

EAST TENNESSEE TECHNOLOGY PARK ACCELERATED CLOSURE

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ABSTRACT

This paper reviews the accelerated closure of East Tennessee Technology Park on the Oak Ridge Reservation in Oak Ridge, Tennessee. The U.S. Department of Energy and its closure contractor, Bechtel Jacobs Company LLC, have taken a ground-breaking approach that will result in substantial taxpayer savings and accelerate the closure process by 8 years. This new approach focuses on rapid risk reduction and mitigation of hazards. It also presses forward with the transfer of surplus facilities to private businesses, resulting in the twin benefits of additional taxpayer savings and job creation.

The process is illustrated by five specific projects: (1) decontamination and demolition of the original gaseous diffusion plants, known as K-25 and K-27; (2) demolition of facilities in the Main Plant area; (3) removal of burial ground K-1070-A, which had been a source of groundwater pollution; (4) removal of nearly 6,000 aging cylinders containing depleted uranium hexafluoride; and (5) reindustrialization of the site to create jobs and save ongoing maintenance expenses.

INTRODUCTION

The East Tennessee Technology Park (ETTP) Closure Project has taken an innovative approach to retiring the nation's first gaseous diffusion plant and turning the facilities over, where possible, for use by private business. The project has turned its focus to rapid risk reduction and mitigation of hazards while producing substantial taxpayer savings and accelerating the schedule by 8 years over earlier plans.

ETTP, formerly known as the Oak Ridge Gaseous Diffusion Plant and as the Oak Ridge K-25 Site, was built during World War II under the Manhattan Project to enrich uranium using the gaseous diffusion process. It carried out this task during World War II and the Cold War, providing enriched uranium for both military and civilian use. Some operations at the plant have been shut down for nearly 3 decades, and the entire production mission ended more than 15 years ago.

Hundreds of facilities and thousands of acres of land were contaminated during the facility's active life. In addition, thousands of cylinders containing depleted uranium hexafluoride (DUF_6) and thousands of cubic meters of legacy waste were stored on site.

This paper looks at several important aspects of the ETTP Closure Project, focusing on five projects: decontamination and demolition of the original gaseous diffusion facilities (the K-25 and K-27 buildings), demolition of seven facilities in ETTP's Main Plant area, removal of burial ground K-1070-A, which had been a source of groundwater pollution, removal of nearly 6,000 aging cylinders containing DUF_6 , and efforts to revitalize ETTP as an economic engine by providing reusable facilities to private industry.

BUILDINGS K-25 AND K-27 DECONTAMINATION AND DEMOLITION

Building K-25 was the original U.S. gaseous diffusion process facility for the separation of uranium isotopes. Construction began in 1943, and the entire building was placed on-line in August 1945. K-25

covers a footprint of 1.6 million square feet, or about 40 acres, near the center of ETTP. The building has 54 units.

K-27 is a 374,000-square-foot building located southwest of K-25. It was built and placed in operation in 1946 and contains nine units. Except for their size and shape—K-25 is U-shaped, while K-27 is rectangular—the two buildings are very similar with respect to materials and construction techniques.

Decontamination and demolition of the two buildings will take place in three phases. The first phase is in progress and involves the removal of asbestos and other hazardous materials. At this point, asbestos removal is more than 50 percent complete, and the job is expected to be finished in September 2005.

In the second phase of work, the process equipment and piping will be removed from the two buildings and sent for disposal to the Environmental Management Waste Management Facility (EMWMF), an engineered disposal facility on the Oak Ridge Reservation (ORR) designed to accept waste generated during cleanup, and to the Nevada Test Site (NTS). Equipment and piping that meet the EMWMF waste acceptance criteria (WAC) will be transported there without further processing. Depending on the effort required, equipment and piping that do not meet the EMWMF WAC will either be decontaminated to qualify it for disposal at EMWMF or will be sent to NTS. All told, the buildings contain 3,564 converters, 6,764 compressors, 927 transformers, 630 switchgears, 3,408 panel boards, 23,600 control boards or racks, and 4.2 million feet of piping.

Bechtel Jacobs Company LLC (BJC) established a Construction Management team in October to manage equipment removal.

BJC has determined that the project does not pose a mechanical challenge. Instead, the greatest challenges will be in the areas of nuclear criticality, security, nuclear material control and accountability, and nuclear facility safety. Other uncertainties include the characterization of technetium-99 and logistics for waste management and transportation.

