CLEANING UP AMERICA'S NUCLEAR WEAPONS COMPLEX

2023 Update for Governors

NATIONAL GOVERNORS ASSOCIATION

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CONTENTS

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D-Reactor complex, Hanford Nuclear Reservation, Washington State. D-Reactor was one of three production reactors constructed at Hanford during the Manhattan Project and World War II. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER WASH,3-RICH.V,1–14.

Executive Summary

The research, testing and production of America's nuclear arsenal that began during World War II and continued throughout the Cold War was critical to U.S. national security. However, this work resulted in significant environmental contamination at sites across the country. That contamination is now the focus of the largest environmental cleanup effort in the world. The U.S. Department of Energy Office of Environmental Management (DOE EM) spends more than $6 billion per year to fund cleanup activities and manage the cleanup sites. States play an important role in the cleanup partnership, overseeing the cleanup effort and working with DOE EM to ensure that federal and state laws are followed and that cleanup decisions are transparent, responsible and equitable. The National Governors Association (NGA) Center for Best Practices' Federal Facilities Task Force (FFTF) is a forum in which states directly affected by the cleanup effort can communicate with each other and with DOE EM on waste disposal progress, priorities and challenges and stay informed about technology, policy and budget developments. The FFTF includes California, Idaho, Kentucky, Missouri, Nevada, New Mexico, New York, Ohio, Oregon, South Carolina, Tennessee, Texas and Washington.

Important progress has been made since DOE EM was established in 1989 and the FFTF was founded in 1993, including the establishment of legal frameworks and agreements for cleanup, completion of cleanup operations at 92 of 107 total sites and significant reduction in risk to public health and the environment at all the sites.[1] In addition to successes across the complex, significant cleanup progress has been made in each FFTF state that hosts cleanup sites.

Examples of successes from each state are contained in the body of this report. Recent highlights since the 2015 version of this report include:

- Removal of an entire uranium enrichment complex by 2020 at the Oak Ridge site in **Tennessee**, the first site in the world to do so;
- Completion of **Idaho's** Transuranic Storage Area-Retrieval Enclosure cleanup in 2017;

[1] U.S. Department of Energy, Office of Environmental Management. (n.d.) Retrieved from https://www.energy.gov/em/cleanup-sites.

- Early transfer of land and facility to a private developer for remediation and redevelopment in **Missouri** in 2017;
- Final cleanup of the Hanford hazardous waste burial grounds in **Washington** in 2018;
- Land transfer for community reuse in **Ohio** in 2018;
- Demolition of the West Valley vitrification plant in **New York** in 2018;
- Restarting waste disposal in 2017 at the Waste Isolation Pilot Plant in **New Mexico** after operations were suspended in 2014 because of an accident and radiation release;
- Cleanup and closure of more than 1,000 contaminated sites at **Nevada** National Security Site; transfer of 70 closed sites on and around the Tonopah Test Range to DOE Office of Legacy Management;
- Removal of contaminated structures, groundwater treatment, and stormwater treatment at Santa Susana Field Lab in 2021-2022 and Lawrence Livermore National Laboratory in **California**; and
- Closure of waste tanks, vitrification of high-level waste, and salt waste processing at the Savannah River Site in **South Carolina**.

Progress continues, but substantial work remains. Completing the cleanup is projected to cost between $652 and $887 billion (in 2022 dollars) and last through at least 2078[2], assuming that all technical, regulatory and funding challenges are overcome.

Each site has its own unique environmental and regulatory challenges, but the states share the following five priority issues, each of which is supported by their adopted principles as noted after each issue:

> **Jointly Setting Funding Priorities.** States have worked with DOE EM to ensure that funding is sufficient to meet cleanup requirements and that budget decisions are made transparently and in consultation with states. Because funding for cleanup fluctuates, however, and cannot cover every project in the DOE EM portfolio, it is important for DOE EM to proactively seek state input on cleanup project priorities and communicate to states the effect that deferred cleanup will have in the short term on the ultimate cost and timeline for completing cleanup. ***The FFTF encourages DOE EM to set priorities jointly with states during budget shortfalls by using the principles developed by the FFTF that incorporate "risk plus other factors" as a priority-setting framework.***[3]
>
> **Ensuring Compliance.** Existing agreements between states and DOE EM that establish cleanup plans and timetables also establish cleanup milestones and provide states with legal recourse when cleanup is not adequately progressing. Understanding whether and how DOE EM will meet its compliance requirements and how it will respond if it cannot do so is a crucial element of state oversight. State concerns with compliance also include determining levels of cleanup that will be protective over the long term, enabling effective state oversight, including appropriate roles for risk in decision making and ensuring that DOE EM assesses and compensates for damage to natural resources. ***The FFTF encourages pursuit of site cleanup levels that allow for public reuse and, if waste must be left in place, application of long-term stewardship to protect human health and the environment. The FFTF encourages risk-informed decision making, open and transparent communication from DOE EM on long-term planning and transparency when DOE EM is in jeopardy of missing compliance milestones. The FFTF also encourages DOE EM's fulfillment of obligations under the Natural Resource Damage Assessment and restoration process.***

[2] Department of Energy, Office of the Chief Financial Officer, *FY2023 Congressional Budget Request - Volume 6, Environmental Management*. May 2022. DOE/CF-0186.
[3] See Appendix E for the FFTF's full principles.

Managing Waste Safely. States and DOE EM have worked together to make transparent, equitable decisions about the treatment, transportation, and disposal of radioactive waste. States continue to work with DOE EM to ensure that all parties manage all waste types according to DOE's internal management guidelines, transport waste safely and appropriately monitor sites with long-term contamination. ***The FFTF supports DOE's efforts to develop interim storage and permanent disposal options for high-level radioactive waste (HLW) that have the consent of host states and to coordinate transportation with affected states.*** DOE published a Federal Register Notice on December 21, 2021 (86 FR 72220) affirming its HLW Interpretation, which outlines an approach, within the existing legal definition, that allows radioactive waste generated from the reprocessing of spent nuclear fuel for atomic defense purposes to be disposed in accordance with its radiological characteristics and not solely from the process that generated the waste.[4] States are concerned that this interpretation could affect agreed-upon strategies and locations for waste disposal. ***The FFTF encourages DOE to consult with states to understand the impact that the change in waste classification methodology will have on compliance agreements and on the ultimate disposition of waste***.[5]

Improving Communication. The FFTF is concerned about unclear processes for discussing concerns with DOE EM and lack of notification on key issues. States have several avenues for communicating concerns, such as advisory boards and local DOE EM site offices, but the FFTF questions whether current forums are adequate to elevate major or long-standing disputes. ***The FFTF supports establishing direct communications channels and protocols with DOE EM to elevate and resolve major and long-standing disputes.***

Developing Uniform Emergency Response Communication Protocols. With the proliferation of smartphones and social media, information, misinformation and unauthorized photographs can be shared rapidly on the internet and national television. During an emergency, it is critical that intergovernmental partners and the public receive correct information and for misinformation to be dispelled quickly. ***The FFTF suggests that DOE EM, in coordination with the states and other parties, develop a uniform public communications protocol for emergency situations that recognizes rapid dissemination of information in the age of social media.***

The development of America's nuclear weapons program lasted several decades and directly affected communities across the country. Cleaning up the program's environmental legacy will take many more decades, cost billions of dollars and require a strong partnership between the states and the federal government to complete. Despite the high cost, lengthy timeline, and other challenges, states appreciate and are committed to their partnership with DOE EM to ensure the success of the cleanup mission. The FFTF looks forward to helping maintain this strong state-federal partnership, which will ultimately result in greater protections for human health and the environment for generations to come.

[4] On June 10, 2019, DOE issued a Supplemental Notice Concerning U.S. Department of Energy Interpretation of High-Level Radioactive Waste (Supplemental Notice; 84 FR 26835), explaining its interpretation of the statutory term "high-level radioactive waste" (HLW), as defined in the Atomic Energy Act of 1954, as amended (AEA; 42 U.S.C. 2011 et seq.), and Nuclear Waste Policy Act of 1982, as amended (NWPA, 42 U.S.C. 10101 et seq.). In January 2021, the HLW Interpretation was incorporated into DOE Manual 435.1–1, Radioactive Waste Management Manual, as a limited change. Additional information on the HLW interpretation can be found at: https://www.energy.gov/em/high-level-radioactive-waste-hlw-interpretation.

[5] U.S. Department of Energy, Office of Environmental Management. (2018, October 10). Request for public comment on the U.S. Department of Energy interpretation of high-level radioactive waste. Federal Register. Retrieved from https://www.federalregister.gov/d/2018-22002.

Mound Site, Miamisburg, Ohio. The facility operated from 1948 to 2003 and supported various DOE weapons and energy programs throughout its existence. Photo courtesy of Library of Congress, Prints & Photographs Division, HABS, Reproduction number HABS OH-2470-D-1

Introduction

America's nuclear weapons complex, developed during World War II and expanded throughout the Cold War, provided important U.S. security benefits. It also created a significant environmental legacy that spanned 107 sites and 35 states and will require decades to clean up. The U.S. Department of Energy (DOE) oversees the cleanup effort in coordination with regulators in states that host or are adjacent to active cleanup sites.

