CONF-970952--8

DEMOLITION OF THE WASTE EVAPORATOR FACILITY AT OAK RIDGE NATIONAL LABORATORY

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ABSTRACT

Lockheed Martin Energy Systems, in conjunction with Allied Technology Group, Inc., successfully executed the decommissioning of a former waste evaporator facility at the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. This project was conducted as a non-time critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The decommissioning alternative selected for the Waste Evaporator Facility was partial dismantlement. This alternative provided for the demolition of all above-grade structures, and concrete which did not exceed pre-established radiological levels were eligible for placement in the below-grade portion of the facility. This project demonstrated a coordinated team approach that allowed the successful completion of one of the first full scale decommissioning projects at ORNL.

I. INTRODUCTION

As a result of prior operations in support of the development of atomic power, numerous facilities at ORNL have become contaminated. These surplus facilities are maintained in the Surveillance and Maintenance Program until the time that decommissioning has been authorized. The Waste Evaporator Facility (WEF) demolition project was performed under the Department of Energy's (DOE) Office of Environmental Restoration (EM-40) Decontamination and Decommissioning Program (D&D) at ORNL. Lockheed Martin Energy Systems (LMES), under contract to DOE to provide environmental restoration support at Oak Ridge facilities, was responsible for the overall project management of this effort. Allied Technology Group, Inc. (ATG), under fixed price subcontract to LMES, developed the method of implementation and provided the work force for implementing the D&D of the WEF. This paper describes the management and decommissioning approach utilized to successfully accomplish this D&D effort.

II. FACILITY HISTORY

The WEF was located in the heart of ORNL, one block away from the site cafeteria. It was situated in an area that contains six large Gunite tanks, known as the South Tank Farm, where another remedial action project is being conducted.

The WEF was constructed in 1949 and was the first liquid waste evaporator at ORNL. The facility was in operation from 1949 to 1954 and received liquid low-level waste streams from ORNL and other processing areas for concentration before final disposition by deep well injection techniques. Operations were suspended when the currently active evaporator facility was brought on line. Subsequent to this time, experimental equipment was installed to assist in the development of fission product purification processes and demonstration of contaminated waste incineration.

The WEF was a split-level building with approximate dimensions of 22 x 28 x 11 ft and consisted of an operating gallery and a hot cell. The operating gallery was a wood structure (except for the floor and west wall) with a crawlspace under the floor. The hot cell was a reinforced concrete cell, with 2-ft-thick walls in the north half and 3-ft-thick walls in the south half and contained a stainless-steel floor liner. The hot cell extended 6 ft below ground level. All process equipment had been removed from both the

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operating gallery and hot cell except for some embedded pipes and a filter housing.

The WEF was accepted into the Surplus Facilities Management Program in 1976, and periodic surveillance and maintenance had been performed since that time. The building structure was basically sound, although roof repairs were performed because of deterioration due to rainwater infiltration. The interior had been decontaminated before being used in the incineration experiments, resulting in low levels of radioactivity, which were primarily associated with the piping and some surface contamination. The facility was unoccupied and locked, and accessed by personnel only occasionally.

As a precursor to D&D, a characterization of the site was conducted in 1993, and the information obtained by this process constituted the basis for D&D planning. Site characterization efforts revealed that the general area exposure rate in the gallery was < 1 mrem/hr, and ranged from 1-6 mrem/hr in the cell area. The cell area was more contaminated, but most of the contamination was fixed to the surface of the cell walls and the majority of measured activity in the cell was within 1 inch of the surface. The primary radioisotope of concern was cesium-137, although it was later discovered during the D&D phase that significant levels of strontium-90 existed within the flanged piping. Sediment in the cell area was sampled and found to contain elevated levels of polychlorinated biphenyl's (PCBs) at 410 ppm, and was co-contaminated with several heavy metals and a mix of transuranic radioisotopes. Cores were obtained from the cell floor which indicated that the cell foundation pad was approximately 4 ft thick and was comprised of several different pours. Minor amounts of non-friable asbestos were identified as being present in the gallery roofing material and window putty. Samples of soil found in the gallery crawlspace were analyzed and subsequently determined to contain low levels of mercury.

