oak Ridge Reservation* (FFA). A Core Team comprised of representatives from DOE-EM, the U.S. Environmental Protection Agency (EPA), and the Tennessee Department of Environmental Conservation (TDEC), has been established to maintain oversight of DOE-ORO actions subject to the FFA. The Core Team is an integral part of the overall projects, providing review and approval from the initiation of the actions through the development of implementing documents such as Waste Handling Plans (WHPs) and project completion documentation. Regular meetings of the Project Teams' management with the Core Team ensure that all parties are apprised of project status and issues requiring resolution can be openly discussed prior to document submission for formal review.

In March 2009, DOE-EM issued the *Time-Critical Action Memorandum for the Facility 3026C&D Wooden Structure at the Oak Ridge National Laboratory, Oak Ridge, Tennessee (DOE/OR/01-2402&*

D1). This action memorandum documented the approval of a time-critical removal action for the abatement of the immediate potential threat to public and worker health and the environment from the collapse of the Facility 3026C&D wooden superstructure, which has no fire suppression system.

In September, 2009, DOE-EM issued the *Time-Critical Removal Action Memorandum for the 2000 Complex Facilities Demolition at the Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/01-2412&D1). This action memorandum documented the approval of a time-critical removal action for the abatement of the immediate potential threat to public and worker health and the environment from the contaminated facility.

The action memorandums highlighted some of the major challenges that faced the project teams, including the central location of the facilities, the dilapidated state of the 3026 wooden structure and collapse of the interior finishes of 2000 Complex structures, absence of active fire suppression systems, the Federal Facilities Compliance Agreement (FFCA) for the 2000 Complex structures relative to high concentrations of polychlorinated biphenyls (PCBs) in peeling exterior paints, plus the presence of fixed and removable radiological contamination, asbestos, lead, and other hazardous materials present in the facilities. These challenges, and the threats to the onsite personnel and environment, will be discussed further in the sections to follow.

OPERATIONAL HISTORY

3026 Complex History. Construction at the Building 3026 site was directed by the Manhattan Engineering District[1] and began with the Chemical Separations Laboratory, Building 706C (later renumbered 3026C). Work on Building 3026C started on December 11, 1943 and was completed on March 3, 1944. The facility housed laboratories and shielded hot cells and was initially used to process targets from the Graphite Reactor. Processing of the targets provided various fission products needed to support chemical and biological research programs. To expand production capacity, construction of an annex on the east side of Building 3026C was started in November 1944. This annex, 706D (later renumbered 3026D), became operational in May 1945 and included shielded chemical process cells specifically designed to support separations and packaging of barium-140 (Ba-140). The two facilities have a footprint of approx. 2,200 m2 (24,000 ft2)

Liquid wastes from processing irradiated reactor fuel elements for uranium and plutonium recovery were piped directly to Building 3026C for fission product recovery. Some of the isotopes recovered from this waste included Iodine-129 (I-129), I-131, Phosphorus-32 (P-32) Selenium-79 (Se-79), Palladium-103 (Pd- 103), Pd-107, Technetium-99 (Tc-99), Neptunium-237 (Np-237), Xenon-135 (Xe-135), and Promethium-147 (Pm-147)[2]. The waste would have also typically contained Cesium-137 (Cs-137) and Strontium-90 (Sr-90), as well as alpha-emitting actinides. In the mid 1960s, the Isotopes Program installed equipment for enriching Kr-85 gas by thermal diffusion in Building 3026C, Hot Cell Bank 2. During this same time period, the ORNL Nuclear Medicine organization used Cell Bank 1 in Building 3026C for processing radioisotopes, which included Copper-64 (Cu-64), Cu-67, Potassium-43 (K-43), Osmium-191 (Os-191), and Tungston-188 (W-188). A tritium storage and leak test facility was added to the northwest corner of Building 3026C and operated for ten years during the final years of the building's operations to test and package radio-luminescent (RL) lights.

Building 3026D hot cells A and B were extensively modified in the early 1960s and were converted for use as a Segmenting Hot Cell Facility to support head-end fuel reprocessing research and to examine and

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[1] *A History of the Radioactive Barium-Lanthanum Process and Production*, ORNL-246, June 22, 1949, W.E. Thompson, Jr.

