

Oak Ridge Cleanup Vision: Moving to the Future by Cleaning Up the Past – 13291

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ABSTRACT

The Oak Ridge Office of Environmental Management (EM) strives to be the leader in the Department of Energy's (DOE's) EM Complex regarding successful and safe project execution and stakeholder interactions that yield positive results. EM's goal has been to become "Investment Worthy" and, in order to accomplish that important objective, has also had to improve communications both within and outside of the Department.

One of our most important missions is to assist the Department in achieving the sustainability goals set forth in Executive Order 13514. In this regard, EM's primary role is to return land to beneficial use and reduce energy impacts and maintenance costs by demolishing unneeded and deteriorating structures and remediating environmental contamination. Recent accomplishments toward meeting these goals include significant progress in the decontamination and demolition of the country's largest facility, the former K-25 Gaseous Diffusion Building, constructed in 1942 to enrich uranium to help end World War II; the disposition of the first phase of Uranium-233 material from the Oak Ridge National Laboratory (ORNL) which involved the transfer of Zero Power Reactor Plates to the National Nuclear Security Administration (NNSA); and a host of other project successes associated with transuranic (TRU) waste processing, hot cell decontamination and demolition, remediation of highly contaminated soils and burial grounds, and removal of mercury from storm sewers and surface waters. With regard to successful stakeholder interactions, recent accomplishments include a new method for collaboration that has renewed EM's working relationship with the regulators, and success in completing an extensive consultation process with over a dozen parties on the historic preservation of the former Oak Ridge Gaseous Diffusion Plant, which is now called the East Tennessee Technology Park (ETTP). Regarding improved communications, EM has successfully revised Program priorities and has received buy-in from the leadership in Headquarters, the regulators, and the community.

Issues EM was facing in 2009 are presented. Resulting lessons learned and subsequent changes that the Office has gone through in the past several years in order to improve performance in the safe execution of work, relationships with external stakeholders, and communications both internally and externally are discussed. Results of these efforts are provided as a summary of Program accomplishments, including a strong focus on the future. EM's motto, *Moving to the Future by Cleaning up the Past*, will be demonstrated through the Program's mission, which includes protecting the region's health and environment; ensuring the continuation of ongoing vital missions being conducted by DOE on the Oak Ridge Reservation; and making clean land available for future use at all three sites, with a near-term focus on Reindustrialization of ETTP.

INTRODUCTION

The Oak Ridge Reservation represents a unique challenge to DOE's environmental remediation program. Home to the world's largest energy research laboratory and America's nuclear weapons stockpile, Oak Ridge is the only site in the DOE Complex that performs every mission in the Department's portfolio – research and development, national security, nuclear fuel supply, science education, technology transfer,

and asset revitalization – some operating in immediate proximity to environmental legacies. The threat posed by these legacies to some of the Department’s largest investments is an important factor in developing the cleanup program’s strategic plan.

The environmental legacies on the 13,760 ha (34,000 ac) Oak Ridge Reservation also present a risk to the region, which warrants cleanup. EM’s vision is that the Reservation will be remediated, modernized, and reindustrialized for long-term future use. Approximately 500,000 people reside within 48 km (30 mi) of the Reservation. Protecting the health of the public and thousands of Oak Ridge Reservation employees, while helping to sustain DOE’s on-going and future vital missions through clean-up of buildings and land, are the cornerstones of the EM mission in Oak Ridge.

CHALLENGES AND OPPORTUNITIES IN 2009

EM faced major administrative and technical challenges in accomplishing remedial activities in 2009. First, EM faces unique challenges at each of the three sites on the Oak Ridge Reservation due to the historical achievements of the previous half century. The cleanup projects that are required as a result of the historical activities are numerous, diverse, and complex. EM has also faced declining budgets (see Figure 1), while still being required to comply with strict regulatory commitments. And finally, each of the sites has different ongoing mission needs with multiple contractors. When the American Recovery and Reinvestment Act of 2009 (ARRA) was promulgated, funding timelines and constraints imposed significant additional challenges, but allowed for considerable opportunities and advancements to be made by EM at each of the three Oak Ridge facilities. ARRA allotted \$755 M to Oak Ridge beginning in 2009, enabling EM to push numerous “shovel-ready” projects rapidly to completion. This required hasty reprioritization for some baseline projects, moving some projects forward in the sequence, pushing others back, while maintaining the progress of on-going projects and minimizing disruptions of projects and programs managed by the NNSA, and the Offices of Science and Nuclear Energy.