III. PROJECT HISTORY

Based on the results of the site characterization effort, an alternatives evaluation study was performed to determine the optimal plan of action for D&D of the WEF. Accordingly, the partial dismantlement alternative was selected. In this alternative, the above-grade portion of the facility would be dismantled, and building concrete removed during the demolition process could be used as backfill for the below-grade portions of the facility provided that it did not exceed pre-established radiological levels. Disposition of the remaining below-grade structure will be reconsidered during future anticipated remedial action efforts that would encompass the soil in this area. Partial dismantlement offered some benefits as well, such as minimizing the volume of generated waste. Deferred excavation eliminated the potential duplication of remedial actions in this affected area, and would permit more efficient larger scale methods to be utilized.

Complete dismantlement (removal of the entire structure, including the foundation) was determined to be undesirable for a variety of reasons. The depth required to exhume the entire facility would have had a potential for structurally impacting one of the Gunite tanks which resided only 15 ft away and contained a significant radionuclide inventory. Moreover, excavation would also have resulted in increased radiological exposure to D&D workers due to the extent of soil contamination in the immediate area, as well as posing additional health and safety risks which are inherent with this activity. The potential for impacting unknown underground utilities was another consideration.

After consultation with the U. S. Environmental Protection Agency and the Tennessee Department of Environment and Conservation, it was agreed that the WEF D&D project would be conducted as a non-time critical removal action under CERCLA, due to the facility's deteriorating condition creating a potential for release of contaminants to the surrounding area. The Engineering Evaluation/Cost Analysis (EE/CA) and Action Memorandum documented this decision and the preferred alternative.

The design for this project consisted of a Performance Specification and applicable environmental, health, and safety requirements. This approach was based upon regulatory defined project end-points, but left the method of implementation up to the demolition subcontractor. The project was also conducted under the auspices of Occupational Safety and Health (OSHA) regulation 29 CFR 1910.120 "Hazardous Waste Operations and Emergency Response".

Successful completion of this project was contingent upon effective communication and participation among the three primary participants, LMES, ATG, and Lockheed Martin Energy Research (LMER). LMER is a newly formed subsidiary of Lockheed Martin that is under contract to the DOE to manage and operate ORNL. LMES provided the overall project management and engineering services. LMER was responsible for Health & Safety and Environmental Compliance oversight, craft support from the Plant & Equipment group, Analytical Sampling Office services, waste management, and health physics coverage and support. ATG provided the work force, supervision, and health and safety coverage for implementing the D&D.

Upon completion of several site preparation activities and a readiness review stage, D&D was ready to commence late December 1995.

IV. D&D IMPLEMENTATION

The location of the WEF, being only 200 ft away from the site cafeteria, posed an interesting challenge. The large volume of site personnel that traversed by the WEF on a daily basis to access the cafeteria, was realized as being a problem early in the project planning stage. To effectively conduct this project, some method of isolating the facility from this high traffic area was necessary. ATG's solution was to totally enclose the WEF in a tent-like structure.

Decommissioning activities commenced with the construction of a durable, framed tent around the WEF. This tent provided a multi-purpose function; the protection of D&D workers from inclement weather (which included snow, ice, heavy winds, and rain), to serve as a contamination control boundary in addition to other engineering controls utilized, and to isolate the facility from the high traffic area. The tent minimized the potential for release of contaminants and dust into the environment during the demolition process. A smaller interlocking tent was fabricated to provide a buffer zone for personnel to don and doff personal protective equipment.

After erection of the tent, the exterior of the WEF was addressed. Lead-based paints were predominantly used during the 1940's for ORNL facilities. Due to age and natural weathering, the lead painted exterior walls were severely peeling. This loose paint was scraped off, collected and contained, and managed as a mixed waste. Various components on the exterior of the building were removed with the assistance of acetylene torches, electric saws, and other hand and power tools. The exterior components removed consisted of stairs, railings, platforms, piping, lead shielding, and electrical boxes.

Demolition efforts now shifted to the gallery of the WEF. The hazardous materials of concern in this area were asbestos containing materials (ACM), lead shield plates, radiological contamination, and mercury contaminated soil. ACM in the gallery area were limited to the window glazing and roof felt. The area was sprayed with water and the ACM removed, contained, and managed according to governing regulations. Based on air sampling results, the Permissible Exposure Limit (PEL) was not exceeded at any time. All doors, windows, and other wood materials were then removed. These items were determined to be radiologically contaminated and were disposed of as radioactive waste. The east gallery wall consisted of several layers of cinder blocks which were removed with the use of a sledgehammer. The cinder blocks and associated rubble were set aside to eventually be used as fill material for the below-grade portion of the facility. The west wall, which was common to both the cell and gallery, would be removed later on in the project.