[2] *Final Safety Analysis Report for the Chemical Separations Laboratory and the Segmenting Hot Cells Facility, Building 3026-C and 3026-D*, October 25, 1984

assemble irradiated metallurgical specimens. Core 1 of the Sodium Reactor Experiment (SRE) was processed at Building 3026D[3], and work with sodium-potassium (NaK) bonded fuels continued into the late 1960s. Much of the work in the cells in the 1970s and 1980s focused on examining irradiated metallurgical specimens associated with various reactors and reactor components.

In the late 1980s, the 3026 Complex buildings were placed into the Isotopes Facilities Shutdown Program (IFSP) where most of the focus was basic S&M. In 1994, the IFSP program function was transferred to DOE's EM-60 Program and the ORNL project was renamed the Isotopes Facilities Deactivation Project. Deactivation under the Isotopes Facilities Deactivation Project began in 1994 and was near completion in 1998 when surveillance and maintenance (S&M) of the facility was transitioned to Bechtel Jacobs Company, LLC (BJC), the DOE- EM management and integration (M&I) contractor. At that time the building utilities and environmental controls were deactivated, and only minimal surveillance activities had been conducted since, resulting in significant deterioration of the wood-frame structure[4]. Figure 2 presents a view of the 3026 Complex north exterior, where the deterioration of the structure is evident.

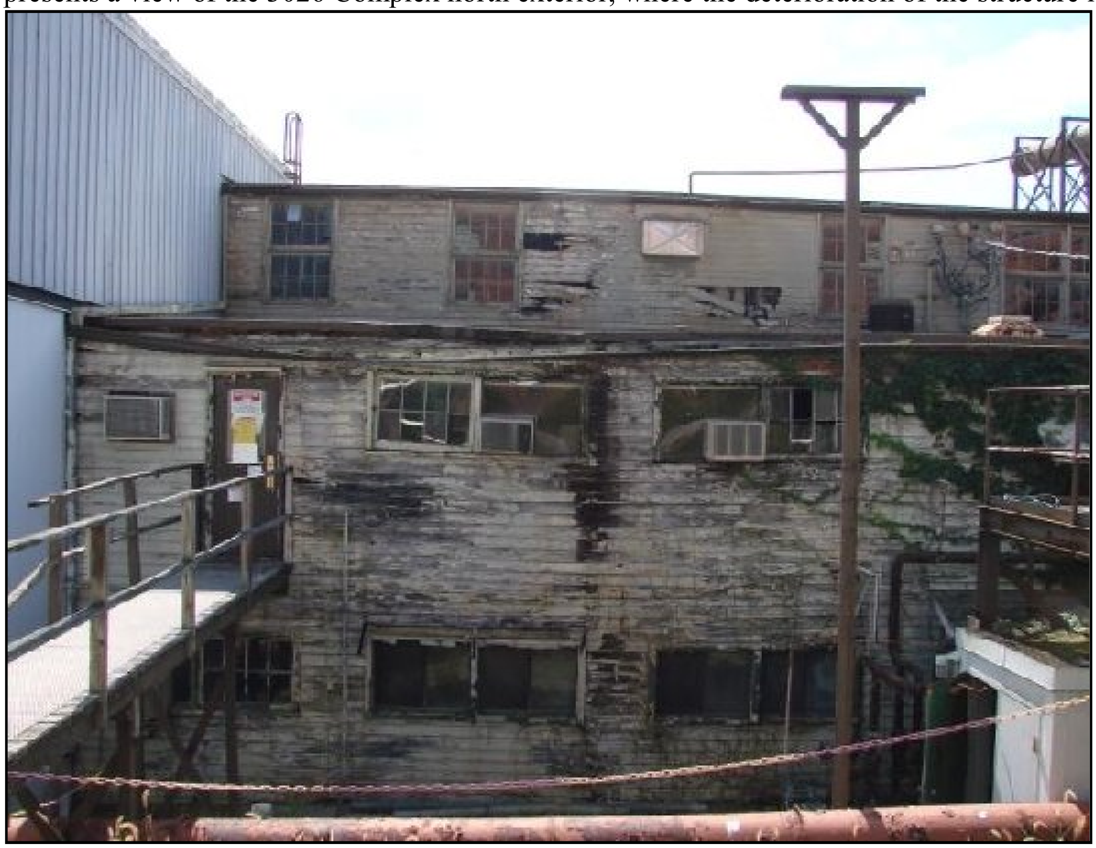

Fig. 2. Exterior photograph of the 3026 Complex showing deterioration

2000 Complex History. The 2000 Complex, also referred to historically as the "Quonset Huts" because two of the three major facilities are of that construction, is comprised of three primary facilities (Buildings 2000, 2001, and 2024), associated outbuildings (2019, 2034, 2087, 2088, and 2092), a filter house and stack, and service utilities. Figure 3 provides an aerial view of the 2000 Complex.