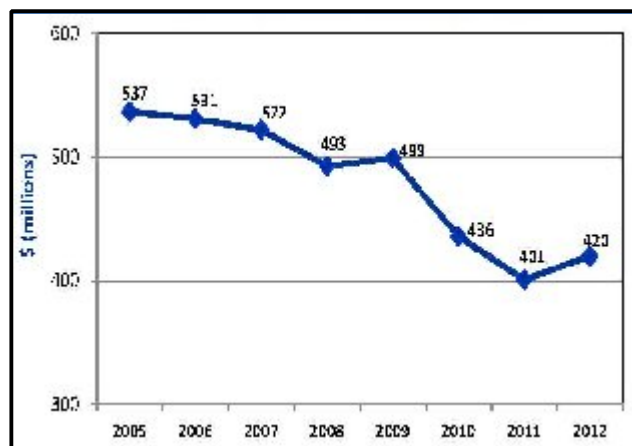


Figure 1. Historical base funding for the Oak Ridge EM Program.

East Tennessee Technology Park

ETTP, the former Oak Ridge Gaseous Diffusion Plant, had served to enrich uranium since the nationally significant World War II Manhattan Project that produced the world’s first nuclear weapon. The plant produced enriched uranium for the commercial nuclear power industry as well from 1945 to 1985, after which uranium enrichment operations were terminated in 1987.

In the midst of a current transformation of the ETTP site to a reindustrialized, privately operated commercial/industrial park, EM is responsible for demolition of the process buildings and the majority of support facilities at the site totaling over 120 ha (300 ac) of building space. In terms of environmental restoration, a total of 891 ha (2,202 ac) of land – 567 ha (1,475 ac) outside the main plant security fence (Zone 1) and 324 ha (801 ac) inside the fence (Zone 2) – require some form of remediation. Groundwater and surface water remediation also need to be addressed.

Y-12 National Security Complex

Early missions of the Y-12 National Security Complex (Y-12) included uranium separations and the manufacture of nuclear weapons components from uranium and lithium, which was associated with the extensive use of mercury. Today, Y-12 is a multifaceted NNSA site, managing the country's uranium storage, processing, and weapons systems as well as providing skilled precision manufacturing and handling of nuclear materials.

EM confronts a number of specific challenges at Y-12 that focus on mercury-related issues, including meeting regulatory mercury levels in surface water that are based on fish mercury concentration limits established by the Environmental Protection Agency, achieving land disposal restriction limits for mercury-contaminated building debris and soils (including the treatment and packaging of significant volumes of mercury-contaminated waste streams), and addressing elemental mercury discovered in various environmental media.

Major D&D-related challenges facing EM at the Y-12 facility include demolition of 99 buildings totaling 0.32M m² (3.4M ft²), of which approximately half is attributed to four mercury-use facilities that, when demolished, will require some portion of the resulting debris be treated for mercury prior to disposal.

Oak Ridge National Laboratory

ORNL was established in 1943 to pioneer methods for producing and separating plutonium. During the 1950s and 1960s, and with the creation of DOE in the 1970s, ORNL became an international center for the study of nuclear energy and related research in the physical and life sciences. ORNL is today one of the world's foremost modern campuses for scientific discovery in materials and chemical sciences, nuclear science, energy research, and supercomputing.

EM's challenges at ORNL are largely associated with the handling of diverse radioactive materials and contaminated equipment and support facilities resulting from the extensive research activities of the past. Many facilities contain hot cells; some facilities have reactor pools containing activated components. Legacy material, including U-233 canisters, TRU waste, and contaminated reactor salts must be treated, packaged, and transported for disposal. These facilities and items pose significant challenges and required specialized handling and tools. Some hot cells will require remote-handling and may require costly structural modifications in order to gain access to contaminated materials. Packaging and shipping these materials for disposal will be costly as well. Logical sequencing of the work, especially when the building has an active interface with waste handling systems, such as the central site gaseous waste system, will require attentive planning.