The crawlspace under the gallery was considered a confined space. As such, a full-body harness connected to an electric hoist was worn and continuous atmospheric-monitoring was performed to ensure safe working conditions. Additionally, full-face respirators were required along with continuous monitoring with a mercury vapor analyzer due to the known presence of mercury in the soil. Numerous pipes and flanges were contained in the crawlspace, and these were all removed. Precautions were taken to collect any liquid that may have still been present within the piping. Collected liquid was subsequently sampled and determined to be free of contaminants. Once all these activities were completed, the removal of the mercury contaminated soil could begin. This soil was excavated down to the level of the building footer, with a resulting volume of approximately 90 cubic feet. Since mercury was present at levels just above the regulatory limits and some radioactive contamination was present, this material was handled as a mixed waste.

D&D efforts now focused on the cell area. The only access to the cell was from the roof, which was covered by stainless steel deck plates. Therefore the cell area was also determined to be a confined space. Rainwater entered and collected in the cell area via the gaps between the deck plates. Several hundred gallons of rainwater were present when the cell was accessed, and was subsequently pumped to the ORNL process waste treatment system due to the limited amount of radioactive contamination. Sludge remaining on the cell floor after water removal, was sampled and found to be contaminated with heavy metals, high levels of PCBs, and a mix of radioisotopes including several transuranics. The sludge was scraped up, placed in a drum with an overpack, and managed as a Toxic Substances Control Act (TSCA) waste. The interior of the cell was scrubbed several times with a PCB cleaner, sampled, and verified free of PCBs. A strong industrial cleaner was used to decontaminate the cell interior to reduce the levels of transferable radioactive contamination.

Although all equipment had already been removed from the cell area (except for a filter box), there were still many pipe flanges, brackets, lead shielding plates, and other protuberances present. In order to maximize the available space for placing building concrete in this below-grade area, these obstructions were removed with electric saws and a torch. Extreme caution was exercised when removing or opening the flanges due to the presence of high levels of internal contamination. Upon removal of the filter box, elemental mercury mixed with water was discovered, and they were managed as mixed wastes.

The technology selected for segmenting the reinforced concrete walls (2-3 ft thick) was the diamond-wire saw. This type of cutting system offered several advantages such as the ability to cut difficult shapes or unusual geometries, the capability to cut long and thick sections, and a resulting smooth surface finish that would not allow any rebar to protrude.

The walls were prepared for saw cutting by coredrilling holes at various strategic locations. A small nozzle at the end of the coredrill sprayed water onto the cutting area which provided lubrication and minimized any airborne contamination. A diamond-beaded steel cable was threaded through the holes and connected to a pulley system which led to a hand controlled motorized saw. The cable rotated through the openings at a high rate of speed, cutting the concrete and rebar in a smooth line as opposing pulleys closed in on each other. As with the coredrilling, water was used as a lubricant and dust suppression mechanism, and was recycled throughout the cutting process. Slurry generated during the cutting was contained within plastic coverings and dikes. Full-face respirators were worn throughout this process, although air samples and daily smear surveys showed no sign of airborne radioactive material. Processing rates varied depending on the geometry of the cut, but in general, a 4 x 4 ft wall section would be completed in less than 2 days with most of this time allocated to set-up of the system.

The cell wall sections were cut into manageable pieces and placed within the below-grade area of the cell. The cinder blocks and rubble from the gallery section were used to fill any remaining void spaces. The gallery floor was cut into sections and anchor bolts were installed into each section to enable a crane to safely and slowly lower the cut floor into the crawlspace area. This action was necessitated by the presence of an underground ceramic tile pipe chase which ran the entire length of the crawlspace. The remaining gallery walls were then cut with the diamond-wire saw and placed onto the floor sections.

Since the volume of void space in the below-grade portions of the building was limited, concrete pieces were remaining. These pieces were either excess or exceeded pre-established radiological levels (defined as being less than 6000 dpm/100 cm^2 alpha and less than 5.0 mrad/h beta/gamma) that disqualified them for below-grade placement. The pieces were surveyed, wrapped in plastic, and placed in a staging area for potential use by other remedial action projects. Several blocks were determined to be clean (per the surface contamination levels specified in DOE Order 5400.5) and were transported to the sanitary landfill.