The third phase of the decontamination and decommissioning (D&D) work will be dismantlement and removal of the non-process equipment and demolition of the buildings. Following the removal of the process equipment, the buildings will be reclassified from nuclear facilities to radiological facilities. This reduces the level of rigor for working within the building systems. All systems that have not been deactivated in Phases 1 and 2 will be disconnected (e.g., fire water, telecommunications, and radiation alarms). Then the non-process equipment (e.g., electrical equipment, instrumentation, lube oil tanks and piping, and coolant tanks and piping) will be dismantled and dispositioned. Some systems, such as heating, ventilating, and air-conditioning ducts and electrical conduit, will be removed as part of the building demolition activities.

After most of the equipment and piping have been removed, the building structures will be decontaminated, if necessary, to remove loose contamination. Demolition will involve a combination of industry standard mechanical or explosive techniques commonly used for razing structures.

The buildings will be demolished down to the top of the basement slab. The concrete slabs and retaining walls will be left in a structurally stable condition. Building debris will be reduced in size, segregated, and analyzed before disposal. Building debris that has no Resource Conservation and Recovery Act of 1976 or Toxic Substances Control Act of 1976 constituents and that is below the radiological release criteria specified in U.S. Department of Energy (DOE) Order 5400.5 will be reused or disposed of in the ORR construction/demolition landfill. Clean structural steel will be released to a scrap metal recycler or a DOE recycle operation, if available.

Following removal of the construction debris, all penetrations in the basement slabs and retaining walls will be tiled with cement grout or a similar material. The slabs and retaining wall will be surveyed for radiological contamination and decontaminated if necessary. Surface sealant may be applied to the slab surfaces to fix contamination, minimize airborne particulates, or minimize surface erosion. If necessary to achieve structural stability, backfill will be placed in front of the retaining walls, and the area will be graded. A radiological survey of the buildings will ensure residual contamination is within acceptable exposure guidelines. Future land uses for the impacted areas will be controlled until a final remedial action is taken to address the subsurface structures and underlying and surrounding soils.

K-1070-A REMEDIATION PROJECT

The K-1070-A remedial action removed a 1-acre burial ground as a source of groundwater contamination at ETTP. The project, carried out between June 2002 and June 2003, removed 28,509 tons of low-level radioactive waste, or more than 21,000 cubic yards. The waste was sent to EMWMF. The project also removed 10 cylinders that may have contained uranium hexafluoride (UF₆) and were sent to NTS.

The work was completed without accident or injury. More than 70,000 hours were worked without a lost work day, recordable injury incident, or first aid case.

The burial ground, located at the northwest corner of ETTP, consisted of 26 unlined trenches and 62 unlined circular pits that had been used primarily to contain uranium-contaminated waste from ETTP and other operations. These trenches and pits contained leached alumina, waste from process and laboratory sources, contaminated containers (including UF₆ cylinders), scrap metals, and waste from construction sources. Because the waste was radioactively contaminated, it was categorized as low-level radioactive waste.

No cleanup standards for environmental media were identified for this cleanup action because the project was designed only to remove the source of contamination. Existing groundwater contamination at the site will be addressed in future decisions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The selected remedy for the project was to excavate the waste and dispose it in an approved disposal facility. Contaminated soil commingled with the waste was also removed, as was visually discolored and disturbed soil adjacent to and underlying the trenches and pits.

With the exception of two low-specific-activity boxes, the waste was considered to be unclassified. The two suspect boxes of waste were transferred to a secure area of ETTP until classification issues could be resolved; this waste was eventually declassified and sent to EMWMF.

The waste and subsurface soil were sampled and analyzed at various depths from 0 to 12 feet before the removal began. Major components of the action included the following:

- site preparation;
- waste characterization;
- excavation, loading, management, transportation, and disposal of waste;
- residual soil characterization of subsurface soil following excavation to support future CERCLA decision-making for the site;
- backfilling of excavated areas with clean fill;
- segregation, nondestructive assay, and processing of intact cylinders; and
- site restoration.

After the waste was removed, samples were collected to characterize subsurface soil and support future CERCLA decisions. A residual materials survey was performed within the completed excavation footprint and sidewalls. In addition to the radiological survey, soil samples were collected for radiological and chemical analyses. No known unacceptable residual risk from soils remains for the uncontrolled industrial land use within the K-1070-A Burial Ground.

The project was completed at a cost of \$15 million, which was \$2 million under budget.

MAIN PLANT DECONTAMINATION AND DECOMMISSIONING PROJECT

The Main Plant D&D Project removed seven CERCLA facilities located at ETPP and demolished them to grade. The project also removed a fluorine and UF₆ process vent line located on an overhead rack between the facilities.

D&D of the facilities was necessary to reduce risks to the environment and the public from releases of radiation and hazardous substances. The removal action, carried out between August 2000 and December 2003, included characterization, decontamination, demolition, material and waste disposition, and site restoration to a maintainable condition. More than 12,000 cubic yards of waste were disposed under the project, which carried a subcontract cost for the project of \$5.8 million.

