

Y-12 National Security Complex



Background

The U.S. Department of Energy (DOE) Oak Ridge Reservation (ORR) includes several contaminated areas that are a result of years of operation at the Y-12 National Security Complex. Remediation of these sites is underway.

Upper East Fork Poplar Creek

Phased Records of Decision

In 1953, the Y-12 National Security Complex began efforts to separate lithium isotopes to develop hydrogen bombs based on fusion. Millions of pounds of mercury were needed to separate the lithium. Three similar processes housed in several buildings were used to perform this task. Flowing at relatively high rates and pressures through numerous pumps, pipes, valves, and seals, the mercury often dripped or spilled. Pump maintenance also allowed mercury to escape, especially during early operating years. An estimated 240,000 pounds of mercury were released from Y-12 directly to Upper East Fork Poplar Creek (UEFPC) from 1950 to 1982. An estimated 2 million pounds of mercury was lost to the environment or not otherwise accounted for, although limited inventory control during that time makes estimating difficult.

The remediation of UEFPC is being conducted in phases. Phase 1 addresses interim actions for remediation of mercury-contaminated soil, sediment, and groundwater discharges that contribute contamination to surface water. The Phase 1 Record of Decision (ROD) was signed in May 2002.

The initial Phase 1 action was the design and construction of the Big Springs Water Treatment System, which collects and treats the largest remaining point source of mercury in UEFPC. Post-2009 actions remaining from this ROD include the removal of contaminated sediments from the UEFPC creek bed and Lake Reality. The Phase 1 ROD was amended in November 2015 to add a mercury treatment system to UEFPC at Outfall 200.

The UEFPC Phase II ROD was finalized and approved by regulators in April 2006. It addresses the remediation of the balance of contaminated soil, scrap, and buried materials within the Y-12 Complex. The remediation activities within this ROD were initiated in 2009 with the removal of scrap from the Y-12 Salvage Yard. Decisions regarding final land use controls and final goals for surface water, groundwater, and stream sediment cleanup will be addressed in a future final decision for the upper and lower East Fork Poplar Creek.

Big Springs Water Treatment System

A water treatment system that continuously treats 300 gallons of water a minute has been constructed at the Y-12 Complex.

The Big Springs Water Treatment System, located near Building 9201-2, is mitigating mercury being released into UEFPC.

Past operations at the Y-12 Complex have resulted in mercury contamination of a natural spring called “Big Spring,” located on the eastern portion of the site. Water from the spring flows through Outfall 51, a culvert that empties into UEFPC. The system will also treat contaminated groundwater collected in sumps in Building 9201-2.

The treatment system consists of three facilities: a 15-ft-deep, in-ground wet well to collect the contaminated water; a 70,000-gallon collection tank, where the water is pumped and stored prior to treatment; and the treatment process system, where the water is decontaminated.

The process system uses a series of granular activated carbon columns to reduce the mercury concentration. Construction began in March 2004 and was completed in March 2005. Operations began in August 2005.

The Y-12 National Security Complex performs critical roles in strengthening national security and reducing the global threat from weapons of mass destruction.

CERCLA Waste Facility

Selected wastes generated in the cleanup of the Oak Ridge Reservation are disposed of in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The CERCLA Waste Facility, also known as the Environmental Management Waste Management Facility (EMWMF), was constructed to receive these wastes. It is an above-grade waste disposal facility located in East Bear Creek Valley, just west of the Y-12 Complex.

The facility is authorized to receive low-level radioactive waste (LLRW) as



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Environmental Management Waste Management Facility

well as wastes regulated under the Resource Conservation and Recovery Act (RCRA) and Toxic Substances Control Act from CERCLA-regulated cleanup work associated with the Oak Ridge Reservation. Potential wastes include soil, sludge, sediments, solidified waste forms, stabilized waste, vegetation, building debris, personal protection equipment, and scrap equipment.

In addition to five disposal cells, EMWMF consists of a leachate collection and transfer facility, support facilities, access roads, storm water retention basins, and monitoring and security systems. The latest expansion of the facility was completed in Spring 2011, bringing the final capacity to 2.2 million yd³.