MAJOR EM ACCOMPLISHMENTS TO DATE

The environmental challenges confronting the Oak Ridge Reservation have been answered with steady remedial progress that has taken place since the formation of EM in 1989. Nearly one-third of the legacy risks on the Oak Ridge Reservation have been remediated through execution of major projects at ETPP, Y-12, and ORNL. Off-site environmental legacy waste sites affected by past DOE operations have been completely remediated. In addition, the supporting processes, permitting requirements, and critical infrastructure such as waste treatment facilities and on-site disposal cells have been put in place to enable demolition, disposition, and remediation to be completed efficiently and effectively. The years since enactment of ARRA in 2009 have seen an acceleration of the remediation pace, with some notable successes as indicated by an **asterisk (*)**.

East Tennessee Technology Park

ETTP has witnessed enormous progress in the last two decades. Notable accomplishments include:

- Demolition of hundreds of buildings, including the former gaseous diffusion buildings: K-33*, K-29, the K-25 west and east wings, totaling ~ 70 ha (175 ac) of building footprint.
- Remediation of approximately 75% of known contaminated soils to a depth of 3 m (10 ft).
- Construction, operation, and closure of the Toxic Substances Control Act Incinerator, which successfully treated 16 M kg (35 M lbs) of waste.
- Agreements with stakeholders regarding historic preservation requirements for the ETTP site.
- Transition of 31,000 m² (332,000 ft²) of building space and 280 ha (693 ac) to the private sector under the reindustrialization mission.

Y-12 National Security Complex

Mercury containment and removal has been EM's remediation priority at Y-12. Past work to remediate mercury at the site includes:

- Constructed two treatment systems that annually remove mercury from 416 M liters (110 M gal) of water.
- Removed and disposed thousands of pounds of mercury-contaminated sludge from Y-12's West End Mercury Area (WEMA) storm sewer system during two different events (one event conducted under ARRA*) that collectively cleaned 4,400 m (14,400 ft) of piping, lined 3,000 m (10,000 ft) of piping, and installed mercury traps in manholes.
- Removed thousands of pounds of mercury from equipment and tanks throughout the complex, under various cleanup initiatives.
- Deactivated and demolished major portions of the Biology Complex* and Building 9735.
- Removed and disposed of almost 17,000 m³ (21,925 yd³) of material/waste from former mercury process buildings (Alpha-5 and Beta-4).*
- Removed contaminated scrap and soils from the Old Scrap Yard, providing portions of the land needed for construction of the new Uranium Processing Facility.*
- Conducted three different vendor tests of a specific mercury treatment method for soils.*
- Constructed the Environmental Management Waste Management Facility (EMWMF), an on-site mixed waste landfill with an operating capacity of 1.68 M m³ (2.2 M yd³) designed to accept only Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) wastes. To date, the landfill has provided disposal capacity for 0.92 M m³ (1.2 M yd³) of CERCLA-generated waste from all three Oak Ridge facilities. Some of the existing capacity was provided under ARRA funds.*
- Expanded waste disposal capacity for industrial and classified landfills at Y-12, increasing on-site industrial waste disposal capacity by 294,000 m³ (384,500 yd³).*

Oak Ridge National Laboratory

Remediation efforts at ORNL have focused upon legacy projects that pose a threat to the public and the environment and to the Department of Energy's ongoing research mission. Accomplishments include:

- Completion of the Transuranic Waste Processing Center, enabling processing of certain legacy ORNL wastes for disposal. ARRA funding during the last several years has accelerated some of the waste repackaging and disposal occurring at this facility.*
- Completion of Melton Valley cleanup, including construction of 59 ha (145 ac) of protective soil caps, removal of 34 facilities, and disposition of 28,300 m³ (37,000 yd³) of materials.