In 1992, Congress passed the Federal Facilities Compliance Act (FFCA).[6] The FFCA required DOE to report on the inventory of waste at its contaminated sites and to propose cleanup plans for state review and approval. The FFCA also gave states additional regulatory and oversight authority, allowing them to levy fines on DOE for failure to comply with agreements, and required that DOE's cleanup adhere to federal environmental laws.[7] Today, DOE's Office of Environmental Management (EM), created in 1989, oversees a significant portion of the cleanup effort alongside state regulators. Following closure, sites may require long-term stewardship (LTS), including surveillance and maintenance, often while being repurposed for other uses.

COMBINED INTERGOVERNMENTAL WORKING GROUP

To facilitate open dialogue across all levels of government, the NGA, in partnership with DOE EM, facilitates the Combined Intergovernmental Working Group (CIWG), which is made up of six state, community and tribal organizations and DOE EM. These organizations include the Energy Communities Alliance, the Environmental Council of the States, the National Association of Attorneys General, the NGA Federal Facilities Task Force, the National Conference of State Legislatures Nuclear Legislative Working Group and the State and Tribal Government Working Group. The CIWG holds conference calls quarterly to coordinate activities and priorities. Since 2003, the six intergovernmental groups have also met annually with DOE EM in a combined intergovernmental meeting to foster open dialogue, transparency and coordination.

[6] Federal Facility Compliance Act of 1992, 102d Cong. (1992) (enacted). Retrieved from https://www.govinfo.gov/content/pkg/STATUTE-106/pdf/STATUTE-106-Pg1505.pdf.
[7] See Appendix B for more information on how cleanup decisions are made.

Federal Facilities Task Force

To ensure achievement of the FFCA's goals, the National Governors Association (NGA) Center for Best Practices established the Federal Facilities Task Force (FFTF) in 1993 to help Governors address challenges and improve coordination with DOE EM. The FFTF currently consists of Governor-appointed policy and technical representatives from 13 states (**California, Idaho**, **Kentucky**, **Missouri**, **Nevada**, **New Mexico**, **New York**, **Ohio**, **Oregon**, **South Carolina**, **Tennessee**, **Texas** and **Washington**).

One of the FFTF's first activities was to coordinate the development of the initial site treatment plans under the FFCA. That process included discussions of equity among the states because some waste would need to be disposed of in other states. Based on the successful collaboration that immediately followed the FFCA site treatment plan process, The FFTF continued to interact regularly with each other and with DOE EM to discuss cleanup progress and explore new technical and policy issues.

The FFTF convenes regularly through bimonthly conference calls and semiannual meetings to coordinate cleanup priorities and activities among the states and with DOE EM and other intergovernmental groups. The FFTF examines critical technical, policy and budget issues and improves coordination among major program decisions on a range of issues related to radioactive material and waste.[8] It also participates in the annual meeting of the CIWG, which is made up of six state, community and tribal organizations and DOE EM (see box on previous page) to discuss critical issues and coordinate activities.

The map in Figure 1 shows the remaining major cleanup sites in the FFTF and highlights states that are members of the FFTF. Also included are DOE's estimated completion dates for final closure of each site. Missouri, Texas and Oregon do not have active cleanup sites run by DOE EM but are members of the FFTF because of their proximity to other DOE EM cleanup sites and because they engage in activities relevant to the group. Sites not shown on the map include Brookhaven National Laboratory and the Separations Process Research Unit in New York, and the Moab Uranium Mill Tailings Remedial Action project in **Utah**.

[8] For more information about the FFTF, see Appendix F.

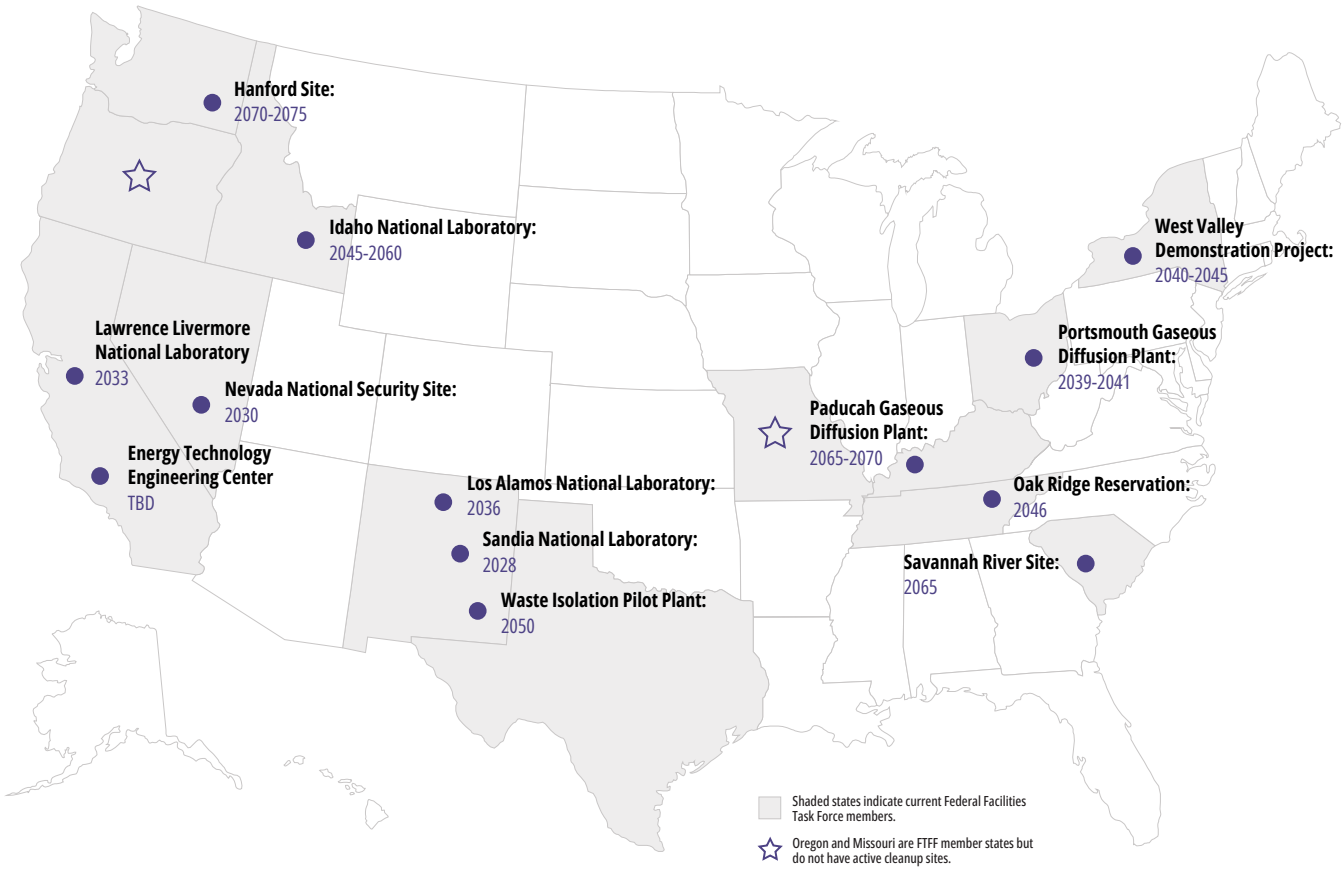

FIGURE 1: Map of the major DOE EM sites undergoing cleanup in the FFTF and the estimated completion dates for final closure of those sites. All FFTF states, including those without active cleanup sites, are highlighted.

Closure dates shown are DOE EM estimates for completion of cleanup at these major sites, as reported in DOE's fiscal 2022 budget request to Congress. Several caveats apply: (1) Several sites — Los Alamos National Laboratory, Idaho National Laboratory, Nevada National Security Site, Oak Ridge Reservation, Sandia National Laboratory and Savannah River Site — have ongoing missions. Because these sites will not close, the dates shown reflect estimated completion of cleanup. (2) The Waste Isolation Pilot Plant in New Mexico functions as a disposal facility. However, it is expected to fulfill its mission once the Land Withdrawal Act volume is reached. (3) In other cases, like at the West Valley Demonstration Center in New York, closure dates are interim estimates, with final closure dates yet to be defined pending forthcoming Records of Decision. (4) In several cases, projected closure dates do not match dates that are in current compliance agreements with states for completion of all required cleanup. (U.S. Department of Energy, 2022, *Department of Energy FY22 congressional budget request: Environmental management*).

