

## Special Feature Presentation: Oak Ridge - History, Heart & Hope (Part 1) - 11326

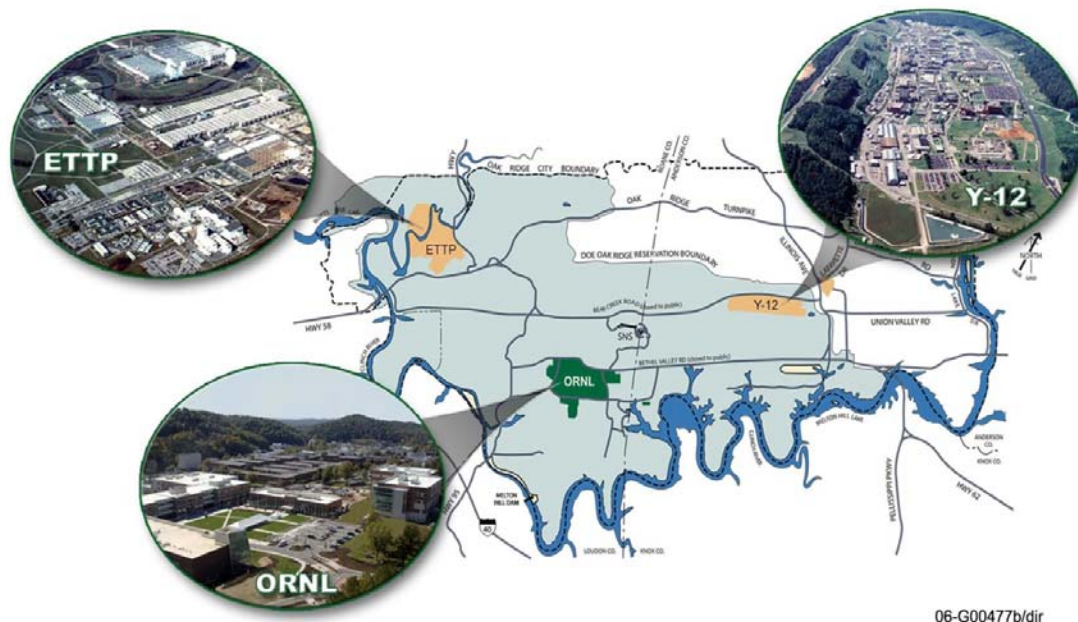
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### ABSTRACT

Numerous entities have played a significant part in documenting Oak Ridge's evolutionary journey over the past 60 plus years; many accounts have been complimented by the evocative photographs of the official photographer of the Manhattan Project, Ed Westcott, and memorabilia collected from local residents. Several of these special historic photographs and artifacts will be shown during this *Waste Management (WM) 2011 Special Feature Presentation* to portray the history, heart, and hope of Oak Ridge. Intertwined with the protection and advancement of essential missions created and maintained on the Oak Ridge Reservation, near Knoxville, Tennessee, is the story of how DOE has innovatively approached its cleanup mission. The story of cleaning up the sites that supported the Manhattan Project is, in many cases, as interesting as the essential national missions these sites performed. Due to reductions in DOE-EM's cleanup budgets, many sites, such as Oak Ridge, must be creative in their approach to the cleanup. Moreover, as the United States moves toward energy independence, the continued modernization and transformation of Oak Ridge National Laboratory, Y-12 and the East Tennessee Technology Park (ETTP) is essential. The Oak Ridge cleanup mission has evolved and matured over time to ensure that the cleanup keeps pace with the transformation and modernization initiatives underway.

### INTRODUCTION

The City of Oak Ridge's initial selection, role and historical significance in supporting the creation of the atomic bomb during World War II has been documented over the years through numerous media and institutions including the American Museum of Science and Energy, the Children's Museum of Oak Ridge, and the New Hope Center at Y-12. *The Oak Ridge Story*, a documentary produced in 2005 by Keith McDaniel, David Bradshaw, and Ray Smith, provides the most comprehensive documentation of why, when and how Oak Ridge emerged as a major player. The film begins with the significance of Oak Ridge's historical missions that included the construction of the Calutrons at Y-12, the graphite reactor at X-10, and the K-25 Gaseous Diffusion Plant (GDP) at ETTP, and progresses to its complimentary newer missions. New missions at these sites include Oak Ridge National Laboratory's Spallation Neutron Source and supercomputing capability, Y-12's center of excellence for uranium, and the transformation of the K-25 site into an industrial park. The DOE Oak Ridge reservation spans 34,000 acres and consists of three unique and complimentary sites, the Oak Ridge National Laboratory (the former X-10 Plant), managed by DOE's Office of Science; the Y-12 National Nuclear Security Complex, managed by DOE's National Nuclear Security Administration (NNSA); and ETTP (the former K-25 GDP), managed by DOE's Environmental Management arm.