After a facility was demolished, its slab was surveyed for radiological contamination. If the slab was contaminated, it was scabbled in an attempt to remove any fixed contamination. If scabbling did not remove the contamination sufficiently, then other measures were taken, such as placement of a cap on the slab. The final state for the slabs or soil is removable alpha and beta contamination below the DOE 5400.5 limit of 1000 disintegrations per minute (dpm), and total alpha and beta below 5000 dpm.

The seven facilities were as follows:

The K-1300 brick vent stack was demolished in September 2002. The aboveground plenum was encapsulated and removed first, and then a crane with a wrecking ball was brought in and used to knock the stack over. The stack was covered with plastic in accordance with the "as low as reasonably achievable" review, sampled, and shipped to EMWMF. The aboveground plenum did not meet the EMWMF WAC and was sent to NTS. The slab is contaminated and, due to the irregular surface, was capped in September 2003 without scabbling.

The K-1301 fluorine production facility was demolished, and the demolition debris was containerized for disposal and shipped to the Envirocare Facility in Clive, Utah. The equipment located inside the production facility was removed prior to demolition and containerized for disposal at the Envirocare facility. A post-demolition survey revealed areas of fixed contamination, which were scabbled. Scabbling was unsuccessful on a portion of the slab, which was capped with a 2-inch layer of asphalt.

The K-1302 fluorine storage facility contained five fluorine tanks and an underground plenum that connected to the K-1300 stack. The fluorine tanks were removed prior to demolition, surveyed, and sent for processing to TOXCO, an on-site recycler. The waste from the facility was sent to EMWMF except for the used chemical traps, which were sent to NTS. The slab was contaminated and, due to the irregular surfaces, was capped without scabbling. Caps were placed over the entry ports in the underground plenum to ensure no water infiltration into the underground plenum.

The K-1303 fluorine liquefaction facility was demolished after equipment was removed from the facility. The building debris and metal debris were placed in intermodals and sent to EMWMF. The slab was

above grade and was removed, and the area was surveyed and reseeded. Samples collected from the area under the slab will be used in the site-wide Record of Decision.

The K-1405 high-temperature laboratory was demolished, with demolition debris containerized for disposal and shipped to the Envirocare facility. Equipment located inside the laboratory was removed prior to demolition and disposed at the Envirocare facility. The slab under the building had already been capped due to high levels of contamination; however, during demolition some of the cap was damaged. Therefore a 2-in. layer of asphalt was placed over the building slab to ensure no migration of removable contamination. A small area of contamination beside the baghouse was scabbled.

The K-1407 laboratory and storage facility was demolished. The equipment located inside the laboratory and storage facility was removed prior to demolition. The equipment and the demolition debris were containerized for disposal and shipped to the Envirocare facility. The K-1407 upper slab failed when a trackhoe was placed on it. The slab was removed and disposed in the DOE construction and demolition debris landfill. A post-demolition survey revealed areas of fixed contamination on the lower slab, which were scabbled to remove any fixed contamination, and a 2-in. layer of concrete was applied to ensure no migration of removable contamination. The K-1407-D calcium hydroxide tank and the K-1407-L sulfuric acid tank were removed, crushed, and disposed at the nearby DOE sanitary landfill.

The K-1413 laboratory was demolished. The fluorine system was purged prior to demolition, and the equipment was removed. The waste from the facility was sent to EMWMF. The classified waste was sent to NTS. The slab was scabbled and capped.

The overhead fluorine pipes were removed and sent to EMWMF. The overhead vent lines were also removed, size-reduced, and sent to NTS. A small section of pipe remains, which will be removed with the K-1401 facility demolition. This pipe was not removed during this project because the pipe rack and supports would have had to be removed, and there are active pipes in this support. A permanent cap was placed over this pipe.

URANIUM HEXAFLUORIDE CYLINDER DISPOSITION PROJECT

ETTP was the original gaseous diffusion plant, enriching uranium for both military and civilian uses between 1943 and 1985. One by-product of this process was DUF_6 , of which ETTP is currently home to about 5,800 cylinders.

Nationwide, the DOE has more than 500,000 metric tons of DUF_6 , which is stored primarily at the facilities where it was produced: ETTP, the Portsmouth Gaseous Diffusion Plant in Ohio, and the Paducah Gaseous Diffusion Plant in Kentucky. Enrichment operations at Portsmouth and Paducah have been transferred to the U.S. Enrichment Corp., but DOE retains responsibility for managing the DUF_6 cylinders.