- Contamination areas within Bethel Valley (solid waste storage areas) were capped, closed, and/or modified with surface and groundwater diversion systems (total almost 12 ha [30 ac]).*
- Demolition and disposal of buildings and infrastructure in the northwest and north-central portions of ORNL’s campus (45 of which were completed under ARRA*) to support modernization and integration of new and sustainable technical innovations into new and existing facilities, systems, and processes, like the MAXLAB and Flexible Research Platforms being constructed on the sites of recently demolished buildings.
- Tank W-1A, a principal source of groundwater contamination in ORNL’s main campus, was excavated and disposed, as well as 316 boxes of associated contaminated soil and debris.*
- Approximately half of the total U-233 inventory of canisters will be direct dispositioned through transfer to NNSA for storage and future use or through direct disposition as waste to the Nevada National Security Site. To date, approximately 25% of this inventory has been removed from the site.

Figure 2 shows the projected rate of remediation for all three sites on the Reservation. The projected completion rate for each site is based on estimates of funding required to complete individual remediation projects, and an annual funding profile as shown in Figure 2. While a significant amount of remediation has been completed at ETTP, the majority of the work at Y-12 and ORNL still remains.

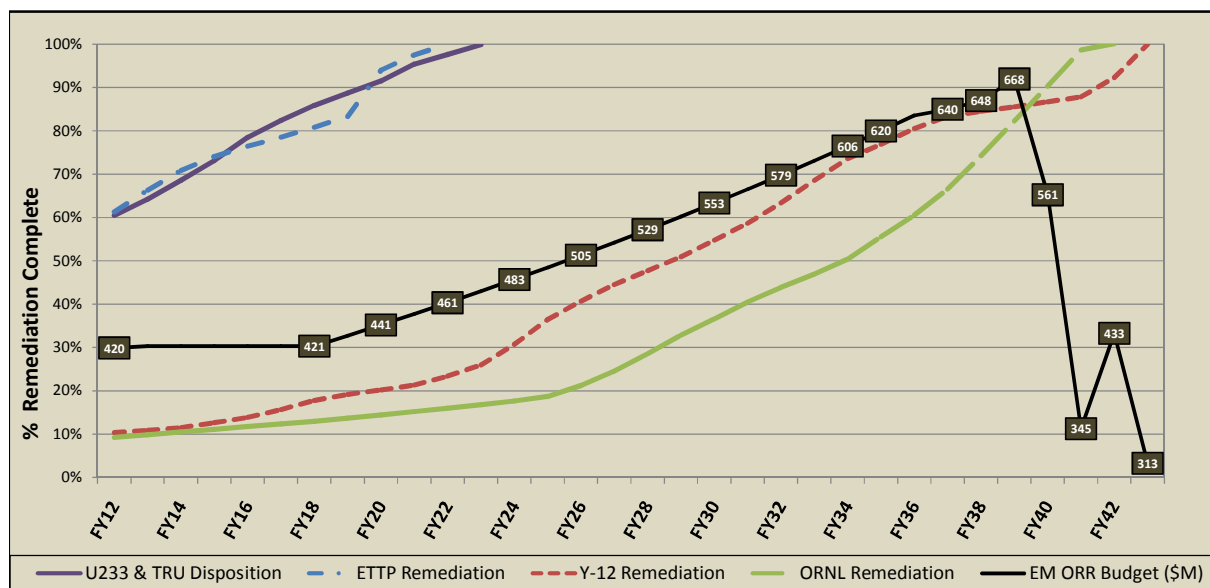


Figure 2. Projected rate of remediation and funding for all three sites on the Reservation.

MOVING TO THE FUTURE

The EM Program in Oak Ridge has worked hard over the past two years to be “Investment Worthy”, and it intends to remain so by continuing to build and sustain collaborative relationships with stakeholders in order to successfully achieve clean-up while accommodating the needs and agendas of programs managed by NNSA and the Offices of Science and Nuclear Energy.

The EM mission completion strategy has been formulated around six long-term objectives:

- Intercept and isolate mercury and other contaminants migrating off-site.
- Remove excess nuclear materials.
- Demolish excess facilities and remediate land.
- Provide on-site disposal capacity for current and future waste.

- Stimulate the regional economy through reindustrialization of ETTP.
- Protect and support DOE’s science, energy, and security missions.