Site restoration began once the remaining concrete pieces were removed. Final restoration consisted of placing layers of sand, a geomembrane, dirt, and gravel over the below-grade area. The containment tent was left in place to serve as a storage area for the excess blocks, and as a staging area for the adjacent Gunite tank remediation project.

V. CONCLUSIONS

Total duration for implementation of the D&D field work was 6 months. Overall project implementation costs for all participants came to approximately $1.0 million. Both schedule and cost were within expectations. Several regulatory groups, including DOE, inspected the site during the course of D&D operations, with no findings or violations cited.

Waste minimization was a priority for this project, and the practices established by ATG proved very successful in this area. A household trash compactor was purchased for the WEF project, and was used for minimizing the volume of compatible waste such as personal protective equipment (PPE), plastic, etc. This novel approach resulted in a volume reduction factor of 3. ATG personnel worked 10 hr days with minimal breaks, and this dramatically reduced the volume of PPE and radioactive waste generated. Water used in the cutting process was recycled to the maximum extent possible, and the resulting slurry was used to fill void space in the below-grade portion of the facility.

Respirators were worn throughout the project due to the frequently changing conditions that had the potential to generate airborne contamination. All air samples collected indicated that exposure limits were not exceeded for lead, asbestos, mercury, or radiological contamination. Confined spaces were continuously monitored and no hazardous atmospheres were encountered.

Limited decontamination was performed on this project, mostly in an effort to free release materials. Attempts were made to decontaminate concrete, lead shielding, and steel deck plates, but this proved to be not economically beneficial due to the pervasive extent of contamination. Site characterization results indicated that a large portion of the building would be capable of being released as free of radiological contamination, but in actuality this was not the case. Most of the metal surfaces had detectable activity after the outer layer of paint had been removed, indicating that the exterior of the building had been exposed to airborne contamination from prior operations and this contamination was fixed in place by the application of paint. Several other unforeseen site conditions were encountered such as the discovery of elemental mercury and the presence of liquids within flanged piping. Future site characterization efforts need to consider these particular areas of concern.

The restored site is currently being used by the Gunite tank remediation project as a storage and laydown area, so productive use is being made of a former contaminated site. Successfully accomplishing the WEF D&D effort was a result of an integrated teamwork approach of which cooperation, communication, and recognition are vital elements.