Waste Calcining Facility, Idaho. The Waste Calcining Facility operated from November 1963 to March 1981 and converted 4,091,000 gallons of aqueous radioactive waste into 77,300 ft3 of calcined solids. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER ID,12-SCOVI.V,1C-2

Successes Around the Complex

Since the 1992 enactment of the FFCA, DOE and states have worked together to clean up the nuclear weapons complex. To date, they have completed cleanup at 92 sites across the United States. Recent examples of successful efforts across the nuclear weapons complex include:

- Removal of an entire uranium enrichment complex by 2020 at the Oak Ridge site in Tennessee, the first site in the world to do so;
- Completion of the Idaho Transuranic Storage Area-Retrieval Enclosure (TSA-RE) transuranic (TRU) waste cleanup effort in 2017;
- Early transfer of land and facility to a private developer for remediation and redevelopment in Missouri in 2017;
- Final cleanup of Hanford hazardous waste burial ground in Washington in 2018;
- Land transfer for community reuse in Ohio in 2018;
- Demolition of the West Valley vitrification plant in New York in 2018;
- Restarting waste disposal at the Waste Isolation Pilot Plant (WIPP) in New Mexico in 2017 after operations were suspended in 2014 because of an accident and radiation release;
- Cleanup and closure of more than 1,000 contaminated sites at Nevada National Security Site; transfer of 70 closed sites on and around the Tonopah Test Range to DOE Office of Legacy Management;
- Removal of contaminated soil and structures, groundwater treatment, and stormwater treatment at Santa Susana Field Lab in 2021-2022 and Lawrence Livermore National Laboratory in California; and
- Closure of waste tanks, vitrification of high-level waste, and salt waste processing at the Savannah River Site in South Carolina.

Additional details on cleanup successes are noted below. Other cleanup successes are included in the state-specific sections of this guide starting on page 20. Earlier cleanup successes at each site have been covered in detail in past reports.

Cleanup Successes

Nevada: Contaminated Site Cleanup

At the Nevada National Security Site, all but 101 of 2,000 identified contaminated sites have been clean-closed or closed in place, meeting specific protective closure criteria that enable DOE to close the site with use restrictions. Also, to date, all 143 soil sites have either been clean-closed or closed in place with monitoring and use restrictions through a process to which the state and DOE have agreed. In September 2020, DOE EM transferred 70 legacy corrective action sites on and around the Tonopah Test Range to DOE LM.

California: Cleanup Progress at Santa Susana Field Lab

Since cleanup began, contractor crews have removed or treated over 45,000 cubic yards of soil, demolished more than 300 structures, restored 900 acres of land and built three stormwater treatment systems and one groundwater treatment system. Crews completed final demolition of the DOE-owned buildings at the Energy Technology Engineering Center in October 2021 and removed and disposed of 22,000 cubic yards of waste and building materials from the site by January 2022.

South Carolina: Liquid Tank Waste Closure and HLW Vitrification

As of 2021, eight liquid waste tanks have been operationally closed — a third of the total old-style tanks scheduled for closure. Since 1996, the Defense Waste Processing Facility has produced 16.4 million pounds of vitrified HLW incorporating over 62.4 million curies in over 4,250 canisters. Finally, as of January 18, 2022, the Salt Waste Processing Facility has processed 2.3 million gallons of high-level waste.

Tennessee: First Site in the World to Remove an Entire Uranium Enrichment Complex

In August 2016, DOE EM contractors tore down the final portion of the Oak Ridge Gaseous Diffusion Complex. This historic milestone marked the first completed demolition of a gaseous diffusion project in the world. The original K-25 gaseous diffusion plant began operations in 1942 as part of the Manhattan Project and produced weapons-grade enriched uranium. DOE added several more buildings to Oak Ridge diffusion operations during the Cold War, creating a massive complex of buildings to support enrichment

Office of Legacy Management

Ideally, waste and other hazards are fully removed from a contaminated site so that the land can be released for unrestricted use. That approach avoids engineered or institutional controls that require ongoing funding and are vulnerable to failure over the long-term. However, it is not always feasible to restore sites to unrestricted use because the associated costs or risks to cleanup workers would outweigh the marginal reduction in risk of such an approach. The residual contamination of those sites presents a danger to human health and the environment that requires long-term management.

With state support, DOE established the Office of Legacy Management (LM) in 2003 to manage responsibilities after site closure and ensure future protection of human health and the environment. As of 2022, DOE LM is responsible for 101 sites (see https://www.energy.gov/lm/office-legacy-management). DOE LM activities include maintaining all engineered and institutional controls designed to contain or prevent exposure to residual contamination and waste, record-keeping activities, groundwater and surface water monitoring and emergency response. Although some smaller sites that DOE LM manages did not require complicated or lengthy closure plans, several sites, including Mound, Ohio, and Weldon Springs, Missouri, are notable for the technical and funding hurdles that needed to be overcome to achieve closure.

activities.[9] In 2020, DOE completed the removal of the remaining facilities within the uranium enrichment complex, returning 1,300 acres of land to the community for economic development. The site of the gaseous diffusion complex is now known as the East Tennessee Technology Park (ETTP).

Idaho: Completion of Waste Retrieval at TSA-RE

In early 2017, DOE EM completed activities at TSA-RE, a building with a seven-acre footprint that housed DOE's largest stockpile of legacy TRU waste for more than 20 years. The TRU stockpile consisted of more than 50,000 cubic meters (m^3) of metal drums and boxes buried under an earthen berm. Excavation and retrieval activities at TSA-RE began in 2003, and all drums and boxes retrieved will eventually be repackaged and prepared for shipment out of Idaho for final disposal.[10]

Missouri: Early Transfer of Land and Facility to a Private Developer

DOE and the U.S. General Services Administration (GSA) jointly owned and managed the 300-acre Bannister Federal Complex in Kansas City, Missouri, for more than 70 years until 2017, when the property was transferred to Bannister Transformation & Development LLC. The transition was completed under the "early transfer" process, whereby a federal property can be transferred prior to completion of remedial action. The private developer will perform environmental restoration on-site and demolish obsolete buildings, with oversight from Missouri Department of Natural Resources. Transfer of the site to a private entity for demolition and remediation is expected to provide significant savings to the federal government.[11]

Washington: Final Cleanup of Hanford Hazardous Waste Burial Ground

During the Cold War, DOE developed and manufactured reactor fuel for plutonium production at the 300 Area of the Hanford site in eastern Washington. Hazardous waste from the 300 Area was buried in the 618-10 burial grounds in pipes, drums, boxes and bottomless tanks, and much of the soil surrounding the grounds was highly contaminated.[12] In mid-2018, DOE EM, the Washington State Department of Ecology and the U.S. Environmental Protection Agency (EPA) certified cleanup at the 618-10 area complete. This intense, eight-year effort involved removal of more than 512,000 tons of contaminated soil and waste debris.[13] DOE EM contractors will work on returning the 618-10 site to a natural state, including planting native species.

Ohio: First Parcel of Federal Property Transferred for Community Reuse

In July 2018, DOE EM transferred 80 acres of federal land to the Southern Ohio Diversification Initiative (SODI), a community reuse organization for the Portsmouth Site. The land is the first to become available for transfer since decontamination and decommissioning began at the Portsmouth Gaseous Diffusion Plant in 2011. SODI will use the land for local economic development initiatives.[14]

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[9] U.S. Department of Energy, Oak Ridge Office of Environmental Management. (2016, August 30). *DOE completes decade-long project at Oak Ridge gaseous diffusion complex* [Press release]. Retrieved from https://www.energy.gov/orem/articles/doe-completes-decade-long-project-oak-ridge-gaseous-diffusion-complex.

[10] U.S. Department of Energy. (2017, March 15). *Transuranic waste retrieval at Idaho's AMWTP now complete* [Press release]. Retrieved from https://www.energy.gov/em/articles/transuranic-waste-retrieval-idaho-s-amwtp-now-complete.

[11] Kansas City National Security Campus. (2017, December 18). NNSA completes transfer of Bannister Federal Complex to private developer for demotion, remediation and redevelopment [Press release]. Retrieved from https://kcnsc.doe.gov/news/latest-news/2017/12/19/nnsa-completes-transfer-of-bannister-federal-complex-to-private-developer-for-demolition-remediation-and-redevelopment.

[12] U.S. Department of Energy. (2018, May 13). Hanford 300 Area. Retrieved from https://www.hanford.gov/page.cfm/300area.

[13] U.S. Department of Energy. (2017, November 30). *Workers finish cleaning up high-hazard waste site near Richland* [Press release]. Retrieved from https://www.hanford.gov/news.cfm/DOE/618-10_wrap_up.pdf.

[14] First parcel of land to be transferred at DOE site. (2018, July 5). *The Pike County (New York) News Watchman*. Retrieved from https://www.newswatchman.com/news/article_a085e58f-9eaf-51aa-80b1-35b62afa2dad.html.

New York: Completed Demolition of West Valley Vitrification Plant

In 2018, DOE EM contractors completed deactivation and demolition of the vitrification facility at New York's West Valley site, marking the first time a vitrification facility at a DOE EM site had completed its mission, from startup to demolition (Figure 2). The vitrification facility at the West Valley site operated from 1996 to 2002; during that time, it converted 600,000 gallons of high-level liquid radioactive waste into solid form by mixing the waste with glass-forming materials, heating the mixture to form molten glass and pouring the molten glass waste material into stainless steel canisters to cool and solidify.[15]

FIGURE 2: Demolition of the West Valley Vitrification Plant. Photo courtesy of U.S. Department of Energy.

New Mexico: Resumed WIPP Operations

The WIPP began receiving shipments of remote-handled TRU waste in 2007 and continued to do so until 2014, when two safety incidents (an underground salt haul truck fire on Feb. 5, 2014, and an underground radiological release on Feb. 14, 2014) resulted in suspension of regular shipping and disposal operations.[16] In April 2017, WIPP resumed operations and began receiving waste shipments for disposal in the facility's underground salt tunnels (Figure 3). As of May 2022, WIPP had received over 13,000 waste shipments from 13 sites across the country.[17]

FIGURE 3: Excavation of the WIPP disposal room. Photo courtesy of U.S. Department of Energy.