EM has identified near-term (2013 – 2018) goals that support the Department’s long-term strategic objectives within the context of our overarching commitment to the health and safety of the public and employees:

- Complete demolition of Buildings K-25, K-27, and initiate demolition of the remainder of buildings and environmental remediation at ETTP.
- Complete the U-233 direct disposition campaign and proceed with downblending the remainder of the inventory.
- Continue to process and dispose of transuranic wastes including TRU sludges.
- Continue to address mercury releases at Y-12 through a combination of reducing mercury flux in the environment and preparing former mercury use facilities for demolition.
- Reduce the risk posed by nuclear materials in the ORNL central campus by removing excess materials and remediating sources of groundwater contamination.
- Continue to plan for and provide future disposal capacity on the Reservation, to accommodate the foreseeable volumes of debris and soil that will be generated throughout the EM cleanup.

EM’s near-term remediation priorities seek to align and sequence activities to leverage available funds, reduce safety risk, accelerate construction of capital projects, support sustainability initiatives, make land available for program growth and mission change, reduce operational costs, and advance the sites’ respective missions for the nation. Correct project sequencing will achieve these goals logically and with minimal disruption of other missions. The currently proposed work sequence is shown in Figure 3.

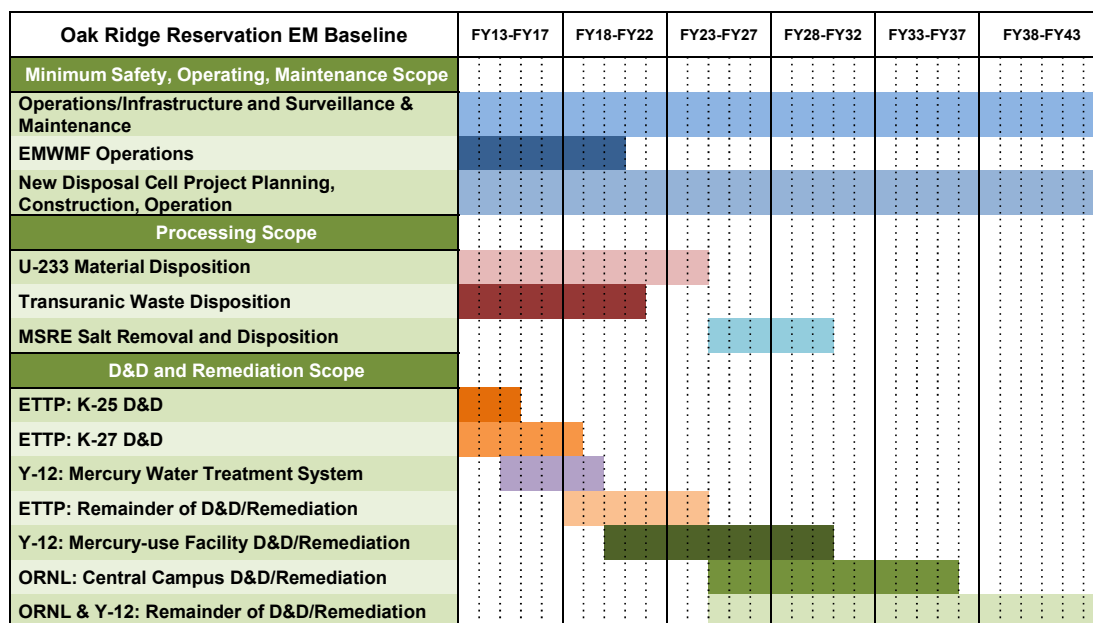


Figure 3. Proposed work sequence for the Oak Ridge Reservation EM projects.

Ongoing sustainability initiatives at both Y-12 and ORNL are supported through the EM Cleanup process. Demolition of facilities opens land for new, more efficient structures and reduces the overall energy footprint of the site. Support to ongoing missions, in terms of reduced risk and improved funding opportunities, is ensured through the reduction and elimination of media contamination and nearby legacy materials and waste.

ORNL has established the Sustainable Campus Initiative to achieve sustainability in its facilities and operations; it currently consists of 28 unique projects or roadmaps, several of which are touched by EM's efforts [2, 3]. For example, under ARRA, EM is installing a new gaseous waste handling system for a number of facilities at ORNL to replace the existing inefficient system that will eventually be demolished. Energy efficient equipment was researched and installed, and waste reduction was a considered element under the project.