[3] ORNL-TM-319, *Building 3026, Segmenting Facility – Hazards Evaluation*, Vol 8, W.F. Schaffer, B.B. Klima, August 21, 1962

[4] BJC/OR-1261*, Plan of Action for Building 3026 C&D Decontamination and Decommissioning, Oak Ridge National Laboratory, Oak Ridge, Tennessee*, November 2002

Building 2000. Building 2000 is a 2,400 m^2 (25,500 ft^2) steel-framed Quonset hut structure 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 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. The building had a once-through ventilation system to remove radioactive materials from the air using a cyclone separator system and absolute filters before release to the environment. This facility was used in the development of the aluminum-clad, aluminum-uranium fuel element used in the Materials Test Reactor (MTR) and the Low Intensity Test Reactor (LITR)[5]. The High Bay of Building 2000 contained the metalworking, melting, casting, and heat-treating equipment for uranium and thorium metal processing; beryllium machining work was also done in the facility. Categorized as a radiological facility, the structure has extensive contamination within the air-handling systems and bonded onto many of the building surfaces. The most recent occupants of Building 2000 were the ORNL Solid State Division and the Quality Service Divisions, who occupied the building from 2000 until 2002 when the building was shut down and emptied of loose materials.

Fig. 3. Aerial view of the ORNL 2000 Complex facilities

Building 2001. Building 2001, also constructed in 1948, is a 2,400 m^2 (25,500 ft^2) steel-framed Quonset hut structure 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 was 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 1980-1992.

[5] LMERC 1997: LMERC (Lockheed Martin Energy Research Corporation), 1997, *Metals and Ceramics Division History 1946-1996*, ORNL/M-6589, Oak Ridge National Laboratory, Oak Ridge, Tennessee), September.

At that time, the former laboratories were converted to office space and slab process drains were covered with vinyl floor tile. Laboratory fume hoods were also removed, but the fume hood ductwork and ventilation equipment remained in place. Between 1992 and 2002 the facility was used for temporary offices. Use of this facility was discontinued in 2002. Building 2001 has low levels of radioactive contamination interior to process systems, primarily in the air-handling units and process drains.

Building 2024. Building 2024 was originally constructed in 1959 between the Building 2000 and 2001 Quonset huts. The facility was expanded in 1969 to its current configuration as a two-story concrete block structure totaling 950 m^2 (10,300 ft^2). 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 used it for laboratories, and multiple divisions have used it for office space. The facility was shutdown in 2002, and emptied of loose material, equipment, and furniture in 2002 – 2003. Contamination is generally limited to the process drains, hoods and associated ductwork.

2000 Complex Outbuildings. There are five small outbuildings, with a maximum size of 82 m^2, associated with the 2000 Complex (Buildings 2019, 2087, 2088, 2092 and 2034). These structures are all either free of radiological contamination or have very limited radiological contamination easily abated prior to demolition.

CHALLENGE

UT-Battelle Selection

ORNL is the largest national laboratory in the country with a budget of over $1 billion annually. Scientists and engineers at ORNL conduct basic and applied research and development to create scientific knowledge and technological solutions that strengthen the nation's leadership in key areas of science; increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security. ORNL also performs other work for DOE, including isotope production, information management, and technical program management, and provides research and technical assistance to other organizations.

UT-Battelle has successfully performed demolition activities on standard industrial facilities. The necessary radiological, chemical, and engineering expertise is present in abundance; however, the requirements for CERCLA demolitions required a shift in the organizational culture, as well as the development of new management systems, procedures, and specifications to effectively control the demolition work and ensure the protection of workers and the environment. Based on previous successful performance and the availability of key staff with prior EM cleanup experience, DOE tasked UT-Battelle to perform the demolition. This decision was also based on the compressed schedule to implement the work and short total duration for completion. This approach also met with the Recovery Act goals of getting "boots on the ground" early to help stimulate the economy. The UT-Battelle Environmental Management Program Office (EMPO) was able to draw from existing staff familiar with the facilities and radiological work to implement the pre-demolition activities simultaneous with awarding the demolition contracts and preparing for subcontractor mobilization. UT-Battelle was also in a position to best integrate the projects with ongoing ORNL operations and control potential impacts to the laboratory's research missions.

