

Making history in Tennessee

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The Uranium Enrichment Complex in Oak Ridge, Tennessee was in operation for 40 years. It has taken almost as long — 35 years — to clean it up. Mike Butler and Susanne Dupes look to its next chapter

ON 27 AUGUST 1985, AT 3:31pm, with a flip of a switch, division superintendent John Shoemaker shut down the last piece of equipment used for over four decades to operate the world's first uranium enrichment complex.

Code-named K-25 during the World War II Manhattan Project, the massive plant produced highly enriched uranium for the world's first atomic bomb. It would take 35 years before the building where Shoemaker stood would be gone. Hundreds of other structures would also be demolished and the land restored in a first-of-a-kind, multi-decade cleanup project that would make way for the transfer of government land for a private sector industrial park.

It was 13 October 2020 when the US Secretary of Energy joined other federal, state, and local dignitaries in Oak Ridge, Tennessee for a ceremony — held in accordance with COVID-19 constraints — to recognise the safe and historic completion of major cleanup activities. The Department of Energy Oak Ridge Office of Environmental Management and its contractor, UCOR, an Amentum-led partnership with Jacobs, led a celebration that showcased decades of effort by UCOR and previous contractors in removing the complete gaseous diffusion complex.

Overcoming early obstacles and inherited deficits, UCOR made up for lost time, bringing the project to completion four years ahead of schedule and \$80 million under budget with a \$500 million reduction in government environmental liabilities. It is recognised as one of the most successful cleanup projects in Department of Energy (DOE) history.

Going out of business

As Shoemaker prepared to pull the switch shutting down K-25 after more than 40 years of operation, he reflected on how his career had tracked the plant's history from its glory days in support of national security and fuel for commercial power through eventual shutdown and environmental cleanup. The cleanup process that concluded successfully this year is what DOE calls "Vision 2020." He is a member of a band of pioneers who achieved a series of firsts include K-25 being the source of enriched uranium for the first atomic bomb, and producing the first propellant for a nuclear submarine and the fuel for the first commercial nuclear power plant. It also became the first of America's Secret City sites to complete environmental cleanup and be transformed into a home for new industry.

Shoemaker, a chemical engineering graduate of the University of Tennessee, started his career as an intern at K-25 while still in college. His first impression: "The thing I remember most on my first day was the sheer size of the plant. It was massive — the biggest buildings I had ever seen. Entering K-25, I was struck by the noise and the heat. Hundreds of compressors were running at once, and the giant room was hot," he said.

So hot, in fact, that nine years later in 1978, a crew would build an enclosed air conditioned platform to accommodate a visit from then President Jimmy Carter, the only president ever to visit K-25. The platform was constructed in a K-33 equipment display cell in four days. Although Carter's visit was short, the platform remained through the life of the plant, providing relief from 100°F (38°C) ambient temperatures during VIP visits.

Word of the plant's shutdown came in the usual way for a government project — an announcement from a member of Congress. On the morning of 6 June 1985, Marcia Katz, science advisor to Tennessee Senator James Sasser, called Shoemaker, then a senior manager for operating contractor Union Carbide. The message: The K-25 complex was going out of business.

The announcement did not come as a surprise. "We knew our production capability was three or four times the demand for enriched uranium at that time," Shoemaker said. "We knew the demand was shrinking. By that time, we were mostly producing fuel for nuclear power plants with little defence production. With newer plants at Portsmouth, Ohio, and Paducah, Kentucky, still operating, it was a matter of time until Oak Ridge would shut down."

Touring the world's largest building

Shoemaker's counterpart, Milton 'Mo' Beeler, also honed his skills at the nation's first uranium enrichment plant. An area supervisor, Beeler began a career at K-25 in 1974 that led him on a recurring tour of miles of meandering piping that connected processes in the uranium enrichment plant. Beeler's career took him through operations, shutdown, and the beginning of decades of cleanup.

"I was here when K-25 was operating, and I was here when they tore it down," Beeler said. "I have personally sat on, crawled over, and inspected hundreds of miles of pipe. I've seen it all."

Beeler was present in Building 402-9, the purge cascade, when Shoemaker shut down the final motor. "The thing I remember most was how quiet it got," he said. "For the entire 15 years I had been there, the noise was constant. I had never experienced so much quiet within those walls. It was eerie."

Days before the complex would be shuttered and no further employee entry would be allowed, Beeler took a non-escorted, self-guided, private tour of K-25. On that day, he was the only person in what was once the world's largest and most secret building.

"I was very humbled to reflect on all those seasoned operators and supervisors who taught me the gaseous diffusion cascade process and equipment operation," he said. "When the time came, demolition of these buildings was an important environmental and safety concern," Beeler said. "DOE managed the process with safety and proper waste disposition as their primary focus. My greatest hope and desire is that the history and significance of K-25 and the Manhattan Project are not forgotten or disposed of with the building debris."

Operations cease, cleanup begins

K-25 began operations in 1944. At the time, the world's largest building had a footprint that spanned 44 acres. Over the next decade, four more uranium enrichment plants joined K-25. These were K-27 in 1945, K-29 and K-31 in 1951, and K-33 in 1954. In addition to the gaseous diffusion processing facilities, the site — known as the East Tennessee Technology Park (ETTP) — was also home to more than 570 infrastructure and support facilities. All Oak Ridge's enrichment operations ended in 1985.

In succeeding years, most of these abandoned processing and support facilities fell into disrepair. For cleanup crews, structural degradation of the facilities made them challenging work environments, complicated by the presence of radioactive contaminants, hazardous chemicals, materials and wastes, industrial and naturally occurring biological hazards, wildlife, insects, and environmental conditions.