Site Closures

States and DOE EM share the goal of safely closing all sites in the nuclear weapons complex. "Site closure" is defined as the completion of cleanup to safe and acceptable levels so that only long-term monitoring and stewardship are required rather than active cleanup operations. DOE EM and the states have made substantial progress cleaning up and closing contaminated sites. A total of 92 of the 107 sites have been closed, 80 of which were closed after the establishment of DOE EM in 1989.[18] As of 2022, five large sites have been successfully closed: the Weldon Spring Site in Missouri, Fernald in Ohio, Rocky Flats in Colorado, Mound in Ohio and Brookhaven National Laboratory in New York.

Missouri: Weldon Spring

Weldon Spring in Saint Charles, Missouri, operated from the mid-1950s to 1967 and included a chemical plant that converted processed uranium ore concentrates. Wastes generated during these operations resulted in significant radiological contamination, and the site was placed on the National Priorities List (NPL) in 1987.[19] Site cleanup, which began in the late 1980s, resulted in a 41-acre disposal cell surrounded by 150 acres of restored native prairie. Weldon Spring was transferred to DOE LM in 2003.[20]

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[15] U.S. Department of Energy. (2018, September 25). *EM crews successfully complete major demolition at West Valley* [Press release]. Retrieved from https://www.energy.gov/em/articles/em-crews-successfully-complete-major-demolition-west-valley.

[16] U.S. Department of Energy, Office of Environmental Management. (2014). *Accident investigation report: Underground salt haul truck fire at the Waste Isolation Pilot Plant.* Retrieved from http://www.wipp.energy.gov/Special/AIB Report.pdf. See also U.S. Department of Energy. (2014, February 14). *Accident investigations of the February 14, 2014, radiological release at the Waste Isolation Pilot Plant, Carlsbad, NM* [Press release]. Retrieved from https://www.energy.gov/ehss/downloads/accident-investigations-february-14-2014-radiological-release-waste-isolation-pilot.

[17] Waste Isolation Pilot Plant Shipment & Disposal Information. Retrieved from https://wipp.energy.gov/shipment-information.asp.

[18] The complete list of sites is available at U.S. Department of Energy, Office of Environmental Management. Cleanup sites. Retrieved from https://www.energy.gov/em/clean-up-sites.

[19] U.S. Department of Energy. (2013). *2012 Annual inspection report for the Weldon Spring, Missouri* [page 2]. Retrieved from https://www.lm.doe.gov/Weldon/ir_wel.pdf.

[20] U.S. Department of Energy, Office of Legacy Management. (2019, March 11). *Weldon Spring fact sheet.* Retrieved from https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=11975.

FIGURE 4: Fernald Site in 1987 (left) and 1990 (right). Photos courtesy of U.S. Department of Energy.

Ohio: Fernald

The Fernald Closure Project is a successful example of an accelerated cleanup process. The Fernald site, 18 miles from Cincinnati, produced approximately 500 million pounds of low enriched uranium for use at other government facilities involved in the production of nuclear weapons from the early 1950s through the late 1980s.[21] A 1992 report forecasted completion of cleanup in 2019 at a cost of $12.2 billion; accelerated cleanup, including the removal of more than a million tons of radioactive material and the demolition of 323 buildings, reduced the final cost to $4.4 billion.[22] DOE EM completed the closure and transition to DOE LM in 2006. Following soil cleanup, restoration ecologists developed nearly 400 acres of woodlots, 327 acres of prairie, more than 140 acres of open water and wetlands, and 33 acres of savanna, restoring the area to an undeveloped park with an emphasis on wildlife and education (Figure 4).[23]

Colorado: Rocky Flats

From 1952 to 1994, the Rocky Flats facility, 16 miles from downtown Denver, produced components for the U.S. nuclear arsenal. The site primarily produced the plutonium pit or trigger for nuclear weapons, generating substantial environmental contamination and cleanup challenges (Figure 5).[24] DOE EM initially predicted that site closure would take approximately 65 years at more than $37 billion in cleanup costs.[25] Beginning in 1996, DOE EM, its contractor and the state of Colorado worked together to develop a more cooperative cleanup agreement that streamlined the regulatory process and included a performance- and incentive-based contract that set an aggressive target closure date of 2006. With an infusion of additional funding to accelerate the work, DOE EM completed cleanup nearly a year ahead of the accelerated schedule

FIGURE 5: Rocky Flats plant circa 1978. The area in which the plant was located is now under authority of the U.S. Fish and Wildlife Service. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER COLO,30-GOLD.V,1—26.

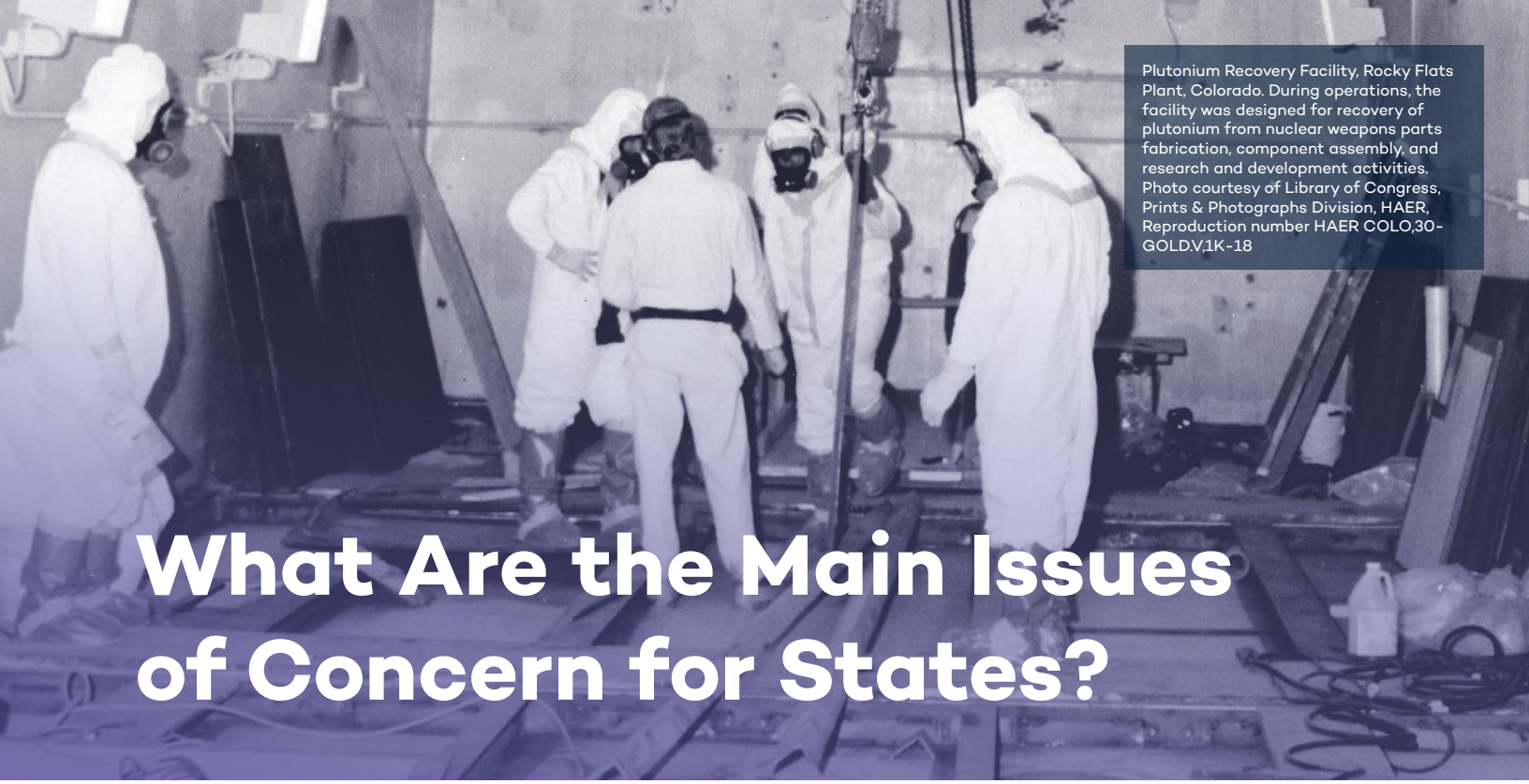
[21] Fluor Corporation. (2007, January 29). *Fluor receives formal acceptance from U.S. Department of Energy; Fernald clean-up is complete* [Press release]. Retrieved from http://www.lm.doe.gov/land/sites/oh/fernald_orig/NewsUpdate/pdfs%5CFluor Fernald ReceiFormal DOE Acceptance.pdf.
[22] U.S. Department of Energy, Office of Legacy Management. *Fernald Preserve, Ohio* [Fact Sheet]. Retrieved from https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=7241.
[23] U.S. Department of Energy, Office of Legacy Management. (2018, November). *Mound, Ohio* [Fact Sheet] Retrieved from https://www.lm.doe.gov/Mound/Fact_Sheet-Mound.pdf.
[24] U.S. Environmental Protection Agency. (2018, October 23). Superfund site: Rocky Flats plant (USDOE) Golden, CO. Retrieved from https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0800360.
[25] U.S. Department of Energy, Rocky Flats Project Office. (2006, August). *Closure legacy: From weapons to wildlife* [pages 1–5]. Retrieved from https://www.lm.doe.gov/land/sites/co/rocky_flats/closure/references/Closure_Legacy_Document.pdf.

and $7.4 billion under budget. After consultation with state government and other parties, most of the site was transferred to the U.S. Fish and Wildlife Service in 2007.[26] DOE LM is responsible for part of the Rocky Flats site and provides ongoing monitoring and maintenance.