Central Location of the Facilities

There are over 4,000 direct employees at ORNL engaged in wide-ranging research and development missions, along with a significant guest and private sector work force located within the ORNL confines.

3026 Complex Location Issues. The 3026 Complex is positioned in the core area of the Central Campus that is considered "Downtown ORNL" and is adjacent to Central Ave., a primary vehicle traffic corridor which also supports a high volume of pedestrian traffic. The 3026 Complex is surrounded by three occupied facilities that are still supporting ORNL initiatives, with two of the buildings being categorized as Nuclear Category 2 and 3. Building 3525, which is a Category Nuclear 2 facility, is positioned south approximately 29 m (95 ft) from 3026, and Building 3025E which is a Category Nuclear 3 facility is located north approximately 29 m (95 ft).

Demolition of the 3026 Complex posed several challenges concerning adjacent facilities, including:

- Providing fire protection to surrounding buildings, since the 3026 Complex's fire protection system had been de-activated, and the facility is constructed of wood;
- Shared site utilities such as steam, air and potable water, which complicated utility isolation activities;
- A shared central cell ventilation system, requiring modification to ensure proper flow for the remaining facilities after isolation of the 3026 Complex; and
- Transportation issues, including adjacent road closure, emergency vehicle access to 3026 and surrounding buildings, and reduced parking areas for surrounding building employees.

To resolve the fire protection issue, EMPO personnel worked with the ORNL Fire Protection engineering group and the Laboratory Shift Superintendent (LSS) to develop a plan to pre-position portable Blitzfire® (aka water cannon) stations in four areas along the perimeter of the demolition site to protect the surrounding buildings should a fire occur within the 3026 Complex.

The EMPO team also worked with utility operations support personnel to develop and implement work plans to air gap and isolate the air supply, potable water and steam supply to the 3026 Complex with minimal impact to the surrounding buildings and their operations. Similar planning activities were conducted with the support of the adjacent nuclear facilities and Energy Solutions (Bechtel Jacobs Company LLC (BJC) liquid and gaseous waste operations subcontractor) staff to isolate the 3026 Complex from the central hot cell ventilation system. Planning, scheduling, communication and worker input were critical in achieving successful implementation of the various utility de-activation projects required to separate the 3026 Complex buildings from the surrounding facilities and systems.

Transportation issues were resolved by working with adjacent facility management, the Laboratory Shift Superintendent (LSS), Laboratory Waste Services, and the demolition subcontractor to develop road closure, construction laydown area, and waste transportation strategies that minimized overall impacts. Signs, barricades, and frequent communication with the general ORNL population via the internal *ORNL Today* website regarding pending changes were key.

2000 Complex Location Issues. The 2000 Complex is also located near active nuclear facilities, and is situated at the top of a steep hill, making site access a challenge for heavy truck traffic challenging. Additionally, in order to close the area for demolition, pedestrian walkways for access to adjacent facilities were compromised, requiring the construction of new pedestrian access routes and the establishment of a new access/egress route for demolition equipment and waste transportation to minimize demolition traffic in the most populated areas of ORNL.

Current Structural Condition of the Facilities

State of 3026 Wooden Structure. As noted previously, the 3026 Complex has been under minimal surveillance for several years, with no ongoing maintenance or active utilities. In fact, an ORNL Engineering Report from the late 1950s had already identified physical deterioration problems with the wood-framed facility and recommended its replacement with a metal or concrete-framed structure. The deterioration of the wooden structure as a whole began to quickly accelerate once all the environmental support systems were turned off (i.e., "cold and dark"), and significant roof leaks developed. Water infiltration then began to impact the condition of the entire facility. Figure 4 highlights the conditions found inside 3026 in early 2009.

The state of the wooden structure both highlights DOE's concern regarding the threat to the onsite population and the environment as well as the challenges faced by the UT-Battelle EMPO project team to access the facility for condition assessment and characterization.

