

Y-12 National Security Complex



Background

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

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, including 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. Initial 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)



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Environmental Management Waste Management Facility

as well as wastes regulated under the Resource Conservation and Recovery Act 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 the 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 is expected to reach capacity before cleanup at Y-12 and ORNL is completed. Planning for another landfill is essential so that cleanup work can continue without interruption. The new facility will be called the Environmental Management Disposal Facility (EMDF).

During 2016, DOE Oak Ridge Environmental Management (OREM) continued to work with regulators to submit a final version of the Remedial Investigation/Feasibility Study (RI/FS) for approval. The document lists options for onsite and offsite disposal. The on-site disposal alternative in the document lists four site options in Bear Creek Valley, including a Brownfield site to the east of EMWMF and three others that incorporate greenfield sites.

Under the offsite disposal alternative, future CERCLA waste would be transported off-site for disposal in approved disposal facilities in other states, primarily by rail. The hybrid disposal alternative considers a smaller on-site landfill in conjunction with sending a larger percentage of waste off-site. For benchmark purposes, a no-action alternative is also listed as a means of comparison.

The document concludes that both on-site and off-site disposal alternatives would protect human health and the environment long-term. Short-term risks are higher for the off-site disposal alternative due to significant efforts to transport the waste. The off-site disposal alternative may isolate the wastes

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more effectively since the disposal sites are located in arid climates. Along with higher costs, off-site disposal would extend the cleanup schedule ten or more years.

The on-site disposal alternative would be located on DOE land within the Oak Ridge Reservation, but it would be much less costly, allow for more expedited waste disposal, avoid transportation risks, and provide a greater level of certainty that long-term disposal capacity remains available, thus offering the most condensed overall cleanup schedule.

American Recovery and Reinvestment Act Projects

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.

The 7-acre site, established in the early 1970s, 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.

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



Building 9735 has been demolished

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 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.

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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-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 FFA milestone of Sept. 30, 2012. The characterization



Workers prepare a soil sample for containerization at Exposure Unit 9

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strategy followed the UEFPC 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 were presented in a Technical Memorandum and 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 EPA and TDEC ahead of the FFA milestone.

Biology Complex and Building 9769 Deactivation and Demolition Project

The Biology Complex and Building 9769 Deactivation and Demolition Project involved four of the buildings in the Biology Complex that were deactivated and demolished. Buildings 9211, 9220, 9224, and 9769 were demolished, and the work took place in six phases: building characterization, utilities deactivation, hazardous material abatement, radiological contaminated surfaces stabilization, building demolition to grade level, and site stabilization.

Support activities such as waste size reduction, waste packaging, and shipping were integrated within the activities of these six major phases. Sanitary and construction/demolition debris that met the facility waste acceptance criteria were disposed at the Y-12 Sanitary Landfill. Radiologically contaminated waste was disposed at the on-site EMWMF. Approximately 32,000 yd³ of waste were generated and disposed from this project.

The Biology Complex project was part of Y-12's ongoing footprint reduction effort, designed to minimize maintenance and security costs. The project eliminated 135,812 ft² of unused building space and the risk associated with the deteriorated facilities. These buildings were vacant since 2003.

Work began in 2016 to characterize the remaining Biology Complex facilities in preparation for eventual demolition.

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 Five Tanks Remediation, Outfall 200 Conceptual Design, Mercury Recovery Trap Installation, Mercury Soils Treatability Study,



Abandoned tanks at the Y-12 Complex

and Secondary Pathway Remediation. Field activities on the Mercury Reduction Project began in May 2012 and continued into FY 2013.

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

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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.

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.

Outfall 200 Mercury Treatment Facility

Historical missions of the Y-12 National Security Complex (Y-12) resulted in the release of mercury to the environment. The West End Mercury Area (WEMA) consists of former mercury use buildings located in the west end of the Y-12 Main Plant Area, including mercury contaminated soils and storm sewers in the immediate vicinity.

Discharges from the WEMA are primary point source contributors to mercury flux in Upper East Fork Poplar Creek (UEFPC), which runs directly from the Y-12 Plant into the city of Oak Ridge. Storm sewer Outfall 200 (OF200) is the integration point for storm sewer effluent entering UEFPC and, under dry weather flow conditions, is consistently the largest single source of mercury to UEFPC. Currently, this is considered the greatest environmental risk on the U.S. Department of Energy (DOE) Oak Ridge Reservation.

Work on a Preliminary Design Report was completed in 2016. A geotechnical investigation to support the final design of the facility was also completed. The facility will be designed to treat up to 3,000 gallons of water per minute and includes a 2-million-gallon storage tank to collect storm water.

Mercury Remediation Technologies

Mercury remediation is a high priority for OREM because of large historical losses of the element in buildings, soils, and surface waters at Y-12. Understanding how mercury moves in the East Fork Poplar Creek system is essential to the development of new technologies and ultimately to the development of remedial options and strategies for the creek.

Remediation of Y-12 and East Fork Poplar Creek (EFPC) is based on a phased, adaptive management approach. The approach to address surface water includes treatment actions in the short term and research and technology development to evaluate longer-term solutions in the downstream environment. As part of this effort, OREM has developed and is executing a Mercury Technology Development Plan.