Y-12 sustainability efforts have resulted in Department awards for innovation and excellence [4, 5]. EM's future treatment and disposal facility plans will look for ways to support sustainability at the site. EM's excess material dispositions support these sustainability efforts as well. Future sustainability efforts at Y-12 will include shrinking the high security footprint, which will have significant impacts toward reducing EM's cost to work in those facilities currently within the footprint.

Preparing for the Future

The Oak Ridge EM organization has undergone important changes during the past two years. Budget constraints and changes in Program priorities necessitated some of these changes including realignment of the EM organizational structure and changes in lines of authority. The result is a more streamlined organization, tightly focused on successful project execution. Project managers are closer to the ground, more in tune with day-to-day project operations, and, therefore, better able to respond to issues as they arise. The effect of this change is expected to be smoother operations with fewer problems; problems that do crop up are expected to be addressed before they grow unmanageable.

The hard-won remedial successes at ETTP have created an experienced and trained workforce skilled in deactivating, decommissioning, demolishing, and disposing large, complex, and highly contaminated structures. Going forward, the relative availability of funding will define the majority of EM's challenges and opportunities at ETTP, including maintaining a skilled core workforce that ideally could be transitioned from ETTP to Y-12. Schedule delays resulting from declining EM budgets would extend surveillance and maintenance costs at inactive facilities that would otherwise terminate upon the completion of demolition. Extended cleanup delays at ETTP might also result in missed opportunities for reindustrialization in the Oak Ridge community.

Alternatively, a sustained restoration of base funding at 2008 levels would generate the opportunity to reduce infrastructure costs at ETTP and accelerate transfer of land to the private sector, as well as to initiate cleanup at Y-12 sooner than planned. One of the changes the EM program in Oak Ridge has made, in response to the regulators' concerns, is to balance the various priorities on the Oak Ridge Reservation instead of performing cleanup at each of the three sites sequentially. The Reservation has three types of risks: environmental, nuclear/radiological, and lifecycle cost. The primary environmental risk on the Oak Ridge Reservation is the mercury at Y-12, while the primary nuclear/radiological risk is found at ORNL. The greatest lifecycle cost risk is at ETTP, where the large process and support buildings are rapidly deteriorating, in turn causing demolition costs to escalate and schedules to be extended. The result is an increase in the number of years that large surveillance and maintenance costs must continue. The new cleanup strategy at Oak Ridge includes re-prioritizing the work so that there is a more equitable distribution of funds to address each of these risks. This is accomplished by identifying and optimizing efficiencies and looking for innovative ways to perform work.

Lessons Learned

Experience is the best teacher, and experience to date in cleaning up the Reservation has resulted in observations and actions that are being put into practice to improve planning, communications, and project executions. These lessons learned include:

- Improve communications through actively engaging with the stakeholders.
- Proactive decision-making to reduce the likelihood of big problems growing bigger.
- Explore opportunities to create “big wins” early.
- Incentivize innovation and efficiencies through contracting mechanisms.

Improved communications include active listening and a willingness to revisit previous agreements. If practiced regularly, it results in fewer misunderstandings and will ultimately build credibility and trust, which are both essential to getting the work done. Proactive decision making basically means that decisions are made sooner, rather than later. This practice reduces the time spent in indeterminate situations and has the potential to reduce the significance of issues or at least keep them from escalating. In order to become “Investment Worthy” in the environmental cleanup business, it is necessary to prove that an organization can safely execute projects within cost and schedule. No matter how small or large the opportunity, seize it and make the most of the situation; although in order to gain the recognition needed, it is important that an organization establish its ability to tackle large, difficult issues/projects. And finally, it is important to look for ways to incentivize the contractors performing the work to be more efficient and effective. This is because incentives go a long way toward improving outcomes.

Reinvigorating Stakeholder Relationships

Oak Ridge EM is employing a new method of stakeholder collaboration that has reinvigorated and strengthened its working relationship with the regulators, contractors, and the community. Active involvement by senior management in collaborating with all stakeholders to define and reach goals has had a positive effect on project accomplishments. A willingness to alter previous paradigms that is based on an understanding of the issues and challenges as well as agreed-to outcomes has resulted in successful execution and final closure of multiple projects as evidenced through the recent successful completion of numerous ARRA-funded projects. Innovative and creative solutions were employed to characterize and dispose of thousands of pounds of waste, soil, and debris. A lengthy process of extensive communication and planning between all involved parties resulted in gained efficiencies later. One example of the positive results of this new collaborative approach is EM’s success in completing the extensive consultation process on the historic preservation of ETTP with over a dozen parties.