Ohio: Mound

The Mound site, located in Miamisburg, Ohio, produced polonium-beryllium initiators used in atomic weapons and conducted research related to radionuclides and detonators. The 1990 Federal Facilities Agreement (FFA) (amended in 1993 to include the state of Ohio) established a procedural framework and schedule for developing appropriate responses; it also facilitated cooperation and exchange of information among the agencies. By September 30, 2006, all nuclear material had been shipped off-site, facilities had been demolished or decontaminated and most environmental remediation activities were complete. Responsibility for site management was transferred to DOE LM in 2010.[27]

[26] U.S. Department of Energy, Office of Legacy Management. (2018, November). *Rocky Flats, Colorado, site* [Fact Sheet]. Retrieved from https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=2963.
[27] U.S. Department of Energy, Office of Legacy Management. *Fernald Preserve, Ohio, site* [Fact Sheet]. Retrieved from https://www.lm.doe.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=7241.



Plutonium Recovery Facility, Rocky Flats Plant, Colorado. During operations, the facility was designed for recovery of plutonium from nuclear weapons parts fabrication, component assembly, and research and development activities. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER COLO,30-GOLD.V,1K-18

What Are the Main Issues of Concern for States?

Since 1993, the FFTF has worked with DOE EM to address individual site concerns and issues of common interest throughout the nuclear weapons complex. The FFTF is focused on five key issues related to environmental cleanup:

- Setting priorities for federal funding to meet agreed-upon, enforceable cleanup milestones;
- Ensuring that cleanup sites comply with federal and state cleanup standards;
- Managing radioactive waste safely, including transportation, disposal and long-term stewardship;
- Improving communication pathways between states with DOE EM sites and DOE EM headquarters; and
- Developing uniform emergency response communication protocols to address rapid dissemination of information in the age of social media.

Setting Funding Priorities

Ensuring sufficient funding to clean up the nuclear weapons complex in a manner that appropriately balances short- and long-term needs is a high priority for states. Because funding for cleanup is allocated through the federal budget process, DOE and the president must request and Congress must appropriate sufficient annual funding to meet cleanup commitments and avoid higher future costs. Under Executive Order 12088, DOE is required to request a budget that complies with environmental requirements.[28] However, the order applies only to DOE's initial budget request.[29] Neither the president's budget request nor the budgets developed by congressional appropriators are subject to those requirements. Therefore, those requests could be insufficient to meet all compliance commitments, potentially slowing the pace of remediation of environmental risks in the short term and likely

[28] Exec. Order. No 12088, 43 C.F.R. 47707 (1978); 3 C.F.R., (1978) Comp., p. 243.
[29] Executive Order 12088 states: "Each Executive agency shall submit to the Director of the Office of Management and Budget, through the Administrator, an annual plan for the control of environmental pollution. The plan shall provide for any necessary improvement in the design, construction, management, operation, and maintenance of Federal facilities and activities, and shall include annual cost estimates. The Administrator shall establish guidelines for developing such plans... In preparing its plan, each Executive agency shall ensure that the plan provides for compliance with all applicable pollution control standards."

contributing to an increase in the total costs associated with cleanup over the long term. This is particularly important given that a significant portion of the DOE EM cleanup budget is allocated to "hotel costs" – that is, the minimum funding required to safely maintain the status quo of existing (often aging) infrastructure without advancing progress toward cleanup.

Since the maturation of the cleanup program in the mid-1990s, DOE EM funding levels for cleanup have typically ranged from $6 billion to $8 billion per year, as illustrated in Figure 6 below, with the exception of a $6 billion funding increase in 2009-2010 from the American Recovery and Reinvestment Act (ARRA).[30]

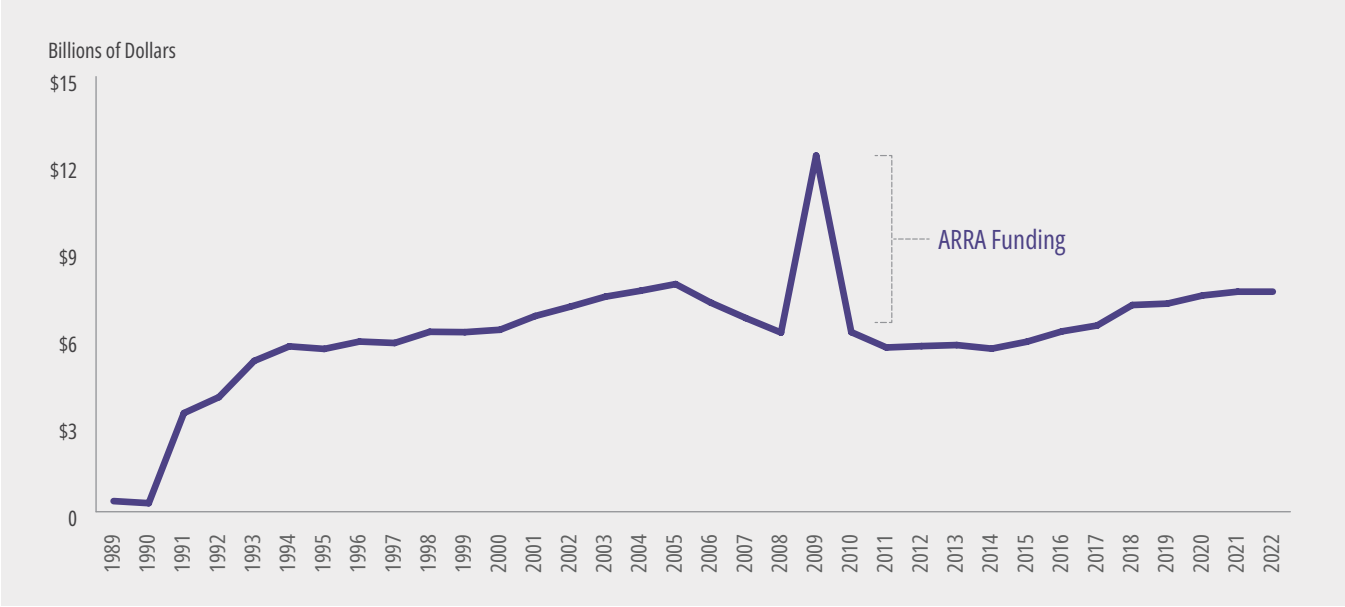


FIGURE 6: DOE EM budget in nominal (as enacted) dollars (1989-2022). Source: Data compiled from historical DOE budget statements.

Even with an annual budget between $6 billion and $8 billion, funding is often insufficient to cover every project in the DOE EM portfolio. Thus, jointly developing priorities for projects within sites and across the complex is necessary. In 2012, the FFTF, with input from DOE EM, developed principles to guide the process by which states and DOE EM would jointly set priorities for cleanup projects. In 2017, the FFTF revisited those principles to ensure that they remained aligned with states' goals and needs. The principles provide a framework for state-DOE EM interaction and coordination when compliance milestones will not be met in a given year because of budget shortfalls. They provide an approach that recognizes the significance and legal standing of state-DOE EM agreements and a path forward that uses environmental risk and other factors to determine the order in which cleanup projects should be undertaken. *The FFTF encourages DOE EM to jointly set priorities with states during budget shortfalls by using the principles the FFTF developed that incorporate "risk plus other factors" as a priority setting framework.*[31]

[30] Pew Center on Global Climate Change. (2009, December). *U.S. Department of Energy's Recovery Act spending*. Retrieved from https://www.issuelab.org/resources/11536/11536.pdf.
[31] See Appendix E for the FFTF's full principles.

Ensuring Compliance

Since the passage of FFCA, state compliance agreements have been an important tool for achieving cleanup. Specific state concerns with compliance and cleanup include determining cleanup levels that are protective over the long run, enabling effective state oversight, ensuring an appropriate role for risk in cleanup decision making and assessing damage to natural resources.

FIGURE 7: Cleanup at Hanford in Washington state. Photo courtesy of U.S. Department of Energy.