New On-Site Disposal Facility Planned

EMWMF will reach capacity before OREM completes its cleanup at Y-12 and ORNL. Planning is underway for another disposal facility that will provide the capacity required to complete Oak Ridge's cleanup. The new facility will be called the Environmental Management Disposal Facility (EMDF).

In December 2017, The DOE Oak Ridge Office of Environmental Management (OREM) and regulators settled a formal dispute on the Remedial Investigation/Feasibility Study with agreement to work toward submitting the Proposed Plan

and perform characterization of the preferred site in Central Bear Creek Valley. In February 2018, characterization of the site began. OREM installed 16 wells and began measuring and recording water levels and collecting other data needed to evaluate the proposed site.

The Proposed Plan was submitted to the public in Sept. 2018. Preliminary design of the facility has been initiated, along with further site characterization to support the design work.

Old Salvage Yard Scrap Removal

A total of 21 million pounds of scrap has been removed from the Old Salvage Yard, located at the west end of the Y-12 National Security Complex within and outside the high-security boundary. Of that amount, 8.7 million pounds were shipped to EMWMF and 7 million pounds to the Nevada National Security Site.

Established in the early 1970s, the 7-acre site was used for storing scrap metal and liquid hazardous wastes from Y-12 operations until 1999.

The Old Salvage Yard received scrap into open piles until 1995, when new procedures required that all scrap metal be placed inside containers.

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The primary contaminants of concern in the scrap yard include uranium and thorium. Forklifts, an abandoned crane, and other equipment were also removed.

Contaminated soil was also excavated and removed from the site. The excavated soil was characterized, profiled, and disposed in FY 2012. Approximately 988 yds³ of contaminated soils and miscellaneous debris were disposed at EMWMF. Site restoration was completed for remediated and non-remediation areas.

The soil characterization data and groundwater modeling indicated soil remediation was required at the former Drum Deheader area. A remedial action was taken to remove contaminated soil that could contribute to future groundwater contamination. A 50-ft by 50-ft area was excavated to a depth of five feet to remove sufficient volatile organic compound concentration to mitigate the impact. The excavated area was then backfilled.

Building 9735 Demolition

Demolition of Building 9735, referred to as the Research Services Laboratory, was completed in July 2010. This building was the last one to be removed from Engineering Row. Demolition of Engineering Row reduced the Y-12 footprint by 92,690 ft².

The other six buildings that once comprised Engineering Row were demolished in 2008. Building 9735 was a two-story, masonry (glazed terra cotta tile), wood-truss structure with a slab-on-grade foundation. The south end consisted of a two-story rectangular structure with a former basement that housed a development calutron.

The project involved complete deactivation and demolition of the building as well as the disposition of 2,964 m³ of material and waste to the Y-12 Sanitary and Industrial Waste landfills and approximately 8 m³ to the Nevada National Security Site. In addition to eliminating safety risks, this project allowed Y-12 to add an employee parking area and contribute to American Recovery and Reinvestment Act (ARRA) goals of creating and saving jobs and stimulating the local economy.

Building 9206 Bag Filter House Removal

The Building 9206 Bag Filter House Removal project at the Y-12 Complex was unlike other ARRA-funded deactivation and demolition projects. Only a section of

the building was demolished. The primary furnace chamber, ash removal unit, and its major control equipment were located inside Building 9206. The remaining components of the system were located on the roof and in the south yard exterior to the building. This project also deactivated the recovery furnace exhaust system. The scope required Y-12 operations personnel to characterize, isolate, disassemble, decontaminate, and dispose of all equipment, support equipment, and waste from demolition of the identified Building 9206 Bag Filter House.

Deactivating the recovery furnace exhaust system reduced exposure from potential release of radiological and hazardous materials in out-of-service equipment. Deactivation also eliminated the need for daily monitoring of the process systems and was a key step in preparing the building for D&D. The Building 9206 Filter House project team removed and disposed of a total of 268 m³ of waste.

Alpha 5 Project

Alpha 5 (Building 9201-5) is the largest building at Y-12, measuring 613,642 ft².