Fig. 4. Interior condition of 3026 at project initiation

2000 Complex Physical Status. The 2000 Complex facilities also were placed in "cold and dark" condition in 2002. Without proper maintenance, the roof drains soon became clogged with pine needles from adjacent trees, and the roofs of 2000 and 2001 began to leak, causing physical deterioration of the internal finishes similar to those shown in Figure 4 for the 3026 Complex. Ductwork sections with interior radiological contamination have fallen twice in the past, resulting in the release of contamination within the facility. With leaking conditions, water transport combined with one of these failures could result in the release of radioactivity exterior to the facility. Additionally, damage has resulted in the release of asbestos fibers, requiring additional levels of control and stringent entry requirements.

Federal Facilities Compliance Agreement (FFCA). The surfaces of the 2000 and 2001 buildings are coated with paint containing high levels of (PCBs) and asbestos. The paint is flaking from the buildings, resulting in release of PCBs and asbestos to the surrounding environment. The facilities are subject to an FFCA due to the PCB release, and measures including installing filter fabric around the buildings, filter systems in nearby drains, and applying fixative to a portion of the exterior paint, have been taken to control the spread of the PCB paint flakes. The fabric and filters require regular maintenance to maintain their effectiveness.

PLANNED APPROACH

Because of the challenges associated with demolishing deteriorating, contaminated facilities located adjacent to operating nuclear facilities in high traffic areas of ORNL, the goal was to award fixed-price contracts to firms or teams with recent, demonstrated capabilities to successfully complete similar projects. Once it was determined that demolition would be performed via fixed-price subcontract, activities to prepare drawings and specifications for CERCLA demolition were advanced to obtain programmatic and legal reviews and approval within UT-Battelle. Information regarding facility characterization activities conducted in prior campaigns was also compiled, even as new characterization activities were being planned and implemented; characterization uncertainties were covered in the Request for Proposal (RFP) packages with a series of pricing options.

Due to the structural condition issues, and to accelerate the schedule to complete the demolition as soon as safely possible, selected stabilization and pre-demolition activities were performed using the UT-Battelle workforce concurrent with procurement and mobilization for D&D. A concerted effort was initiated to gather and understand the available process knowledge. This process knowledge allowed the detailed planning to proceed based on reasonably solid, verifiable information as opposed to simply "tribal knowledge." The degree of success of this information gathering and its impacts are one of the lessons learned shared later in this paper.

Because the majority of the contaminated demolition wastes were eligible for disposal at DOE-Oak Ridge Reservation (ORR) CERCLA cell, the Environmental Management Waste Management Facility (EMWMF), UT-Battelle's EMPO established a team with this waste disposition experience to prepare and obtain approval of the necessary documentation (e.g., Sampling and Analysis Plans, waste lot profiles, etc.), as well as to implement the sampling and analysis requirements. This approach helped eliminate missteps as well as alleviate concerns of the FFA Core Team and EMWMF management personnel since the 3026 and 2000 Complex Teams were comprised of "familiar faces" with known competencies.

The highest risk associated with the 3026 Complex was identified as a radiological contaminant release resulting from failure of the wooden structure, either by fire or continued physical deterioration. To eliminate this risk as rapidly as possible, the project team chose to procure a demolition subcontractor to remove only the wooden structure and ancillary equipment while leaving the hot cells intact for a follow-on project. Similarly, the 2000 Complex was broken into two procurements: one to address the lightly-contaminated structures which had a significant amount of current characterization information available, and one to address the more highly-contaminated structures which required additional characterization to obtain approval to dispose of demolition debris at the EMWMF.

STABILIZATION AND RISK REDUCTION ACTIVITIES

Early risk reduction efforts focused on making the interiors of the facilities safe for entry and gaining an understanding of what items had to be removed in advance to protect the environment during demolition. Given the state of the facilities, initial entries focused on gaining an understanding of structural, industrial hygiene, and radiological concerns for the safe conduct of building characterization and stabilization activities. Entries were made with a structural engineer, health and safety professional, radiological protection professional, facility engineer, and the UT-Battelle facility manager to assess the inter-related concerns.