Four separate global contractors addressed the challenges over the years. The latest, UCOR, spent nearly a decade bringing demolition and cleanup to a successful conclusion. It executed elaborate facility, equipment, component, soil and groundwater characterisation plans to provide data required to create work plans. Extensive analyses were designed to identify hazards and implement controls to protect workers and the environment.

Meeting a massive waste management challenge

From an efficient 'pack-as-you-go' approach for moving radioactive debris from the demolition site for secure on-site disposal, to a digital-based monitoring system that helps combat heat stress, DOE's Oak Ridge Office of Environmental Management brought dozens of innovative solutions to enhance safety and efficiency in cleanup of ETTP.

When UCOR began its role in support of DOE's cleanup mission at the site, it was continually challenged regarding how to handle tonnes of debris and discarded equipment. A key factor in the success of the cleanup was a 'waste factory' approach that offered streamlined waste handling, transportation, and permanent on-site disposal. In this model, waste is hauled to an on-site disposal facility as it is generated.

This has resulted in lower life cycle costs, schedule efficiency, and reduced risk of environmental issues associated with ageing waste exposed to the elements.

Without the availability of dedicated haul road and secure disposal on-site, DOE would have been forced to send hundreds of millions of tonnes of waste by truck to repositories across the country, increasing costs and slowing cleanup. What is more, the delay between generation and disposal would make the process more complex and expensive.

As the cleanup project concluded, approximately 95% of the volume of demolition waste had been placed in a secure, regulated disposal facility on nearby federal land known as the Environmental Management Waste Management Facility. However, only about 10% of the radioactive curie content has been disposed at this facility, while 90% is moving out of state for disposal.

Innovation keeps workers safe

Other initiatives have focused on worker safety. DOE piloted a telemetric heart rate monitoring system to reduce the threat of worker heat stress in the summer months when temperatures can reach in excess of 37°C (98.6°F).

It includes a wearable chest strap heart rate sensor that operates in conjunction with a tablet computer.

The quest for innovation continued with specially- designed reusable containers for certain types of contaminated waste that have saved millions in shipping costs. Palletising contaminated equipment with bright colours allowed workers to easily segregate those pieces for off-site disposal. An aerial lift virtual reality training programme has allowed operators to practice motor skills and improve their performance in a risk-free environment.

"We are always searching for ways to perform our projects in the safest and most cost-effective manner," said Jay Mullis, manager of DOE's Oak Ridge Office of Environmental Management. "Through the hard work and innovation of our federal and contractor employees, we've completed DOE's largest cleanup effort to date. We were mindful not only of reaching that milestone, but how we reached it. We remained focused on doing the best job possible with the taxpayer funds allocated for this important mission."

A family business

Several generations of employees have worked at the K-25 site. For some, the nation's first uranium enrichment plant became a family business where fathers, mothers, sons and daughters worked side-by-side over seven decades.

When Wayne Hetzel started work at K-25 in 1972, he became part of that family tradition. His father, Jim, and mother, Audrey, had both worked there. As an instrument mechanic, Hetzel fabricated electrical panels, circuit boards and panel configurations and calibrated test equipment. "We were proud of what we did and always wanted our work to be excellent," said Hetzel, now 63. "We worked every day to the best of our ability. I always thought how lucky I was to have a good paying job at one of the Oak Ridge plants. It was a good place to work."

Those who have worked at K-25 in recent years have witnessed dramatic changes as massive, contaminated structures and dozens of associated buildings disappeared. New job-creating businesses have moved to the site as it undergoes transformation into a private sector industrial park.

The next chapter

With hazards removed and the environment restored, DOE and UCOR continue to work in close partnership with organisations like the National Park Service, the Tennessee Wildlife Resource Agency, and local and state organisations to transfer the land. DOE has already transferred ownership of many ETTP buildings and nearly 1300 acres to the East Tennessee community for redevelopment and reuse. Another 600 acres is slated for transfer in the years ahead.

Another critical activity — infrastructure stabilisation — enabled transfer of utilities and systems to the City of Oak Ridge and other entities. In some cases, due to the age of some of the infrastructure, DOE had to conduct repairs or upgrades to ensure public safety and comply with current codes and standards before infrastructure could be transferred. The stabilisation and ultimate transfer of site infrastructure reduced DOE's long-term landlord responsibilities and paved the way for transfer of land for a multi-purpose industrial park.

Through environmental cleanup of ETTP, UCOR facilitated DOE's vision of transforming once-contaminated government land into a clean, multi-use industrial park that will boost economic growth in Oak Ridge and the region.

The revitalised site is home to new industry, historic landmarks — including a new national park — and conservation areas that honour the past while supporting development.

Some 3000 acres adjacent to the ETTP site have been placed in a conservation easement that is available to the public for recreational purposes, including greenways and trail systems. A history centre tells the story of the men and women who built and operated the K-25 site during the Manhattan Project and Cold War. New facilities are planned in the near term that will capture and share more history about the site to future generations.

As ETTP moves into its next chapter, other workers will have the opportunity to reflect on the site's contributions and make new memories of a once-secret piece of land.

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US President Jimmy Carter visited K-25 in 1978



The enrichment plant was permanently shut down in 1985, after 40 years of operation



A ceremony in October 2020 marked the completion of major cleanup activities at K-25



Mo Beeler, a retired subject matter expert at UCOR, started working at K-25 in 1974



Waste from K-25 was transported along a dedicated haul road



The Oak Ridge site pictured during construction in 1947 (Photo credit: US DOE)



A view of the K-25 Building before decommissioning



A new K-25 history centre, located next to the original foundation for the K-25 building, was opened in February



A view of the K-25 Building during decommissioning



A view of the K-25 Building after decommissioning

