



The on-site EMWMF waste facility is an above-grade waste disposal facility that is authorized to receive low-level radioactive and other regulated wastes from cleanup work associated with the Oak Ridge Reservation. (Photos courtesy of UCOR)

# The Waste Factory Approach

Meeting the formidable waste management challenges  
at Oak Ridge's East Tennessee Technology Park  
using on-site resources.

By John Wrapp

**O**ver its 75-year life, the 2,200-acre East Tennessee Technology Park (ETTP) in Oak Ridge, Tenn., has seen unprecedented transformations—from weapons production facility to environmental cleanup site to multiuse industrial park.

In 1942, the rolling hills of east Tennessee became part of the most significant defense initiative in the history of the United States—the Manhattan Project. Within 18 months, a 44-acre concrete and steel facility, known as K-25, replaced the rural landscape. The plant would enrich uranium using the gaseous diffusion process.

Ultimately, K-25's product would fuel one of two atomic bombs that would end World War II. Over the next decade, another four uranium enrichment facilities joined K-25. For more than 40 years, the site evolved and adapted to meet the nation's changing defense and energy needs.

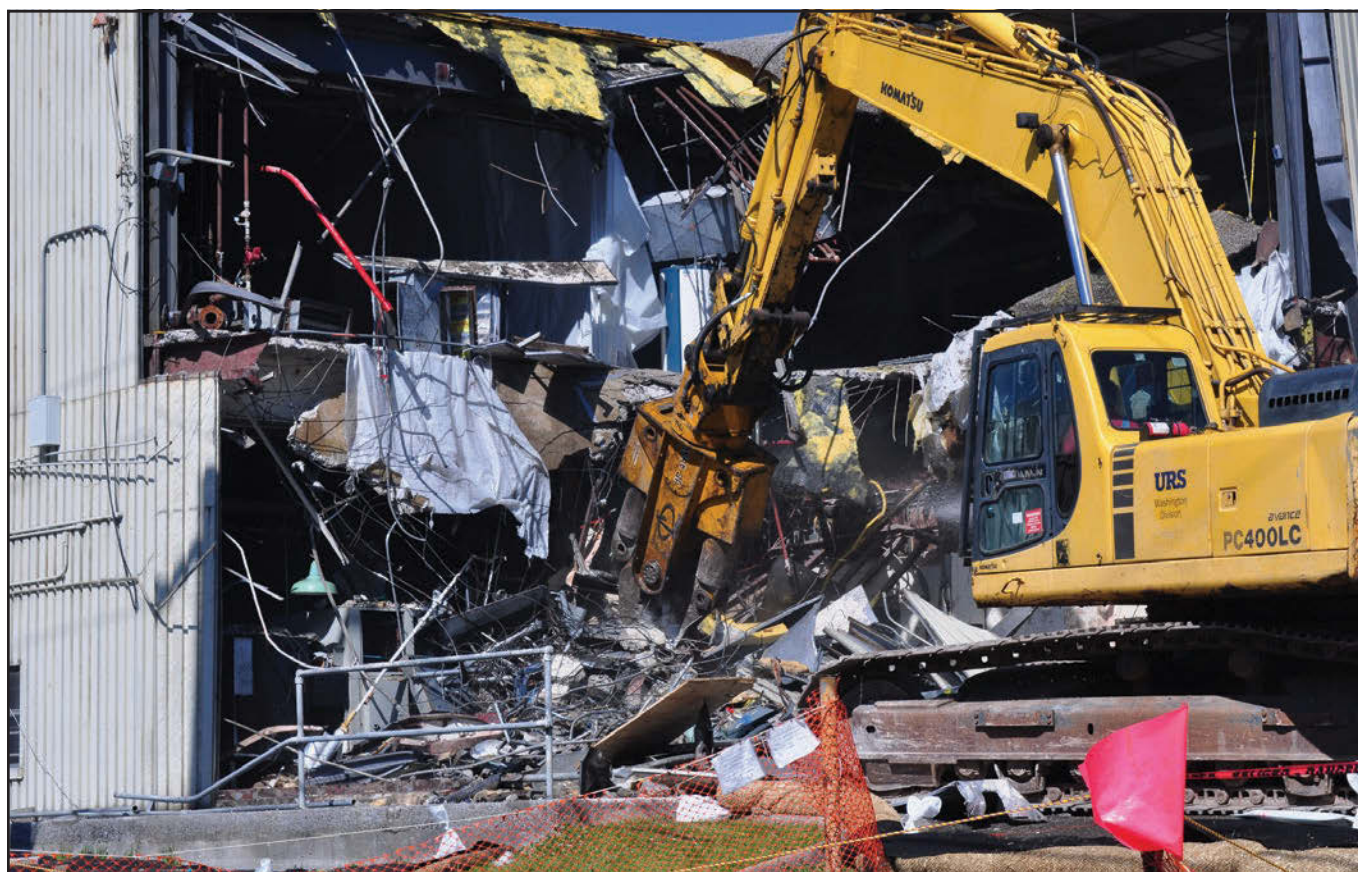
In 1985, uranium enrichment activities ceased at the site and a new mission emerged. The Department of Energy, the site's owner and operator, turned its focus to the cleanup of the environmental legacies created by Oak Ridge's industrial processes. By the mid-1990s, a comprehensive cleanup strategy was in place, and the DOE announced its long-term vision for the site as a private-sector industrial park. Through a process known as reindustrialization, infrastructure and restored lands and buildings were transferred to private entities for redevelopment and reuse.