Previously completed work scope for the project included removal and disposal of legacy materials from the building (floors 1 through 4). Legacy materials were defined as those being easily removed and involving minimal reconfiguration efforts (e.g., unbolting, unplugging, wire cutting, cold cutting). The building was organized into 82 units, and legacy material was present in 67 of the units located on four floors. The building was completely emptied of its legacy materials, and those materials were appropriately disposed at on-site and off-



Building 9735 has been demolished

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site facilities. Approximately 464,000 ft³ of legacy waste was disposed.

In FY 2012, characterization of building materials and equipment that was physically connected to the building was completed. This effort was a critical necessary step in preparation for the eventual deactivation and decommissioning of the building. The final Characterization Report was completed in January 2012.

Beta 3 (9204-3) Legacy Material Disposition Project

The Beta 3 Legacy Material Disposition project work scope included completing the refurbishment of 36 glove boxes, 4 Plexiglas enclosures, and associated ventilation systems to maintain and ensure containment capability within the facility Actinide Lab area.

Debris stored and accumulated within the glove boxes was characterized, removed, packaged, and disposed as either low-level radioactive waste, mixed low-level waste, or transuranic waste. Following removal of the debris, the Hazard Analysis for the facility was re-evaluated, resulting in a revised Hazard Assessment Document and lower hazard category, which will reduce the long-term surveillance and maintenance costs for the facility. A completion report documenting the work performed was prepared, submitted, and approved in FY 2012.

Beta 4 Legacy Material Disposition Project

The Beta 4 Legacy Material Disposition Project consisted of removal and disposal of legacy materials from the second floor and second floor mezzanine of Building 9204-4. This work will prepare the facility for deactivation and demolition as part of the site transformation plan. As with the Alpha 5 Project, legacy materials were defined as those being easily removed with minimal reconfiguration efforts. The second floor and second floor mezzanine were likewise organized into 16 units, and legacy materials not salvaged or reused were managed as waste and characterized, segregated, size-reduced, compacted, and/or treated to meet the waste acceptance criteria for disposal at approved facilities. Approximately 128,000 ft³ of legacy waste was disposed.

Disposition plans for Beta 4 waste were accelerated with ARRA funding. Results of these efforts were improved site safety and security, reduced operating costs, and reduced environmental risk to site personnel and to the immediate and surrounding areas.

Exposure Unit 9

An 11.7-acre Exposure Unit (EU) 9 at the Y-12 National Security Complex was addressed in FY 2012.

This project included characterization of the EU and development of a Remedial Design Report (RDR) that had an Federal Facility Agreement milestone of Sept. 30, 2012. The characterization strategy followed the UEFPD Remedial Action Work Plan (RAWP) and included radiation walkover surveys and soil sampling and analyses. The goal was to identify contaminants exceeding industrial worker remediation limits and contaminants that were a threat to surface and groundwater below two feet.

Characterization results indicated that a remedial action is required in the former 81-10 Area for protection of the industrial work force. The proposed remedial action is excavation of a 45-ft by 70-ft by 2-ft deep area with an estimated volume of 6,300 ft³ of soil in the remedial action boundary. An RDR detailing the method of accomplishment, waste management, and waste disposition was submitted to the regulators ahead of the Federal Facility Agreement milestone.

Biology Complex

OREM is preparing to remove five high-risk excess contaminated facilities, known as the Biology Complex, at Y-12. The 350,000-square-foot area poses asbestos hazards as well as structural deterioration risks. Demolition of these facilities is part of a nationwide effort to eliminate excess contaminated facilities throughout the DOE complex.

Originally constructed in the 1940s to recover uranium from process streams, the complex later housed DOE's research on the genetic effects of radiation. The facilities once housed more individuals with doctorates than anywhere in the world.



Workers prepare a soil sample for containerization at Exposure Unit 9

Y-12 National Security Complex (continued)

The complex originally consisted of 11 buildings until OREM demolished four of them in 2010 as part of the American Recovery and Reinvestment Act of 2009.

Buildings 9743-2 and 9770-2 were demolished in FY 2018, and mobilization started for the demolition of the remaining buildings. The completion of this project will clear land for important future national security missions.