Fig. 1. The Waste Evaporator Facility during the site characterization phase

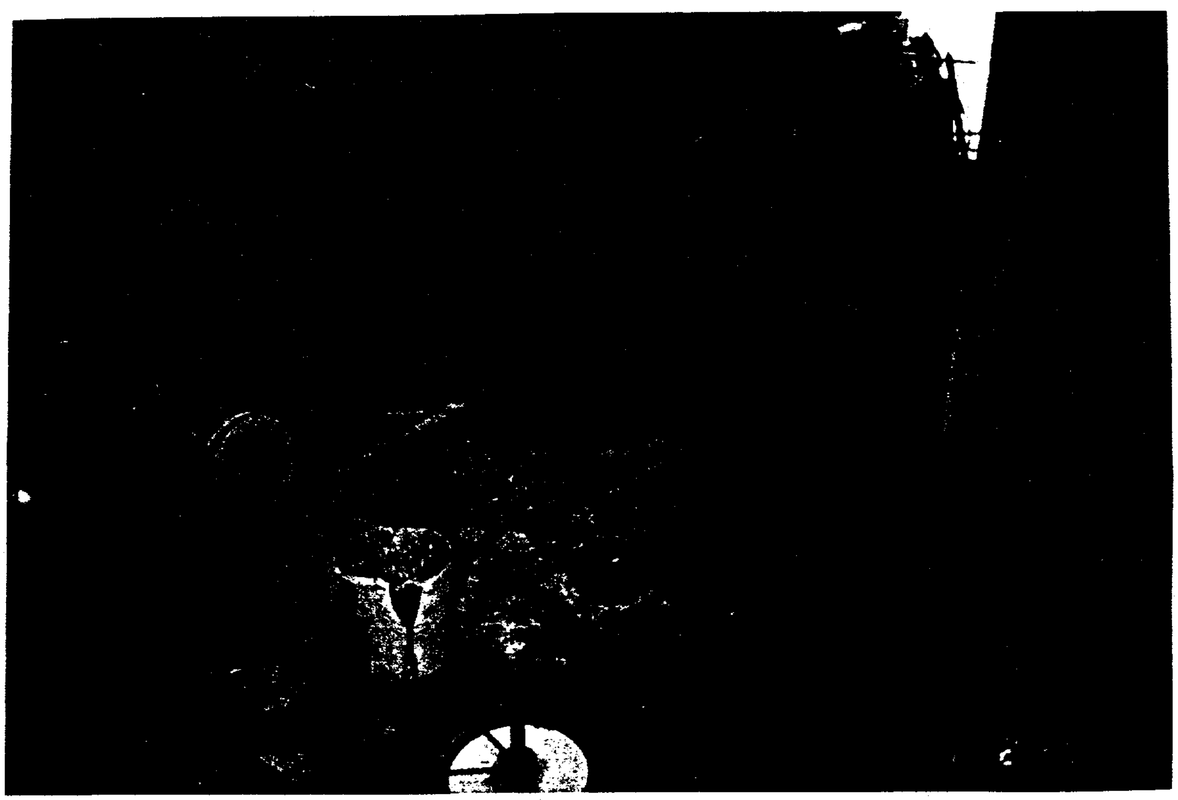

Fig. 2 Utilization of the diamond-wire saw to segment concrete walls

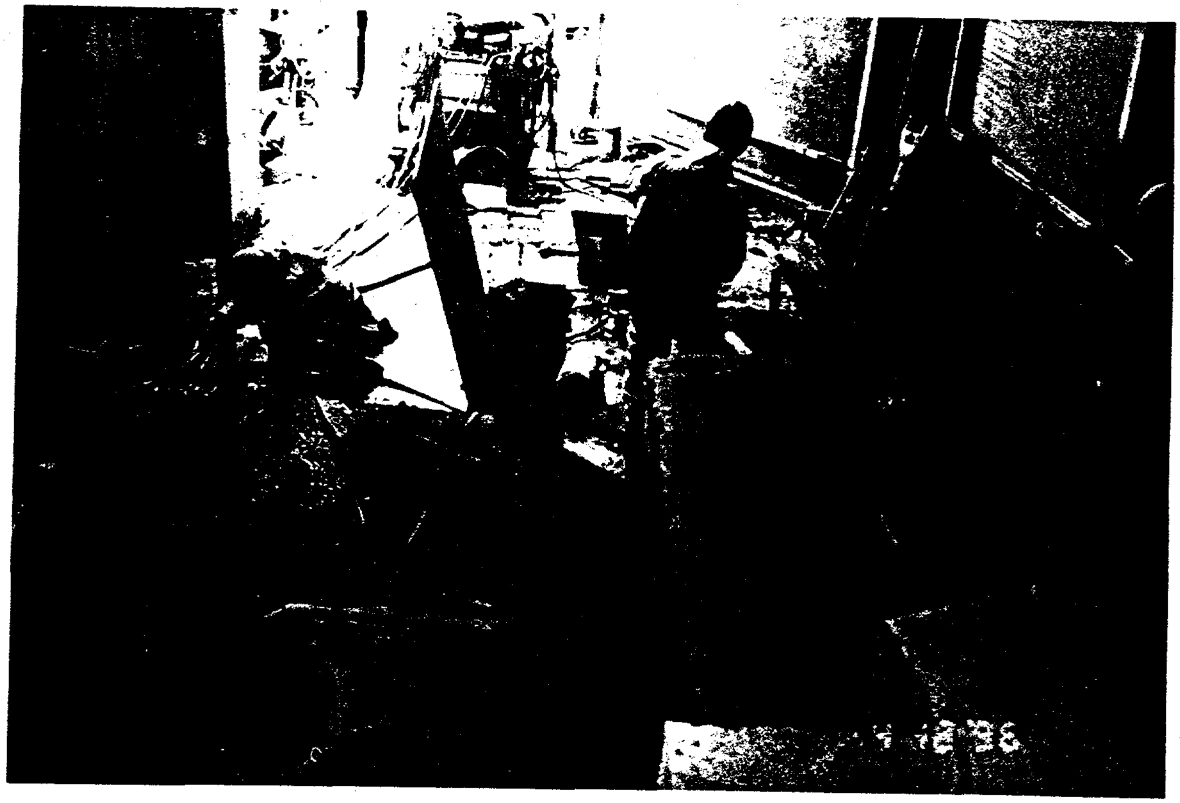

Fig. 3   Placement of building concrete in the below-grade cell area

Fig. 4   View of the Waste Evaporator Facility area after completion of site restoration