Now, in the final chapter of one of the nation's largest environmental cleanup projects, all five enrichment buildings have been demolished. Crews have begun work to remove the site's remaining structures and restore contaminated land. Their work will include closure activities that fulfill the DOE's cleanup obligations and completing the transfer of lands and properties for redevelopment and reuse.





A truck is loaded with demolition debris for transfer to Oak Ridge's EMWMF.



An inoperative Oak Ridge building is torn down. Since August 2011, the DOE and UCOR have completed 67,850 shipments containing 784,878 y<sup>3</sup> of waste without injury or release to the environment.

## Cleanup challenges

As a former uranium enrichment plant site, the ETPP presents many formidable cleanup challenges. Buildings planned for demolition are laced with radioactive materials and years of unregulated waste disposal practices have polluted the soil and groundwater. The extent of contamination was not fully known, and the unsafe, deteriorated condition of many of the structures forced many delays in demolition.

Demolition of the site's centerpiece—the K-25 gaseous diffusion plant—was the largest teardown ever undertaken within the DOE complex. The building enclosed some 2 million square feet of space—44 acres under one roof—making it the largest building in the world at the time. Because it was contaminated with radioactive materials and was in a deteriorated state, its demolition was a high priority for the DOE.

Four other massive gaseous diffusion facilities known as K-27, K-29, K-31, and K-33 were also demolished as part of the site cleanup.

## The waste factory

When DOE contractor URS CH2M Oak Ridge (UCOR) began its role to support the department's unprecedented environmental cleanup at ETPP, it was continually challenged regarding how to handle tons of debris and discarded equipment that was once part of this historic national security complex. A large part of the answer, and a key factor in the success of the cleanup, lay in an innovative "waste factory" approach that offered streamlined waste handling, transportation, and permanent on-site disposal.

In disposing of low-level radioactive and other wastes from demolition activities, the approach relied on the availability of on-site facilities to streamline disposal, reduce costs, and enhance cleanup schedules while confining shipments and attendant hazards on-site.

The waste factory approach has demonstrated exceptional value and benefits and has proven worthy of consideration as a model for waste management operations across the DOE complex and in other industries where significant quantities of waste must be disposed of. Without the availability of dedicated haul roads and secure disposal on-site, the DOE would have been forced to send hundreds of millions of pounds of waste by truck to repositories across the country, increasing costs and slowing cleanup.

As an example, assuming that a typical road shipment to an off-site facility could range from 25 to 75 cubic yards, the number of shipments through the surrounding counties and communities across the country could range from 1,200 to 3,700 per year. This equates to six to 18 shipments per day. The substantial cost required for cross-country transportation would have resulted in fewer cleanup activities in Oak Ridge and added years to the cleanup schedule.

On-site disposal also greatly enhances safety. Since August 2011, the DOE and UCOR have completed 67,850 shipments containing 784,878 y<sup>3</sup> of waste, traveling 4.5 million miles without injury or release to the environment.

Strict waste acceptance criteria governed the type of wastes that were disposed of on-site. For the most part, the wastes comprise soil, sludge sediments, solidified waste forms, stabilized waste, vegetation, building debris, personal protection equipment, and scrap equipment.