Mercury Reduction Project

The Mercury Reduction Project was initiated to facilitate reduction and lower mobility of mercury at Y-12. Subprojects under the Mercury Reduction Project included Mercury Soils Treatability Study, Five Tanks Remediation, Outfall 200 Conceptual Design, Mercury Recovery Trap Installation, and Secondary Pathway Remediation. Field activities on the Mercury Reduction Project began in May 2012 and continued into FY 2013.

Mercury Contaminated Soils Treatability Study

A treatability study for mercury-contaminated Y-12 soils started in FY 2012. The treatability study was initiated to define treatment options and available disposal options for Y-12 soils contaminated with mercury.

In FY 2013, the Treatability Study Report for Y-12 Site Mercury Contaminated Soil was prepared, detailing the results of treatability studies and providing treatment and disposal options for the mercury-contaminated soils.

Five Tanks Remediation Project

A tank removal project was initiated in FY 2012 to dispose of five tanks formerly used for mercury-related activities at Y-12. These tanks were removed from service in the 1980s. Characterization was completed along with the necessary

documentation needed for disposal of these tanks.

The tank removal project was completed in FY 2013. Based on characterization results, two tanks were sent to the sanitary landfill at Y-12. Three tanks were transported to Materials and Energy Corporation for residual removal of tank contents and size reduction of the tanks. After size reduction, the tank residuals and debris were disposed. Approximately 650 pounds of mercury was removed and treated. A formal report documenting completion of the project was submitted to the Environmental Protection Agency and Tennessee Department of Environment and Conservation.

Outfall 200 Mercury Treatment Facility

OREM has broken ground on the Outfall 200 Mercury Treatment Facility at the Y-12 National Security Complex. The facility will reduce mercury in water exiting the site through the East Fork Poplar Creek. Outfall 200 is the point where the west end of the Y-12 storm drain system creates the headwaters of the Upper East Fork Poplar Creek.

The mercury treatment facility will help OREM achieve compliance with regulatory criteria for the East Fork Poplar Creek. It also supports and opens the door for large-scale facility demolition to begin by helping to control potential mercury releases that could occur when disturbing the mercury-contaminated buildings and soil.

OREM has completed early site preparation ahead of the planned facility construction. Early site preparation included construction of the necessary utilities, installation of secant piles, and demolition of existing structures in the area to prepare the site for construction of the mercury treatment facility. OREM anticipates beginning construction of the mercury treatment facility in 2019.

Mercury Remediation Technologies Explored

Mercury remediation is OREM's highest priority at the Y-12 National Security Complex due to the large historical losses of the element in buildings, soils, and surface waters. Remediation of Y-12 and East Fork Poplar Creek is based on a phased, adaptive management approach.

The approach to address surface water includes Outfall 200 treatment actions in the short term, and research and technology development to evaluate longer-term solutions. In FY 2017, OREM led a multi-organizational meeting series focused on updating and prioritizing the mercury remediation strategy and technology development plans.

In the near-term, the recommended mercury technology development activities will support the successful completion of the demolition of Y-12's mercury-contaminated facilities and soils remediation, and reducing mercury-related ecological risks in the East Fork Poplar Creek.



A worker takes a sample from a Biology Complex facility

Y-12 National Security Complex (continued)

Mercury technology development activities have been ongoing since 2015, and they will ultimately support an evaluation of remediation alternatives for the creek in the 2020s. East Fork Poplar Creek research activities have emphasized understanding mercury transport as an important precursor to the development of targeted remedial technologies.

To date, stream bank sources in select areas with higher mercury values are thought to be a major source of mercury to surface waters. Technologies under investigation include the use of materials that will bind mercury and prevent its release into surface waters. Water chemistry is also thought to play a major role in mercury transport and uptake in the food chain. Controlling nutrient releases that impact algae in the creek is one strategy under investigation. Lastly, studies on the form of mercury in animal and plant life in the areas provide new insights that suggest managing stream biological communities may help decrease mercury risks.

ORNL scientists have prepared a report titled “Mercury Remediation Technology Development for Lower East Fork Poplar Creek—FY 2017 Progress Report.” This report provides a detailed description of each of the study areas and findings from studies performed in FY 2017.