Improved communications within Oak Ridge’s EM Division have allowed the Division to successfully respond to changes in budgets and regulatory initiatives. These changes have enabled EM to revise its Program priorities to meet these changes, with strong support from Headquarters leadership, the regulators, major contractors, and the community at large. Continued implementation of the collaborative method is expected to pay dividends in the form of stakeholder support and trust.

Priorities for the Coming Years

EM is moving to the future by preparing long-term strategies to meet the Department’s mission, vision, and objectives for Oak Ridge. The Oak Ridge EM baseline is being developed with the assumption that funding will remain relatively flat at about \$420 M per year for the next five years. A further assumption is that, if funding grows as projected after 2018, the EM mission can be largely accomplished by 2043, leaving only reduced long-term monitoring and surveillance activities for the years beyond 2043. The availability of funding will define the majority of EM’s challenges and opportunities going forward. Figure 4 illustrates the completion of EM’s scope at the expected funding levels as noted.

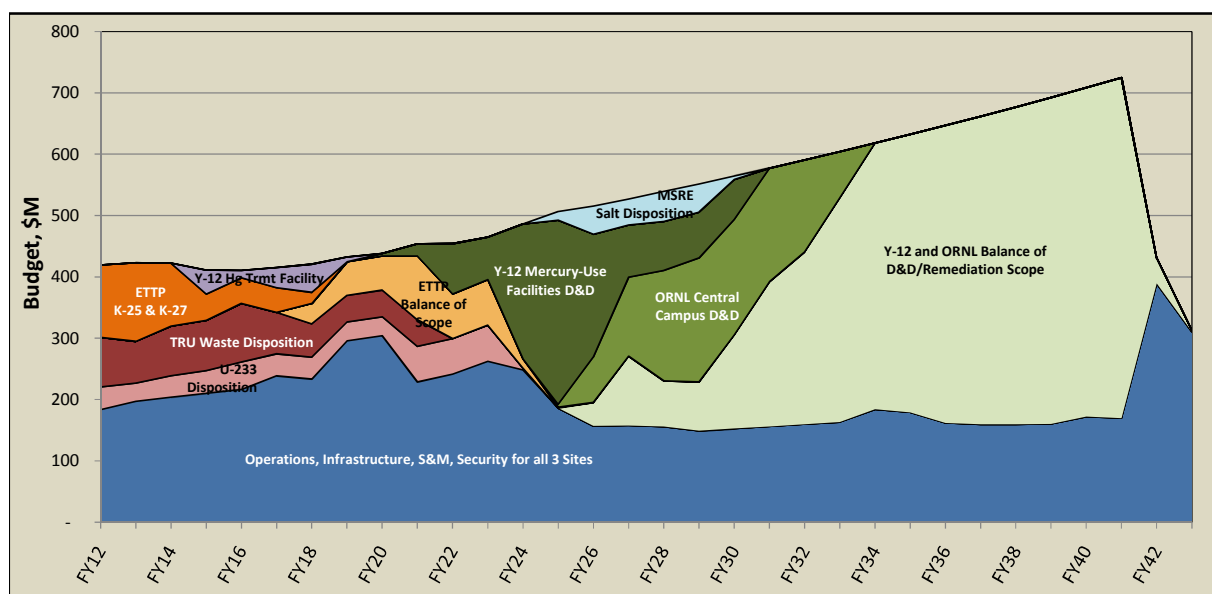


Figure 4. Estimated completion of the Oak Ridge Reservation remediation and major waste disposition.

East Tennessee Technology Park Priorities

The Department’s ultimate goal for ETTP is to turn it into a Brownfield industrial park that plays a vital role in the region’s economy. Near-term objectives are to reduce or eliminate risks to worker safety and the environment and to reduce the high cost of ownership including costs for utility and worker services needed to maintain security, structural integrity, and safety in deteriorating structures. Surveillance and maintenance of these structures drains money from productive uses elsewhere on the Reservation.