Inevitably, some waste that does not meet the on-site waste acceptance criteria must be shipped to other locations for disposal,





A sodium shield at Oak Ridge's ETPP awaits disposition.

but it is a small amount. Approximately 95 percent of the volume of cleanup waste on the Oak Ridge Reservation is stored on-site, while only about 5 percent has been disposed of off-site. At the same time, only about 15 percent of the radioactive curie content has been disposed of on-site, while 85 percent is being disposed of off-site.

## Work scope

When UCOR assumed responsibility for the cleanup of ETPP in 2011, one of the first tasks was to survey the site to discover any outstanding issues and hazards that might not have been identified in the initial scope of work. Any major issues that were uncovered as part of this standard due diligence exercise are termed “material differences” and are addressed with a contract modification. With the DOE agreement, additional work scope is added to the base contract along with the funding necessary to complete the tasks.

One set of material differences identified in the early days of UCOR's contract with the DOE involved assorted legacy waste items scattered across the site but not captured as part of the contract's cleanup scope. The waste ranged from clean surplus steel ready for recycle to abandoned waste tanks, hazardous

chemicals, and radioactive-contaminated equipment.

After negotiating a contract modification, UCOR went to work cleaning up the waste, a task that has just been completed as the DOE work agreement enters its sixth year. Most of the waste was not associated with specific projects but were random equipment and materials considered stray hazards that still constituted a threat to the environment, as well as the health and safety of employees and the public.

Cleaning up legacy waste poses special challenges that are not encountered in a pack-as-you-go approach to managing new waste and debris that are generated in the demolition process. If waste is not disposed of at the time it is generated, the cost and complexity is much higher and more difficult.

One primary reason is that it is often difficult to know exactly what is in old waste containers that have been stored for years. It takes time to examine the containers and determine what is inside. The possibility of exposure to workers is much higher because of the unknown. It is a meticulous process that requires a container-by-container inspection and characterization. The overall cost associated with characterizing legacy waste is generally much higher because of the unknown nature of the waste and, in most cases, has to be done on an individual basis versus a waste-stream basis.

Once the waste was characterized, it was prepared for disposal either on-site in the Environmental Management Waste

Management Facility (EMWMF) or the Oak Ridge Reservation sanitary landfill. Some waste was shipped to the Nevada National Security Site for disposal.

## Waste streams

On another front, the DOE seeks the safest, most environmentally protective and fiscally responsible treatment for its large inventory of radioactive-contaminated metals known as “shields.” Sixty-six sodium and lithium shields were constructed for use in experiments at the Tower Shielding Facility (TSF) at Oak Ridge National Laboratory. The TSF operated from 1954 to 1992 and was designed and built for radiation-shielding studies.

The shield containers are constructed of aluminum or stainless steel of varying sizes and shapes that were then filled with either sodium metal or lithium hydride material. The sodium and lithium shields were initially used at the TSF to perform in-depth measurements of the neutron transport through the shield materials. Based on process knowledge, the shields are managed as radiologically contaminated containers. Efforts have been made over the last 15 years to find recycle markets for both the sodium and lithium hydride shields. This includes an on-site operation that was initiated at ETTP in 2004.

The amount of time needed to reasonably identify safe disposition or recycling outlets for the shields was expected to exceed the DOE’s one-year land disposal restrictions storage time limit; therefore, approval was received to add the shields to Oak Ridge’s site treatment plan in March 2017.

Until a disposition path is determined, the shields will continue to be stored in a safe configuration that protects human

health and the environment. This engineering evaluation identifies and screens the alternatives for dispositioning the shields at the Oak Ridge Reservation. Four alternatives were evaluated, including: 1) macroencapsulation, 2) deactivation, 3) recycle, and 4) leave-in-place. An initial screening was performed and the alternatives passing the initial screening were then evaluated in more detail. The evaluation criteria that were used included environmental risk, technical feasibility, administrative feasibility, worker safety, nuclear safety, transportation safety, and cost. To date, no alternative has been accepted, but studies continue.

When UCOR inherited the cleanup contract at ETTP, there was an inventory of seven waste streams that were identified as having no path to disposal. This meant that the previous contractors could not find a compliant disposition method for treatment/disposal of these seven waste streams. After an extensive effort to evaluate the characterization and treatment options for these waste streams, UCOR has dispositioned the inventory of 6.5 of the seven original streams. The only portion that remains is a liquid-phase dioxin/furan waste stream. UCOR is working with the Environmental Protection Agency on a treatment variance to open a path for the disposition of this final partial waste stream. ■

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