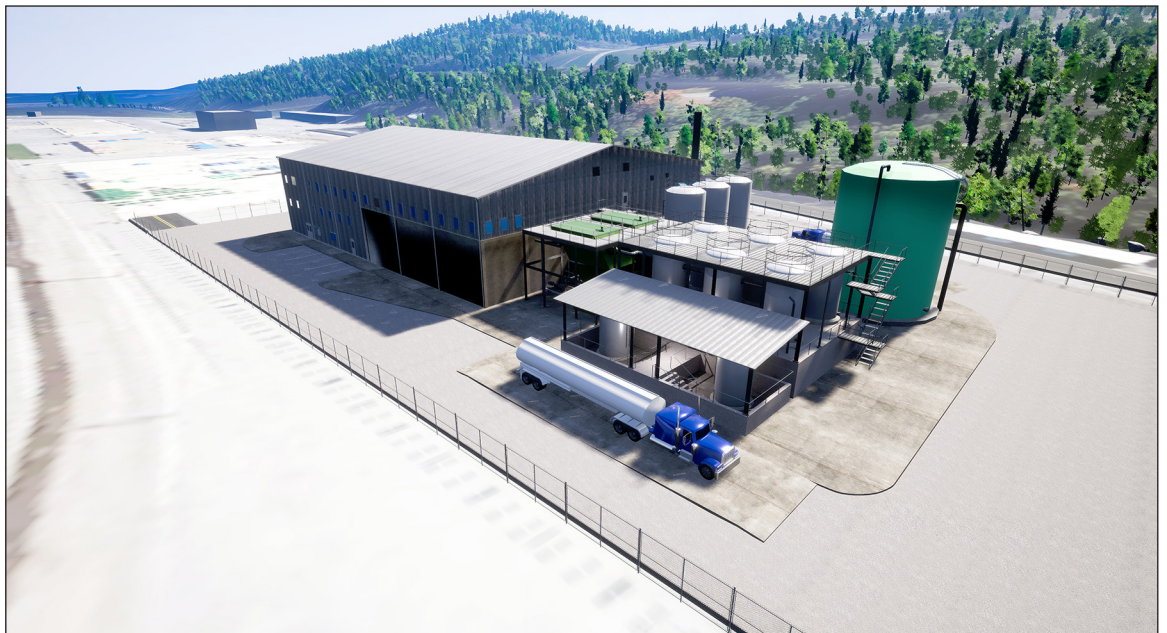
Mercury Recovery Project

The Mercury Recovery Project designed and installed mercury recovery traps at locations upstream of Outfalls 150, 160, 163, and 169. The traps collect elemental mercury and mercury-contaminated sediment. Y-12 personnel remove that mercury and sediment from the traps and other storm drain locations.



Abandoned tanks at the Y-12 Complex

Artist's rendering of the Outfall 200 Mercury Treatment Facility



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Y-12 began collecting mercury and sediments from storm drains in FY 2013. Ongoing collection and disposition of elemental mercury and associated contaminated sediments from the storm drain system from the traps are summarized in the annual Remediation Effectiveness Report, which details the effectiveness of remediation activities.

In FY 2013, the Mercury Recovery Project installed a decanting facility to separate mercury from co-collected sediment and water, and potential amalgamation of collected elemental mercury for disposal purposes. Trapping and removing elemental mercury from the storm drain system will remove some mercury before it reaches the Upper East Fork Poplar Creek at Outfall 200.

Secondary Pathways

In 2013, actions to reduce or eliminate secondary mercury infiltration around Alpha 4 (9201-4) and Alpha 5 (9201-5), and identification and confirmation of open drains inside Alpha 5 and Beta 4 (9204-4) were completed.

These massive facilities were involved with lithium isotope separation activities, which utilized large quantities of elemental mercury. These activities included modifying some roof drains and drainage systems, installing graded impervious surfaces to ensure rainwater runoff is routed to storm drains to reduce percolation through mercury-contaminated soils, and investigating potential mercury source points inside the facilities. The actions were documented in a completion report. All waste generated was disposed in 2013.

Water Resources Restoration Program

The Water Resources Restoration Program (WRRP) coordinates activities for three ORR watershed-specific Water Quality Programs, and implementation of the ORR Groundwater Strategy including the ORR Groundwater Program and the Off-site Groundwater Assessment.