Because the physical deterioration of the Building 3026 Complex was so dynamic, maps were developed and regularly updated to communicate the areas of concern to work teams that would be entering to perform tasks. The maps were color-coded to match the physical barriers and postings that were installed in the field to denote areas with structural concerns. All personnel were briefed at each Plan of the Day meeting prior to their first daily entry regarding the different hazards in the building, the postings that established their boundaries, and any changes to the map were marked and discussed. Updated maps were generated on a regular basis and displayed in the control room. Several areas had to be structurally shored due to either the critical nature of the work in or near the area or the concern that the existing failures would propagate to the point that safety in the work areas would be compromised. The shoring not only protected UT-Battelle personnel during stabilization efforts, but allowed the characterization and demolition subcontract personnel access to areas that would not have otherwise been readily available.

3026 Hot Cell Stabilization. Since the hot cell structures in the 3026 Complex will remain in place to be addressed under a separate action and the wooden structure demolition was performed around the cells, efforts were made to minimize the potential for damaging the cells and avoid a release of contamination. These activities, performed in advance of demolition, included removal of the 17 master-slave manipulators from the hot cells, applying a wetting agent (e.g., fogging) inside the hot cells to minimize potential airborne contamination, and isolation of the central cell ventilation system that provided

negative pressure on the hot cells but was connected to other facilities, the ventilation fans, and the central gaseous waste system stack via above-grade ductwork supported by the wooden structure.
Additional Stabilization Activities. In both the 3026 and 2000 Complex facilities, several cleanups were conducted in advance of release of the facilities to the demolition subcontractors, ranging from beryllium and perchlorate abatement activities to cleanup of animal wastes and asbestos releases. Prior to and during the demolition activities, several monitoring stations were set-up in various locations to monitor atmospheric conditions around the facilities. Wind study data covering the past three years was used in determining the location of the monitors; data was collected each day and evaluated for contamination and asbestos issues.

CHARACTERIZATION AND WASTE DISPOSAL STRATEGIES

DOE- ORR CERCLA activities generating waste are required to have a Waste Handling Plan (WHP) which is submitted to and approved by the FFA Core Team. For waste being disposed of on-site, the WHP includes a Sampling and Analysis Plan (SAP) which addresses the sampling and analysis required to obtain approval from the on-site disposal facilities, specifically the EMWMF. Since the planned disposal facility for the bulk of the debris generated from the demolition of the 3026 and 2000 Complexes was the EMWMF, the sampling required to obtain approval at the EMWMF were addressed in the WHP.

The SAPs for the 3026 and 2000 Complexes used a graded approach following the EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (DQO). The DQO process evaluated available characterization data and process knowledge, end use of the data, established the quality level of the data, and identified potential data gaps. The DQO determined that the 3026 and 2000 Complexes needed to be intrusively sampled to determine radiological and chemical constituent concentrations and probability distributions. Based on the results from the DQO, SAPs/Quality Assurance Project Plans (QAPPs) were prepared for the 3026 and 2000 Complexes following the EPA's *Uniform Federal Policy for Quality Assurance Project Plans Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs*.

The SAP/QAPP divided the building debris into sample populations based on expected contaminants and concentrations and the practicality of segregating an item/area from the rest of the debris. A statistically-based sample design was generated for each sample population. The statistically-based sample design consisted of random statistically based samples utilizing a nonparametric upper tolerance limit (UTL) on the largest order statistic (i.e., maximum) collected from representative samples of each media.

To minimize potential issues with sample tracking, laboratory procurement, sample analysis, and validation and verification (V&V) and ensure the data is received from the laboratory in a form and format familiar to the EMWMF WAC Attainment Team and the FFA Core Team, the ORNL Project Team utilized the BJC Sample Management Office (SMO). Upon approval of the SAP/QAPPs from the FFA Core Team, the SAP/QAPPs were implemented and the samples shipped to a BJC SMO-approved analytical Laboratory. As the sample data packages were received from the analytical laboratory, 100 percent of the data underwent V&V.

The validated data was then evaluated statistically to determine what sample populations could be grouped together into a single EMWMF waste lot. Based on this evaluation, EMWMF waste lot profiles were developed for each statistically unique population and submitted to the EMWMF WAC Attainment Team for review and approval. Waste profiles were prepared and approved prior to demolition.

The debris from these complexes represents the first waste streams generated by a UT-Battelle project approved for disposal at the EMWMF. Although characterization and EMWMF waste profiling were performed by the UT-Battelle EMPO Team, waste loading, certification and transportation was included in the scope of the fixed-price demolition subcontractors.