Cleanup Levels

States are concerned about the thoroughness of cleanup efforts — or determining "how clean is clean." Ideally, sites will be cleaned to a level that requires no further restrictions on land use. Unfortunately, cleanup to unrestricted levels is often not technically or financially feasible. At most sites, some level of waste will remain after cleanup, and the amount and type of waste can vary greatly, even within a site. States want to ensure that waste left in landfills, underneath caps or in the soil or groundwater will not eventually threaten the public or the environment. *The FFTF encourages DOE EM to clean sites so that they can serve various land uses, including public reuse. If contamination must be left in place, DOE must maintain and fund long-term stewardship that employs a combination of controls to restrict land use and long-term sampling and surveillance of the remaining contamination.*[32]

State Oversight and Compliance Agreements

Meeting compliance milestones is extremely important to states. Under the FFCA, states can oversee the treatment of DOE's waste and some aspects of shipment and disposal to ensure citizens' health and safety as well as environmental protection. States have authority to regulate DOE's mixed hazardous wastes while DOE self-regulates for specific types of radioactive wastes in compliance with a variety of statutes, regulations, directives and guidance for cleanup and disposal. Compliance agreements are mandatory and intended to force action, yet states recognize that changing information and circumstances at cleanup sites may warrant adjustments. Complex-wide, since 1995, states have modified compliance agreements hundreds of times to make appropriate changes based on new information.

Understanding whether and how DOE EM will meet its compliance requirements and how it will respond if it cannot, is a crucial element of state oversight. In the absence of longer term plans, it has been difficult for states to predict whether DOE will be able to meet its compliance requirements until it is in jeopardy of missing them. *The FFTF encourages DOE EM to transparently and openly communicate with the states, particularly regarding compliance milestones and longer term planning.*

The Role of Risk in Cleanup Decisions

States have a strong interest in DOE EM achieving its cleanup goals in a timely and efficient manner, thereby reducing the risk to public health and the environment — one of several factors that can influence cleanup decisions. States support setting priorities to balance environmental risk with regulatory obligations and other factors. This approach, known as "risk plus other factors," stems from a consensus report of the 1996 Federal Facilities Environmental Restoration Dialogue Committee. The report was developed with assistance from the Keystone Center in Colorado and known as the "Keystone Report."[33] The committee that prepared the report was made up of federal agency representatives from

[32] Further detail available in DOE Order 458: https://www.directives.doe.gov/directives-documents/400-series/0458.1-BOrder.
[33] U.S. environmental Protection Agency. (1996, April). *Final report of the Federal Facilities Environmental Restoration Dialogue Committee: Consensus principles and recommendations for improving federal facilities cleanup* (Report EPA/540/R-96/013). Retrieved from https://energy.gov/sites/prod/files/2014/03/f8/fferdc.pdf.

EPA, DOE and the U.S. Department of Defense (DoD), with representatives of state agencies, local governments, tribal governments and nongovernmental organizations.

State oversight and compliance agreements are risk informed — that is, they consider both risk and other relevant factors. State decision making is not risk-based — a term that implies that risk is the only consideration used to set priorities. As recognized in the Keystone Report, such decisions, based solely on risk, are both unwise and contrary to law. Moreover, the process of measuring and comparing risks is fraught with technical problems and not well accepted by the public. *The FFTF supports DOE's continued effort to maintain risk-informed decision making, as established in the Keystone Report, that respects the primacy of compliance agreements.*

Natural Resources Damage Assessment

In addition to compliance agreements, states can ensure that DOE fulfills both its responsible party and trust responsibilities to restore states' natural resources and the ecological and economic services they provide their citizens by conducting natural resources damage assessments (NRDA).

To develop the NRDA, Trustee Council members at each site, including states, tribes, and federal agencies, collect and analyze information to determine the likelihood of the occurrence and extent of harm to natural resources (injury), and then the cost for restoration (damages). Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the public has a right to compensation to restore, replace, or acquire the equivalent of damaged natural resources and associated loss of services from the release of hazardous substances or from the removal and remedial actions taken to respond to a release.[34]

Risk Plus Other Factors

The following list of "other factors" was developed by the 1996 Federal Facilities Environmental Restoration Dialogue Committee and included in the Keystone Report. The report notes that these factors "warrant consideration in setting environmental cleanup priorities and milestones":

- Cultural, social and economic factors, including environmental justice considerations;
- Short-term and long-term ecological effects and environmental impacts in general, including damage to natural resources and lost use;
- Making land available for other uses;
- Acceptability of the action to regulators, tribes, and public stakeholders;
- Statutory requirements and legal agreements;
- Life-cycle costs;
- Pragmatic considerations, such as the ability to execute cleanup projects in a given year, and the feasibility of carrying out the activity in relation to other activities at the facility; and
- Overall cost and effectiveness of a proposed activity as well as actual and anticipated funding availability.

Excerpted from Federal Facilities Environmental Restoration Dialogue Committee Final Report, page xii.

DOE is responsible for injuries to natural resources (for example, land, aquatic species, water and wildlife) that occur on or near DOE EM sites because of a contaminant release. States help assess the extent of injury to a natural resource and determine appropriate ways to restore that resource and compensate for its damage. The level of cooperation among trustees can vary widely from site to site. Disagreements among the responsible party and trustees about the assessments or even when to begin the assessment phase have led to lawsuits. DOE is both a trustee of and the responsible party for NRDA at weapons complex sites, creating unique challenges for ensuring that assessment and restoration occur. *The FFTF*

[34] For more information, see U.S. Department of the Interior. (n.d.). Restoration program. Retrieved from https://www.doi.gov/restoration.

encourages DOE to fulfill its obligations as a responsible party under the NRDA while appropriately engaging in the process as a trustee.

Managing Waste Safely

Some waste developed at nuclear weapons sites will persist in the environment for hundreds, thousands, or even millions of years. As such, proper transportation and disposal of waste are critical for reducing risks to public health and the environment. Key aspects of that effort include the safe transportation and disposition of all radioactive wastes as well as HLW in a geologic repository and defense TRU waste emplacement at WIPP.

Changes to Federal Waste Management Strategy

The United States is unique among countries with radioactive waste in that it defines much of the waste by its origin rather than by its radiological characteristics (see Appendix C for a more detailed description of U.S. nuclear waste definitions). The statutory definitions for radioactive waste classify it largely by source and method of production (such as high-level liquid waste from plutonium production), certain technical criteria (including overall radioactivity levels) or some combination of those factors.[35] Over years of environmental cleanup at DOE EM sites, many groups have suggested reforms of the U.S. waste classification system and definitions to provide greater clarity in definitions of nuclear waste, including suggestions to move toward defining waste based on radiological characteristics.[36] In 2019, DOE issued a public notice stating its intention (affirmed in a second notice in December 2021) to interpret risk-based aspects of the language of the statutory definition for HLW. DOE's interpretation provides the technical criteria that can be applied to individual waste streams on a case-by-case basis to determine whether the standard for HLW has been met.[37] States have concerns about the Department's HLW interpretation because of the potential impact on agreed-upon strategies for disposing of waste from the cleanup sites, as well as potential effects on other wastes and their disposition pathways throughout the weapons complex. DOE has stated: "The Department will work closely with State and local officials, regulators, tribal governments, and stakeholders, on a site-by-site basis, to ensure compliance with applicable programmatic requirements and regulatory agreements before classifying any reprocessing waste as non-HLW under the HLW interpretation or consequent disposal decisions."[38] *The FFTF urges DOE to adhere to this commitment and to consult with states to understand potential issues and challenges related to changes to legal waste definitions and their application.*

Greater-Than-Class C Low-Level Radioactive Waste Disposal

Greater- than-Class C (GTCC) low-level radioactive waste (LLW) contains concentrations of radionuclides that exceed the limits established by the Nuclear Regulatory Commission for Class C LLW. DOE has not yet issued a Record of Decision for the disposal of GTCC LLW. In accordance with congressional direction, DOE released a final Environmental Impact Statement (EIS) in 2016 that analyzed alternatives for disposal of GTCC waste. The EIS identified the WIPP geologic repository or land disposal at generic commercial facilities as the preferred alternative. In October 2018, DOE issued the Environmental Assessment (EA) for the disposal of GTCC Low-Level Radioactive Waste and GTCC-Like Waste at Waste Control Specialists (WCS), Andrews County, Texas.[39] On October 1, 2020, NRC staff recommended combining the proposed rulemaking to promulgate requirements for the near-surface

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[35] See U.S. Department of Energy. Order DOE O 435.1. Retrieved from https://energy.gov/sites/prod/files/2016/03/f30/DOEO435-1RadWasteMan.pdf.
[36] For reference see: https://www.energy.gov/sites/default/files/2019/06/f63/Independent-Reports-Supporting-a-Risk-Based-Approach-to-Radioactive-Waste-Management-June-2019.pdf.
[37] In 2020, DOE applied its HLW interpretation to a small amount of waste from the Savannah River. This waste was disposed of at a licensed commercial facility, as supported by NEPA and technical analysis, which included public comment on the draft NEPA document. DOE is currently analyzing a second SRS waste stream for disposal at a licensed commercial facility under the HLW interpretation.
[38] Supplemental Notice Concerning U.S Department of Energy Interpretation of High-Level Radioactive Waste (84 FR 26835, June 10, 2019).
[39] For more information, see DOE's information page on the GTCC environmental assessment at https://www.energy.gov/em/waste-management/waste-and-materials-disposition-information/greater-class-c-low-level.

disposal of GTCC waste with another rulemaking in progress (related to low-level radioactive waste disposal) in one consolidated rulemaking. DOE submitted its Report to Congress in 2017 that describes the disposal alternatives under consideration, and DOE must await action by Congress prior to making a final decision on the disposal alternative or alternatives to implement. *The FFTF encourages DOE to make a final decision on a disposal location with the consent of the host state to allow removal of this high- risk waste, after the NRC and the agreement state license the site.*