To that end, completion of demolition activities at K-25 and initiation of demolition at K-27 represent the first remediation priority for the ETTP site. Soil remediation will be performed as two CERCLA remedial actions – Zone 1 and Zone 2. Completion of Zone 1 remediation is the second priority following the K-25 and K-27 demolitions. All remaining facility demolition scope will be completed before final Zone 2 remediation is undertaken.

Y-12 Priorities

The nation’s security needs are changing, and Y-12 has been undergoing modernization and operational consolidation to meet these changes for more than 10 years. The goals for Y-12’s physical transformation include significant reductions in the high security area, the nuclear operations footprint, and the total building footprint [4, 5], as well as construction of new facilities that incorporate sustainable technologies, such as cool roofs. EM is supporting Y-12’s efforts to reduce the total building footprint primarily through the D&D program. Footprint reduction reduces energy and maintenance needs to assist Y-12 in meeting sustainability goals set forth in Executive Order 13514.

Halting the migration of mercury contamination off-site is the highest EM priority at Y-12 because of the risk associated with mercury levels in fish and Upper East Fork Poplar Creek. Recent increases in surface water mercury flux at the site boundary were attributed to WEMA storm water drain cleanup activities. This increase in mercury flux raises a concern that future demolition and remediation activities will also increase the mercury flux where Upper East Fork Poplar Creek exits the site. Several near-term initiatives are underway in an effort to reduce mercury flux. A key component of these initiatives is construction of

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a centrally located water treatment facility to treat the site's west end area runoff and storm water discharging to Upper East Fork Poplar Creek at Outfall 200 (the sewer discharge point contributing the largest proportion of mercury to Upper East Fork Poplar Creek).

Following this effort, the near-term (2013 – 2018) priorities for Y-12 are construction of the Outfall 200 Water Treatment System and preparation of the three largest former mercury-use process buildings for demolition.

The EMWMF is expected to reach capacity sometime between 2020 and 2023, depending on funding; a new facility will need to be in place before capacity is reached. An additional high-priority project is to design and construct a new CERCLA waste disposal facility to support clean-up efforts beyond 2020.

Priorities for Y-12 in the years beyond 2020 include the remainder of building D&D and remedial actions for soils, groundwater, and surface water.

ORNL Priorities

ORNL is implementing a campus-wide modernization program which, in conjunction with its Sustainable Campus Initiative, will transform ORNL's physical environment to reduce energy and water consumption, produce less waste, and provide an uncontaminated platform for continued research excellence well into the future [3]. Among ORNL's reindustrialization and revitalization priorities provided in the current 10-Year Plan are disposal of legacy facilities and materials and revamping waste management systems accordingly to provide room for sustainable growth [2].

With these site redevelopment priorities in mind, EM has identified the three highest near-term remediation priorities at ORNL as U-233 disposition, TRU waste processing and disposition, and removal/disposition of spent salts from the Molten Salt Reactor Experiment facility. Successful performance of these projects will remove much of the higher activity radioactive waste, allowing D&D work to proceed.

The balance of environmental clean-up scope at ORNL includes building D&D projects (over 250 facilities/structures), legacy material disposition, subsurface structure remediation (piping and tanks), soil, and groundwater/surface water remediation.

EM will continue to perform surveillance and maintenance, security, waste storage operations, and environmental monitoring at ETTP, Y-12, and ORNL. These activities are expected to be reduced commensurate with remedial progress. Final Record of Decision documents, which have yet to be developed for any of the sites, will specify required further and final actions for any remaining contaminated areas in groundwater, soil, and surface water such as long-term monitoring.

CONCLUSION

Going forward, EM's ultimate goal is to complete remediation of the Oak Ridge Reservation, and through this effort, protect the public's health, make land available for sustainable future economic growth, and support the critical science and security missions of DOE. EM will continue to seek input from the public, stakeholders, and state and federal agencies while implementing a strategic plan to reach near-term goals in the context of the long-term focus. This approach will enable EM to balance and prioritize competing risks, optimize progress while maintaining an impeccable safety record, and enhance remedial efficiencies by employing innovative technologies.

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