Keeping prohibited items out of the EMWMF-destined waste streams was of utmost importance throughout the duration of the projects. Waste items outside the limits specified in the appropriate approved profile and items expressly prohibited at the EMWMF (e.g., free liquids, pyrophoric items, etc.) were segregated and disposed at commercial facilities by UT-Battelle. UT-Battelle did not subcontract this scope since the relatively small waste volumes could be effectively managed through the ORNL Laboratory Waste Services organization, freeing the demolition subcontractor to focus on demolition and primary waste disposal activities. UT-Battelle initiated management of these wastes and items typically abated prior to demolition during stabilization activities. Working with UT-Battelle Laboratory Waste Services, the EMPO Team developed strategies and ensured waste disposal outlets were in place for all anticipated wastes.

DEMOLITION BY FIXED-PRICE SUBCONTRACT

Evaluated procurements were conducted, with the subsequent award of the 3026 Complex Wood Structure demolition contract to Clauss Construction, and the 2000 Complex East demolition award to Safety and Ecology Corporation (SEC). The 2000 Complex West procurement is pending. These firms were determined by the evaluation teams as offering UT-Battelle and DOE the best value in terms of experience, technical approach, and cost for the particular scope of work. The Clauss Construction team for the 3026 Complex included subcontractors AECOM, SET Services, EnergX, and Washington Safety Management Solutions (WSMS); the SEC Team for the 2000 Complex East included E Luke Greene and WSMS.

Demolition Scope. The demolition subcontractors were tasked to perform all activities needed to safely and compliantly demolish the structures; in the case of the 3026 Complex, the subcontractor was tasked with removing the wooden structure from around the hot cells. Major elements of this work included:

- Hazardous Material Abatement. UT-Battelle initiated identification and removal of hazardous materials as part of the facility stabilization effort. As the fixed-price subcontractors mobilized and were assigned operational control of their respective facilities, their initial activities consisted of continuing this work to ensure hazardous materials were removed. Chemicals, oils and lubricants, lead, and universal wastes were collected, consolidated, and packaged under the guidance of UT-Battelle's Waste Management personnel. Additionally, other items prohibited from disposal at the EMWMF or the DOE-ORO Sanitary/Industrial landfill were identified and segregated.

- Asbestos Abatement. The use of asbestos-containing materials (ACM) was standard practice at the time the 3026 and 2000 Complexes were constructed. A significant abatement phase was therefore required to remove non-friable and friable ACM from the buildings. Floor tiles and mastic, thermal system insulation (TSI), and transite items were systematically removed, packaged, and shipped to the appropriate DOE-ORO disposal facility. Several areas of the 3026 Complex were structurally compromised to the extent that access for friable ACM abatement was not feasible. Friable ACM was left in these areas to be demolished with the wooden structure, requiring special handling of the demolition wastes.

- Structure Demolition. Piping systems within the facilities provided process services (ventilation, air, natural gas, vacuum, water, waste drains, etc.) to fume hoods, hot cells, and other process systems. These piping systems were breached, checked for contents, and "surgically" removed if unacceptable contamination was found. The 3026 Complex hot cell exterior surfaces were cleared of piping and appurtenances and armor was installed to protect cell windows during demolition. Piping and ductwork systems with little or no detected radiological contamination were left in-place for demolition with the structures.

- Site Restoration. To maintain containment and protect the 3026 hot cells from the elements while awaiting demolition under a follow-on project, a weatherproof polyurea coating system (Instacote M-25 or comparable) will be applied to each remaining structure. For both Complexes, the remaining slabs will be sealed and final site cleanup and grooming performed.

Current Status/ Projections/ Future Site Activities

Asbestos and radiological hazard abatement of the 3026 Complex was completed in November 2009, and demolition of the wooden structure was initiated in early December 2009. The demolition is scheduled for completion and the debris shipped for disposal by December 31st. Hazardous mixed wastes were shipped to the Energy*Solution* facility in Clive, Utah and non-radioactive hazardous and universal wastes were shipped to appropriate Clean Harbors treatment, storage, disposal, and recycle facilities (TSDRF) during the second quarter of FY2010.

The 2000 Complex East subcontractor began field activities in October 2009, with demolition of the structures scheduled to be complete by April 2010. At that time, field activities for the 2000 Complex West subcontract will be initiated. Final activities for the 2000 Complex demolition are scheduled for completion by December 2010.