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Fig. 1. Oak Ridge Reservation's 59,000 acres include the city of Oak Ridge and three major DOE facilities.

## THE MANHATTAN PROJECT

In 1942, the United States began to develop the capability of producing nuclear weapons under the U.S. Army Corps of Engineers' Manhattan Engineer District (known as the Manhattan Project). These efforts resulted in the manufacture and creation of the first atomic bombs used at the end of World War II. Nuclear weapons development and production was conducted by the newly created civilian Atomic Energy Commission (AEC). AEC developed and managed a network of research, manufacturing, and testing sites, focusing the efforts of these sites on stockpiling an arsenal of nuclear weapons. In the late 1940s and early 1950s, during a period of great expansion of the nuclear weapons complex, these functions were consolidated into a complex of large, centralized, government-owned production facilities. The Manhattan Project operated like any other large construction company. It purchased and developed sites, procured contracts and subcontractors, hired personnel, built housing, provided and maintained services, and established an extensive communication network. What made this particular construction project unique was that it was accomplished under a veil of secrecy and at break-neck speed – converting small family farms and townships, such as Robertsville, Wheat and New Hope, into massive production facilities. Secrecy in the project was so tight that the majority of the workers did not know what they were working on until the first atomic bomb had been dropped on Hiroshima. The need for being the first to have a nuclear capability clarified priorities and hastened decision making research, design, construction, operations and product delivery in just two-and-a-half years.



Fig. 2. Secrecy was important.

## THE CLINTON ENGINEER WORKS AND BIRTH OF OAK RIDGE

Prior to President Roosevelt's official authorization of the Manhattan Project, work had already begun in Tennessee where the first production sites were to be located. In the ridges just west of Knoxville, the government procured 59,000 acres and site preparation was underway. This military reservation was named the Clinton Engineer Works and initially was developed to house 13,000 people in prefabricated housing, trailers and dormitories. In the summer of 1943, the Manhattan Engineer District headquarters had been moved from Washington, D.C. to Tennessee and estimates for housing had escalated to more than 45,000 tenants. The city was not officially named Oak Ridge until after the end of World War II. By the end of the war, Oak Ridge was the fifth largest town in Tennessee and over one-tenth of the power being produced in the United States was being consumed by the Clinton Engineering Works' three production facilities. The Y-12 area, the electromagnetic plant, was located one ridge away, close to Oak Ridge. The X-10 area, located further south, contained an experimental plutonium pile and separation facilities.. The K-25 area, south and west of Oak Ridge, became home to the Gaseous Diffusion Plant.

### The Y-12 Plant

While the gaseous-diffusion process for enriching uranium led the electromagnetic technology in early 1943,



Fig. 3. Women ran the Calutrons.

national pressures led resulted in advancing both processes (from research to production) simultaneously. As the electromagnetic technology continued to evolve, it was incorporated into the design throughout the construction of the Y-12 production plant. Research on beam resolution, and magnet size and placement led to a design configuration coined "the racetrack," with two magnets and 48 gaps containing two vacuum tanks in each building. Ten buildings were constructed to provide 2,000 sources able to collect 100-grams of U-235 daily. The final design of the Y-12 Plant resulted in a two-stage design: the Alpha (stage 1) to collect the U-235, and the Beta (stage 2) to use the enriched U-235 derived from stage 1 as the feed material for stage-2, which contained tanks that were half the size of the stage-1 tanks. As construction of the Alpha and Beta plants began in February 1943, over 5,000 operating and maintenance personnel were recruited, hired and trained. Y-12 had numerous operation issues due to its quick transfer from a bench-scale application to the full production operational phase. Many modifications and refinements in the design of the technology were

necessary as it became apparent that the K-25 gaseous diffusion technology mission might need to be combined with the Y-12 electromagnetic technology to ensure the necessary production capacity.