Disposal of HLW

A permanent solution for HLW and spent nuclear fuel (SNF) disposal is of great concern for states in which such materials are located. Although Yucca Mountain in Nevada was designated as the United States' national geologic repository for nuclear waste, it is not clear whether the site will ever be available as a repository. *The FFTF supports DOE's effort to develop permanent disposal options that have the consent of the host state to accept HLW as it is available; FFTF does not express a preference for any specific disposal site or method.*

Disposal of TRU Waste (WIPP, New Mexico)

WIPP is the only licensed deep geologic repository for defense transuranic (defense generated TRU); as such, it is critical to the states in which TRU waste is currently stored. Because of several safety-related accidents in February 2014, WIPP was closed to new waste until corrective actions had been taken. WIPP was reopened on Jan. 9, 2017, with generator sites resuming shipments in April 2017. Since its initial opening, WIPP has accepted over 13,000 shipments from 13 sites.[40] To enable increased waste shipments and emplacement, construction of a new ventilation system and other critical infrastructure is currently underway. *The FFTF encourages DOE EM to continue at an appropriate pace and sequence for removing defense TRU waste from sites and transporting it to WIPP and to operate WIPP at the highest level of safety.*

Transportation of Radioactive Waste

DOE EM has a responsibility to design and operate a safe nuclear waste transportation system. States (with local governments) provide emergency response and other services to protect public health and safety and to ensure safe shipment within their borders. DOE EM has generally worked cooperatively with states to plan major waste-transportation efforts. *The FFTF encourages DOE EM to continue its efforts to plan, coordinate and fund transportation activities in full consultation with affected states. The development of the WIPP transportation program, which was a collaborative process between western states and DOE EM, is an appropriate model for the development of a transportation safety program to support shipments to an HLW repository.*

Long-Term Stewardship

Even when DOE EM considers its cleanup actions complete, ongoing monitoring and surveillance measures will be needed at most major sites to ensure that remediation and disposal systems and institutional controls function as needed. Few sites will be cleaned to unrestricted use; therefore, additional long-term steward (LTS) activities include varying degrees of surveillance, inspection, restrictions on public access and future uses of land and water, maintenance of relevant information, monitoring the migration of residual contamination and the effectiveness of remedies, and responsible long-term care of the site. A reliable LTS program should be implemented at each site, with roles and responsibilities shared appropriately among DOE offices, states, and local governments; tribal nations; and other federal agencies as needed. To adequately protect human health and the environment, LTS activities must continue, uninterrupted, for decades or centuries. *The FFTF supports DOE in carrying out its long-term responsibility to fund LTS activities and will work with DOE and others to determine*

[40] Waste Isolation Pilot Plant Shipment & Disposal Information. Retrieved from https://wipp.energy.gov/shipment-information.asp.

available funding mechanisms to make the certainty of funding commensurate with the certainty of residual risk at sites where LTS is required.

Improving Communication Between States and DOE EM

States have expressed concerns regarding communication with DOE EM, including unclear processes for discussing problems and concerns and lack of notification on key issues. DOE EM has noted a few avenues for the states to communicate concerns, including site-specific advisory boards, congressional representatives and local DOE EM site offices. However, as regulators, states question whether these are appropriate forums for discussing issues specific to their sites. *Implementing direct lines of communication and appropriate protocols for elevating issues of concern when necessary is a priority for the FFTF.*

Coordinating Emergency Response Communication Protocols

The collapse of the Purex Tunnel at Hanford on May 8, 2017, resulted in an important discussion at the Hanford site and other sites across the complex about how to appropriately, accurately and efficiently communicate internally with states and DOE EM and externally with the public during and following an emergency event.[41] With the proliferation of smartphones and social media, it is critical that intergovernmental partners and the public have access to correct information and that misinformation is dispelled quickly. Within ten minutes of the Purex Tunnel collapse, ABC News, Fox News and the Los Angeles Times had information and photos of the collapse; after 20 minutes, the news had gone global. The Hanford website had two million hits within a matter of minutes. There were tens of thousands of posts on Facebook, and the tunnel collapse was among the highest trending stories on Twitter. The response to this incident demonstrates how social media has introduced challenges to providing accurate and accessible information to the public because increased flow of information can lead to widespread inaccuracies. *The FFTF suggests that DOE EM, in coordination with the states and other parties, develop a uniform public communications protocol for emergency situations that recognizes the rapid dissemination of information in the age of social media.*

[41] Washington Department of Ecology. (n.d.). Updates on PUREX Tunnels at Hanford. Retrieved from https://ecology.wa.gov/Waste-Toxics/Nuclear-waste/Hanford-cleanup/PUREX.

Building 305-A and Building 777-10A, Savannah River Site, South Carolina. Both buildings were used to test components and aid development and testing for reactor design. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER SC-43-1

State by State Overview

This section provides an overview of DOE nuclear weapons sites located in the states that participate in the NGA Center for Best Practices Federal Facilities Task Force (FFTF). Each section contains background information about the tasks each site performed and the types of waste it generates as well as any specific waste disposal functions, cleanup accomplishments, current site-specific issues and the site's relationship to other sites in the nuclear weapons complex. The accomplishments discussed here are distinct from the major complex-wide successes that the report covers.

- **CALIFORNIA:** Santa Susana Field Laboratory and Lawrence Livermore National Laboratory
- **IDAHO:** Idaho National Laboratory
- **KENTUCKY:** Paducah Gaseous Diffusion Plant
- **MISSOURI:** Kansas City Plant, Weldon Spring
- **NEVADA:** Nevada National Security Site (NNSS)
- **NEW MEXICO:** Los Alamos National Laboratory, Sandia National Laboratories, WIPP
- **NEW YORK:** West Valley Demonstration Project
- **OHIO:** Portsmouth, Mound, Fernald
- **SOUTH CAROLINA:** Savannah River Site (SRS)
- **TENNESSEE:** Oak Ridge Reservation
- **TEXAS:** Pantex
- **WASHINGTON and OREGON:** Hanford Site

CALIFORNIA

Santa Susana Field Laboratory and Lawrence Livermore National Laboratory

Background

The two primary active cleanup sites in California are the Santa Susana Field Laboratory and the Lawrence Livermore National Laboratory.

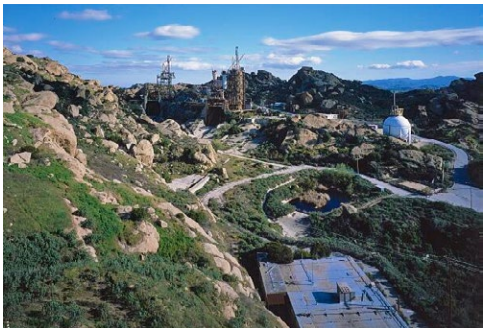

FIGURE 8: Santa Susana Field Laboratory, Coca Test Area. Coca Test Area was one of four rocket engine and component testing areas within Area II at SSFL. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER CA-2285-8 (CT)

The Santa Susana Field Laboratory (SSFL) was built by North American Aviation (NAA) in 1947 on 2,850 acres in the Simi Hills, 30 miles northwest of downtown Los Angeles. NAA established the site to static-fire large rocket engines and conduct its government and commercial nuclear research and development.[42] The site is divided into four production and two buffer areas (Areas I, II, III and IV and the northern and southern buffer zones). Areas I, II and III were used for the research, development and testing of rocket engines and associated components, and Area IV was used for nuclear experimentation and research. The two NAA groups were split into separate divisions, Atomics International and Rocketdyne, in 1955.[43]

The Atomics International division of NAA, and later the U.S. Department of Energy, conducted several national defense programs and research, development and testing for nuclear energy at Santa Susana's Energy Technology Engineering Center (ETEC). Nuclear operations facilities at ETEC included ten nuclear reactors, seven critical facilities, a "hot laboratory," the Nuclear Materials Development Facility, the Radioactive Materials Handling Facility, and various ancillary test and storage areas. Most nuclear research-related programs at the site ceased in 1988. A 1989 DOE study found widespread chemical and radioactive contamination on the site. A resulting cleanup project overseen by the U.S. Environmental Protection Agency (EPA) began soon after and most of the site's buildings have since been razed.[44]

Boeing, NASA, and DOE are currently cleaning up the site under the direction of the California Department of Toxic Substances Control (DTSC).[45] DTSC has repeatedly confirmed that the site is safe for visitors and workers and does not pose a threat to people in surrounding areas. Boeing performs soil and groundwater investigations and cleanup work pursuant to the 2007 Consent Order, that defines the requirements for investigating contaminated soil and groundwater at SSFL.[46] NASA and DOE perform investigations and cleanup work for groundwater pursuant to the 2007 Consent Order and investigations

[42] https://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/Santa_Susana_backgrounder.pdf.
[43] https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/miscplansandreports/65845_4-Site_Safety_and_Health_Plan_Revision_1_060611.pdf.
[44] Ibid.
[45] https://dtsc.ca.gov/santa_susana_field_lab/ssfl_site_activities_overview/.
[46] https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/4615513682/SSFL%20Consent%20Order%202007.pdf.

and cleanup work for soils pursuant to their respective 2010 Administrative Orders on Consent.[47,48] Investigations and cleanup work are performed under the direction of the DTSC, and the Los Angeles Regional Water Quality Control Board regulates the site's stormwater permit compliance.