The cylinders at ETTP are of many different designs. Some are overfilled, and some are above their allowed internal pressure. In addition, DUF_6 cylinders are placed into several different categories, depending on the makeup and mass of their contents.

Cylinders with the lowest mass are known as "empty" or as having "heel" quantities. Empty cylinders contain residual uranium compounds other than UF_6 . All such cylinders at ETTP were shipped to NTS and to Envirocare of Utah between 2001 and 2003.

"Heel" cylinders fall within a set mass limit and contain a very small amount of UF_6 and possibly other uranium compounds. At this point, they may be shipped without a protective overpack, but new U.S. Department of Transportation (DOT) regulations are expected by January 2005 that would require

all of the ETTP cylinders to be shipped in protective overpacks capable of withstanding a fire of 800 degrees centigrade (1472 degrees Fahrenheit) for 30 minutes. ETTP must remove the DUF₆ cylinders in its possession in order to complete closure of the site. In April 1999, DOE issued a programmatic environmental impact statement focused on its inventory of DUF₆. DOE has decided to convert the material to a more stable form as soon as practicable.

To carry out this decision, DOE decided to build conversion plants at the sites of the gaseous diffusion plants in Ohio and Kentucky. The two plants are about the same distance from ETTP, approximately 300 miles, and will be operated by Uranium Disposition Services. In October 2002, DOE decided that the ETTP cylinders will be shipped to Portsmouth. In September 2003, DOE awarded a contract to BJC for accelerated closure of the ETTP site, including responsibility for shipping the containers. Shipment of the cylinders had been expected to begin in mid-2003 but had been delayed because of a disagreement between DOE and state regulators in Ohio. Resolution of these differences is expected soon, allowing shipments to begin in 2004.

BJC has also proposed a plan to save money by shipping some of the cylinders by barge to Paducah. The company made this proposal in a December 2003 letter to DOE, arguing that the move could save up to \$35 million in shipping costs and improve safety. Because barges are slow moving, covered, and free of onboard hydrocarbon fuels, barge-only transport creates a strong safety case for DOT to exempt the entire cylinder population from the need for overpacks and American National Standards Institute compliance inspections (fire, especially hydrocarbon fuel fires, are thought to pose the greatest safety risk to UF₆ cylinders). Transportation by barge avoids movement over public highways and exposure to vehicles moving at high speeds. Early removal of cylinders from the ETTP offers a substantial reduction of safety and security risks at the ETTP. A decision on this proposal is also expected soon.

Whichever site receives the ETTP cylinders, plans are in place to convert material contained in 48-inch diameter depleted assay cylinders to an oxide form in the next 25 years at the two conversion sites. Converted material will then be shipped to final land disposal at NTS or Envirocare of Utah. The ETTP cylinder population includes about 4,700 cylinders eligible for conversion, and the 1,100 ineligible cylinders include 48-inch diameter and smaller cylinders, including some depleted, normal, and enriched assays in heel, partially full, and full cylinders.

The Tennessee Department of Environment and Conservation (TDEC) and DOE have signed a commissioner's order requiring ETTP's cylinders to be removed by the end of calendar year 2009. Current plans, however, call for the cylinders to be removed before the end of 2006, at least 3 years before the consent order deadline.

REINDUSTRIALIZATION PROGRAM

ETTP, via the Reindustrialization Program, has a unique opportunity to save money for the taxpayer, provide jobs in an area that has been hard hit by DOE cutbacks, and provide new businesses with massive and valuable industrial facilities complete with a well-developed infrastructure.

The ETTP Closure Project is pursuing these opportunities through the ETTP Reindustrialization Program, a groundbreaking partnership between DOE, its environmental regulators, BJC, and the community. So far, the program has led to the decontamination of 4.6 million square feet of facility space while leasing 1 million square feet of space and recycling 47,000 tons of materials and equipment. Currently, about 40 businesses lease space at the former Oak Ridge Gaseous Diffusion Plant. All told, more than 1,200 jobs with an annual payroll of \$40 million have been created either through leasing activities or through employment related to three major cleanup contracts.

Until recently, DOE leased facilities to the Community Reuse Organization of East Tennessee (CROET), an agency created to manage the transfer of property. CROET in turn subleased the property to private businesses. Under the Accelerated Closure Contract for ETPP, however, CROET will receive title to transferred properties. Twenty-six such properties currently exist, representing about 6 million square feet of floor space.

CONCLUSION

By focusing on rapid reduction of risks and on the mitigation of existing hazards, DOE and BJC have taken an innovative approach to cleanup that will result in substantial savings in both time and money. By pressing ahead with the transfer of surplus facilities to private businesses, the approach will also save money as well as providing new jobs in the region.