LESSONS LEARNED

Start with an Experienced Team

All projects are just a series of tasks performed by people. Senior leadership at ORNL realized this from the beginning and sought out people for the project teams that are good at what they do and had specific experience with the stakeholders involved. Thus a relatively small team with proven success record was able to develop the paths forward through all three phases (stabilization, procurement, and demolition) and implement the necessary work effectively and efficiently. While this was UT-Battelle’s first experience working on CERCLA demolition projects, the selection of team members with established reputations with the FFA Core Team and the waste disposal facilities prevented mis-steps and sped the projects through the many hurdles required.

Solicit Experienced Craft Support and Encourage Input During Planning

The project teams included skilled craft and craft management that saw the vision and have significant experience working in ORNL’s contaminated facilities under the site-specific constraints. These personnel provided a significant number of ideas for the safe and efficient conduct of stabilization and abatement activities that aided the overall project progress significantly.

Be a Good Neighbor

Close coordination and communication with personnel responsible for operation of adjacent facilities assisted planning efforts for utility isolation, hot cell ventilation isolation from the shared system, and traffic management. Installation of new pedestrian routes and construction access routes, and strategic placement of barricades, construction fencing, and signage kept key travel corridors around the projects open. The use of the exiting ORNL plant communication system and electronic road sign information boards assisted in notifying plant personnel to changes within the immediate work area.

Work Closely With Customer, Regulators, and Other DOE Primes

Early briefings with key stakeholders during the planning stages ensured that the projects remained on track with customer and regulator support. Preparing documented condition assessments required significant up-front effort, but helped establish a common understanding among the involved parties of the conditions and scope from the beginning. During the project, frequent, informal updates and communication with the DOE customer and regulators, including FFA Core Team briefings, avoided surprises and facilitated the exchange of information and expectations.

Can't Get Enough Process Knowledge (PK) but PK can be Unreliable

To determine the conditions of the 3026 Complex prior to transfer, UT-Battelle solicited the assistance of BJC, the contractor with operational responsibility. Prior to FY2009, personnel entered the facility infrequently and then only to perform the most basic of S&M tasks due to the condition of the structure. Under BJC's initial supervision, routine entries had to be made to allow UT-Battelle personnel to perform the visual portion of the assessment. The goals of this part of the assessment were to thoroughly understand the physical risks posed by the facility, to establish the safe working areas currently available to enter, and to determine the areas that must be improved to access and perform critical work activities prior to the demolition subcontractor mobilizing.

During the condition assessment phases, existing process knowledge, characterization information and historical project drawings were collected and used as the basis for further characterization and the development of demolition plans. In some cases, this data was insufficient and project impacts due to "discovery" were significant. For example, on the 3026 project, there was PK relative to the potential for Tc-99 to be present as a contaminant, but the extent of Tc-99 was not known. During abatement, levels of Tc-99 contamination that were higher than anticipated were encountered in some piping systems. Since the concentrations were higher than those established in the waste profiles, alternate abatement and disposal strategies had to be implemented to avoid compromising waste disposal of the bulk of the demolition wastes at the EMWMF.

Old historical engineering drawings also proved unreliable. Many piping runs and features had obviously been "field-constructed/modified" and their locations were not captured on drawings. Years of renovations in the facilities and lack of a rigorous "as-built" drawing process meant that construction drawings detailing the locations of piping, ductwork, ventilation equipment, etc. were all suspect. This required detailed field verification of existing drawings, and the issuance of new drawings to communicate specific building features and requirements to the demolition subcontracts.

Cold and Dark Costs More Money in the Long Run if Achieved too Early

With so many aging facilities located within the DOE Complex, the competition for funds for their maintenance is intense, and those facilities which are actively slated for demolition are the least likely to be maintained, especially as limited maintenance funds are rightly applied to those facilities which actively operate to expand DOE and the country's many energy, science and engineering goals. The 3026 Complex is a prime example of failing in the race for limited resources. The building ceased operations in the 1980s. The initial efforts did focus on reducing the risks associated with the building's contents but as time progressed more pressing needs for the resources pushed out the timeline for completion of the work. A similar situation developed in the 2000 Complex facilities, which went cold and dark in 2002. The lack of resources inexorably led to the buildings' slow deterioration over the intervening years, thus creating dangerous conditions for what would otherwise be routine abatement and demolition work. Pre-demolition abatement, facility access, and characterization were all impacted significantly in terms of cost, schedule, and complexity of planning and implementation.

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