The primary objective is to support groundwater and surface water management decisions and to develop and implement long-term monitoring strategies and plans to support future groundwater monitoring decisions. The program also tracks compliance with long-term stewardship requirements.

Summaries of monitoring results and interpretations of data collected by the watershed Water Quality Programs and other related projects are reported in the yearly Remediation Effectiveness Report. Additionally, every five years the Program evaluates the protectiveness of ongoing and completed CERCLA decisions in the Five-Year Review.

Surveillance and Maintenance

Surveillance and Maintenance (S&M) activities involve maintaining 65 surplus sites and facilities covering more than 650,000 ft² and approximately 500 acres of land within the Chestnut Ridge, UEFPC, and Bear Creek Valley watersheds and at several off-site locations in a safe and compliant condition until sites are remediated or facilities are demolished through EM cleanup projects. The project is responsible for safe-keeping radiologically and chemically contaminated facilities, structures, equipment, and land parcels. The main objectives of the S&M project are to keep site personnel and the public safe and prevent any impacts to the environment.

The S&M scope covers former burial grounds, closed waste treatment/disposal facilities and land areas, waste storage vaults, and surplus process buildings, as well as closed storage tanks, diked areas, trailers, storage sheds, etc.

Routine S&M includes numerous activities, such as facility/site inspections required by federal and state regulations (e.g., CERCLA RODs and RCRA Post-Closure Permits), relevant DOE orders, and other regulations/requirements; characterization of hazards; radiological surveys; routine, corrective, and preventative maintenance of facilities, structures, systems, and components (e.g., roofs, fire protection systems, building steam and ventilation supply, land area caps, access roads, etc.); RCRA cap leachate collection and transport for treatment; and pumping accumulated precipitation from diked areas. S&M also includes one-time activities necessary to reduce facility inventory, remove unneeded utilities and reduce utility costs, perform waste management/recycle activities, and mitigate other risks.

Alpha 4 Roof Repair

Workers successfully completed the 9201-4 roof repair campaign in 2014. The 9201-4 project included repairs to large areas of roof membranes, flashings and drains across the nearly four-acre Alpha 4 roof footprint.

The team, lead by DOE cleanup contractor UCOR, an AECOM-led partnership with Jacobs, completed the project ahead of schedule and on budget and, most importantly, safely and without security incident. The project is expected to extend Alpha 4's roof life by 7-10 years.

Alpha-4 is a 600,000-square-foot steel and concrete facility with three floors and a sub-basement. The building began operating in 1945 as a uranium enrichment facility until 1947. In 1953, workers installed the Column Exchange (COLEX) process, which used substantial quantities of mercury as a solvent agent to separate lithium; the operations continued until 1962. Additional roof leaks were repaired in 2016.

COLEX Equipment

OREM cleanup crews have completed recovery of more than a ton of mercury from a former lithium production facility at the Y-12 National Security Complex, marking another milestone in the highest priority cleanup challenge on the ORR.

Workers successfully removing mercury from tanks in the Column Exchange (COLEX) equipment on the east side of the Alpha-4 building. Earlier, UCOR safely collected nearly 3.5 tons of mercury from COLEX equipment on the building's west side. The latest effort boosted total mercury removal to more than 4.6 tons.

The mercury-contaminated COLEX equipment is connected to the four-story, 500,000-square-foot Alpha-4 facility, which was used for uranium separation from 1944 to 1945. Workers finished installing the COLEX equipment in 1955 for lithium separation, a process that required large amounts of mercury.

While workers drained the majority of the materials from the equipment when operations ceased in 1962, not all of the systems and components were cleaned. Recoverable amounts of mercury were still in the equipment and lines.

Workers inspected, cleaned, and retrieved mercury from tanks and equipment prior to their removal. Approximately 9,477 of the 9,947 feet of piping, 22 tanks, and 4 heat exchangers have been tapped, drained, and deactivated on the west side through FY 2018. In addition, 21 of those tanks were demolished and removed from the site. Equipment on the east and south sides will be removed in the future.



Mercury collected from the COLEX equipment is being poured into a container.