In 2016, research and technology development activities continued to focus on the major factors influencing the accumulation of mercury in fish (fish are the major route of both human and wildlife exposure). Three lines of investigation for EFPC continue to be pursued to: (1) examine potential downstream sources, such as bank soil and sediment control, (2) investigate the water chemistry and flow characteristics of the creek and its influence on mercury, and (3) study the ecology and how differences in food chain processes may influence the uptake of mercury in fish.

In FY 2016, the study identified and sampled a historical source of mercury entering EFPC. Researchers will continue to study the extent and impact of this source in FY 2017. Stream sediments were also obtained and analyzed for traces of mercury and how the mercury is bound to sediment particles. Additionally, the water chemistry and flow characteristic studies monitored the effects of chlorination on mercury mobilization and concentration in EFPC.

The ecological investigations continued to sample EFPC fish, algae, and invertebrates. They also analyzed the exposure pathway the leads to elevated concentrations of mercury in fish.

ORNL scientists are preparing a report titled “Mercury Remediation Technology Development for Lower East Fork Poplar Creek –FY 2016 Progress Report.” This report will provide a detailed description of each of the study areas and findings from studies performed in 2016.

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, and Y-12 personnel remove that mercury and sediment from the traps and other storm drain locations.

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 will be 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 be of benefit by removing 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

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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 Oak Ridge Reservation (ORR) watershed-specific Water Quality Programs, and implementation of the ORR Groundwater Strategy including the ORR Groundwater Program and the Offsite 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 where there is monitoring and/or other land use controls.

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, Upper East Fork Poplar Creek, and Bear Creek Valley watersheds and at several offsite 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 Records of Decision 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.

Y-12 Surveillance & Maintenance FY 2015 Corrective and Preventative Maintenance

In FY 2015, after eight months of planning and coordination between Consolidated Nuclear Security (CNS), which operates the Y-12 Complex, and cleanup contract URS | CH2M Oak Ridge LLC (UCOR), extensive corrective maintenance and utilities tasks were completed to restore/reroute power into the G and H groundwater sumps and to remove/ replace the G and H groundwater primary and auxiliary groundwater sump pumps as well as level floats and switches in Building 9201-4 (Alpha-4).

These corrective maintenance and utilities activities utilized engineering, maintenance, power operations, work planning and health and safety personnel obtained using two UCOR Interface Agreements with CNS. UCOR provided facility management, facility engineering and radiological protection services for the project. Completion of these significant corrective maintenance and utility activities allows UCOR to return the groundwater sump pump operations from 9201-4 to the U-2100 holding tank to as-designed conditions which conveys the potentially mercury-laden groundwater from the sumps to the holding tank and on to the Central Mercury Treatment Facility. Most importantly, this work was completed safely without incident in the extremely challenging work environment presented by the wind tunnels below grade in the 9201-4 facility.

UCOR Y-12 S&M, using a Consolidated Nuclear Security (CNS) Interface Agreement (IA), worked with the Y-12 Fire Department who performed semi-annual inspections and testing on wet pipe systems 2, 3, 5, 6 and 7 in 9201-4. Also using an IA, Y-12 Power Operations completed the 5-year re-certification of the 480 volt main electrical breaker in 9201-4. Meetings were conducted between CNS Y-12 Maintenance and UCOR Y-12 S&M to initiate planning to isolate plant and instrument air to buildings that may not need the utility service any longer. UCOR emphasized that plant air is still utilized for back-up sump pumps in 9201-4, but would work with the CNS Y-12 Maintenance division to look for ways to isolate lines that were no longer needed.

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Using an arborist subcontractor, the UCOR Y-12 S&M program removed 20 large, high risk trees and approximately 150 small trees near fencing at White Wing Scrap Yard. This fence clearing campaign supports providing access to the areas to enable a fencing subcontractor to repair sections of fencing that have been damaged due to felled trees and storms in the area late in FY2015. The scope of work was completed to obtain a fencing contractor and the necessary fence repairs were completed at the White Wing Scrap Yard.

Three large dumpsters from the 9201-4 West Yard which contained low-level waste and possible mercury were shipped to Materials and Energy Corporation (M&EC) for sorting and segregation and eventual disposal at the Nevada National Security Site. M&EC confirmed that no mercury was found in the waste.

Planning was conducted and ten high risk and two medium risk steam repairs were made in 9201-4 during FY2015 using craft obtained through an IA with CNS maintenance. Two remaining high risk steam repairs in 9201-4 and the balance of the planned repairs in the facility will be scheduled to be worked in the fall of 2015.

Another significant project was completed which isolated 9201-4 Deluge System 1 Fire System which will reduce S&M costs for inspections and maintenance in the range of \$2,000-\$8,000 annually and prevent the repair of steam leaks in that area of the facility which will result in an additional \$30,000 cost savings.

Alpha 4 Roof Repair and COLEX Equipment Removal

UCOR Y-12 Surveillance & Maintenance 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 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.

The 560,000 ft² building was constructed in the 1940s to support uranium enrichment using electromagnetic separation. The building has been in safe, secure shutdown since 1997 in the Y-12 Surveillance and Maintenance program.

Characterization work began in 2016 to prepare the Alpha 4 column exchange (COLEX) process piping, tanks, and equipment to be removed. Additional roof repairs were also completed.