### **The K-25 Plant**

In late 1942, the construction of the K-25 GDP just 11 miles southwest of Oak Ridge on the Clinch River, was authorized to begin. The gaseous diffusion technology had been based on a sound technology championed by the British. The mammoth facility was sprawling, covering two-million square feet (give in SI units) and comprising 50, four-story buildings designed in a U-shape, a half mile by 1,000 feet. In the late summer of 1943, it was determined that K-25 would play a lesser role than originally planned. In lieu of producing fully enriched U-235, it would instead produce 50-percent enriched material to be used as feed to the Y-12 plant, as the decision was made to double the Y12 capacity and utilize a combination of methods and technologies to deliver sufficient fissionable material to produce nuclear weapons.

### **Clinton Pile (X-10)**

As part of the Manhattan Project, “semi-works,” a prototype reactor was built, code-named “X-10.” Originally planned for the Chicago area, the project relocated the semi-works to the more isolated area of eastern Tennessee for safety and security reasons. The X-10 reactor (also called the Clinton Pile or the “Graphite Reactor”) was the pilot plant for the large plutonium-production reactors eventually built at Hanford, in southeastern Washington state. The reactor consisted of a cube of graphite moderator, 24 feet on each side, fueled by aluminum-clad natural uranium cylinders that were fed into and discharged out of the reactor through 1,239 horizontal cylindrical holes. A machine inserted fresh slugs (cylinders) through the front face of the reactor, and pushed the irradiated or spent slugs out through the rear, where they fell into a water-filled channel. The irradiated slugs were then transferred by an underwater monorail to a nearby separation plant. Initially, X-10 had a power output of 1,000 kilowatts, which was eventually quadrupled. The X-10 reactor became operational on November 4, 1943 and by mid-February 1944, was producing several grams of plutonium per month. X-10 also produced radioactive lanthanum, for use as a tracer in high-explosives experiments, and irradiated bismuth targets to produce polonium-210 for weapon initiators. The X-10 site became Oak Ridge National Laboratory in 1948.

## **ENVIRONMENTAL CLEANUP & MODERNIZATION – THE NEXT CHAPTER**

The non-mission-essential facility decontamination and demolition and environmental cleanup of the Oak Ridge Reservation is as noteworthy a part of the Oak Ridge story as the days of Clinton Engineer Works. Thus, for the public to fully appreciate the Oak Ridge story, they must learn about the Reservation’s rich history, recognize its global impact, and understand the rationale behind DOE’s environmental cleanup mission.. With an annual budget



Fig. 4. The massive ½-mile long west wing of the K-25 Gaseous Diffusion Building is being demolished.

of roughly half a billion dollars, the complicated, often dangerous work of tearing down enormous, contaminated buildings and remediating soil and groundwater goes on with no disruptions. Oak Ridge’s cleanup has evolved and matured to ensure that the cleanup maintains pace with the modernization and reindustrialization initiatives underway at ORNL, Y-12 and ETPP. The thousands of people engaged in this work are as well-trained, dedicated, and motivated as those who toiled in those buildings, creating the material for the weapons that ended World War II.

This special feature will frame the story of Oak Ridge in its historical context while discussing past and ongoing efforts to bring the cleanup campaign to the forefront of public awareness. One example is the Oak Ridge Graphite Reactor – decommissioned in 1963, it is now a national historic landmark, open to visitors. Another example is the addition of the Y-12 New Hope Visitor Center that houses many historical exhibits and serves as the cornerstone to the modernization of Y-12.. These efforts are among many underway to educate the general public about the significance

of both cleanup and the continued modernization of these national assets. The next chapter of the Oak Ridge story

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will evolve as buildings come down, landscapes are transformed, and plans for reindustrialization and new ideas become realities.

## **SUMMARY**

Oak Ridge's historical significance, coupled with its innovative modernization and cleanup, is a story worth telling. . Only through public outreach and education will individuals – local, national, and international – be able to understand the value of the cleanup mission and its importance in setting the stage that will enable the profound transformation of this small town in Tennessee, created by the Manhattan Project almost 70 years ago.