California's Lawrence Livermore National Laboratory (LLNL) was established in 1952 as a multidisciplinary research and development center focusing on weapons development and stewardship and national security. Soil and groundwater contamination from research activities was discovered at the site in the 1980s. The site was subsequently placed on the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) list. Livermore Laboratory has since partnered with DOE, EPA, the National Nuclear Security Administration (NNSA), DTSC and the Regional Water Quality Control Boards to clean up legacy waste material.[49] DOE EM is tasked by Congress to demolish excess facilities at the site.[50]

Major Accomplishments

Santa Susana Field Lab

Since cleanup began at Santa Susana Field Lab, over 45,000 cubic yards of soil have been removed or treated, over 300 structures have been demolished, 900 acres of land have been restored, and three stormwater treatment systems and one groundwater treatment system have been built. The final demolition of the DOE-owned buildings at ETEC was completed in October 2021, and 22,000 cubic yards of waste and building materials from the demolitions were removed from the site and disposed of by January 2022.[51] DOE and DTSC will continue to focus on soil and groundwater remediation to complete cleanup activities.[52] Cleanup of soil, groundwater and related media at the site is conducted under the Corrective Action Program of the Resource Conservation and Recovery Act (RCRA), with requirements defined in the 2007 Consent Order for Corrective Action and the 2010 Administrative Orders on Consent. To date, cleanup crews have installed more than 500 on- and off-site monitoring wells, collected approximately 28,000 groundwater samples and analyzed 8,400 rock samples for contaminants in rock porewater. The sampling shows that groundwater contamination is contained within half a mile of where contaminants first entered 60 years prior.[53]

Lawrence Livermore National Laboratory

Cleanup at LLNL has resulted in the removal of about 18,000 cubic yards of contaminated soil to certified off-site disposal sites and provided alternative water supplies to residents with wells affected by contamination. LLNL has also constructed several treatment plants for groundwater pumping and treatment and for soil vapor extraction (SVE).[54]

Site-Specific Issues

Rocket engine testing and nuclear research at SSFL created significant contamination at the site over multiple decades. Historic operations included the use of chemicals, primarily the solvent trichloroethene (TCE) to remove residual petroleum-based fuel products following rocket engine testing. These operations resulted in the release of chemicals to soil, bedrock and groundwater. During active operations, ten nuclear reactors operated at SSFL, some of which experienced incidents that may have resulted in radiological releases and contamination. Other constituents of concern associated with site

[47] https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/9113356649/SSFL_NASA_AOC_20101206.pdf.
[48] https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/7760207951/64791_SSFL_DOE_AOC_Final.pdf.
[49] http://www.energyca.org/site-profiles/lawrence-livermore-national-laboratory.
[50] https://www.energy.gov/em/lawrence-livermore-national-laboratory.
[51] https://www.energy.gov/em/articles/remaining-demolition-waste-departs-etec.
[52] https://www.energy.gov/em/energy-technology-engineering-center-etec-2021-year-review.
[53] https://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/Santa-Susana-groundwater-fact-sheet.pdf.
[54] https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0902740.

operations include other volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), petroleum hydrocarbons, metals, perchlorate and other inorganic compounds, polychlorinated biphenyls (PCBs), dioxins and furans, pesticides and herbicides, and energetics.

Relationship to Other Sites in the Complex

Lawrence Livermore National Lab is one of the national laboratories within the DOE national laboratory system. The national laboratory system was established during World War II as part of the nuclear weapons complex and has a continuing mission to address the critical scientific challenges of today.[55] Lawrence Livermore's ongoing mission includes research in the fields of biosecurity, counterterrorism, defense, energy, intelligence, nonproliferation, science and weapons development to enhance United States' national security and defense systems.[56] DOE and contractors have cleaned up much of the legacy contamination from research activities at several national labs such as Lawrence Livermore while maintaining their ability to serve as important hubs for science and innovation.

The other connection between Santa Susana Field Lab, Lawrence Livermore National Lab, and other sites in the complex is in waste disposition. According to the Waste Information Management System, most low level and mixed low-level waste from Lawrence Livermore is destined for disposal at Nevada National Security Site's low-level waste and mixed low-level waste disposal units while a smaller quantity will be shipped to commercial facilities such as Perma-Fix-Northwest in Washington State and Energy Solutions in Utah.[57] Most of the low-level waste from Santa Susana Field Lab cleanup has been shipped to the commercial disposal facility operated by Energy Solutions in Utah, with a smaller amount of low-level waste and mixed low-level waste sent to the US Ecology facility in Idaho.[58]

[55] https://www.energy.gov/national-laboratories.
[56] https://www.llnl.gov/.
[57] https://www.emwims.org/ForecastData.
[58] https://www.emwims.org/ForecastData.

IDAHO

Idaho National Laboratory

Background

The Idaho National Laboratory, located in southeastern Idaho with additional research and support facilities in Idaho Falls, was established in 1949 as the National Reactor Testing Station.[59] For many years, Idaho National Laboratory housed the largest concentration of nuclear reactors in the world.[60] In total, 52 reactors were built at Idaho National Laboratory, including the U.S. Navy's first prototype nuclear propulsion plant.[61] Four agreements form the regulatory framework at the Idaho National Laboratory: the Federal Facilities Agreement Consent Order, which mandates milestones for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act; the Site Treatment Plan; the Notice of Noncompliance Consent Order, which governs certain waste management activities; and the 1995 Settlement Agreement, which settled a lawsuit between the State of Idaho, the U.S. Navy and the U.S. Department of Energy (DOE) and requires that certain waste be removed from Idaho by specific dates.[62]

FIGURE 9: Demolition of CPP 601-602 at the Idaho site. Photo courtesy of U.S. Department of Energy.

Major Accomplishments

DOE EM has worked with Idaho to achieve the following outcomes:

- Completed a total of 6,716 shipments of transuranic waste to the Waste Isolation Pilot Plant (WIPP), representing approximately half of all shipments to the repository since it began receiving waste in 1999;
- DOE EM completed transuranic waste retrieval activities at the Advanced Mixed Waste Treatment Project's Transuranic Storage Area-Retrieval Enclosure (TSA RE), and removed equipment and debris from a combined area of 179,000 square feet in support of RCRA closure;
- Completed more than 50 equipment modifications focused on contamination control and off-gas filters in preparation for radiological operations at the Integrated Waste Treatment Unit (IWTU), which culminated in a successful confirmatory run in mid-2022 where the facility ran over 60 continuous days treating nearly 140,000 gallons of simulated waste. During the run, the facility also successfully completed two independent assessments which verified the facility readiness to commence radiological waste treatment operations;

[59] U.S. Department of Energy. (n.d.). Brief history of the Idaho National Laboratory (INL). Retrieved from https://www.id.energy.gov/insideNEID/BriefHistory.htm.
[60] Public tours offer insight into Idaho National Laboratory. (2011, June 10). Idaho State Journal. Retrieved from https://www.idahostatejournal.com/news/online/public-tours-offer-insight-into-idaho-national-laboratory/article_960e3196-9332-11e0-a7d0-001cc4c03286.html.
[61] U.S. Department of Energy. (n.d.). Brief history of the Idaho National Laboratory (INL). Retrieved from https://www.id.energy.gov/insideNEID/BriefHistory.htm.
[62] U.S. Department of Energy. (n.d.). Commitments and agreements. Retrieved from https://www.id.energy.gov/insideneid/commitme.htm.

- Certified 2,497 drums stored at the Advanced Mixed Waste Treatment Project (AMWTP) for shipment and disposal at WIPP;
- DOE EM completed the required exhumation of solvent, transuranic waste, contaminated graphite and filter media waste for eventual shipment to WIPP in New Mexico from nearly all of the required acres at the Subsurface Disposal Area;[63]
- DOE EM treated and shipped 124 m3 of remotely handled transuranic waste for disposal at WIPP; and
- DOE EM transferred more than 118 metric tons of heavy metal from spent nuclear fuel (SNF) from wet storage facilities to dry storage.

Site-Specific Issues

Leading challenges at Idaho National Laboratory include meeting the obligations of the 1995 Settlement Agreement and other legal agreements between DOE and the state. Among other things, the agreements require disposal of transuranic waste outside of Idaho, retrieval and treatment of high-level waste (HLW) calcine from the bin sets generated from SNF reprocessing conducted decades ago, and treatment of liquid HLW (including sodium-bearing waste) stored in tanks above the Snake River Plain Aquifer, a critical drinking water and agricultural resource for much of southern Idaho. DOE EM has constructed the Integrated Waste Treatment Unit (IWTU) for the liquid sodium-bearing HLW, but delays during testing prevented DOE EM from meeting deadlines to achieve full facility operation. During the 2021 outage, over 50 modifications were made to the IWTU to improve the performance of the process gas filter elements, increase plant reliability, long-term operability and implement numerous contamination control measures. DOE completed testing with waste simulant and performed multiple readiness assessments Waste treatment operations are scheduled to begin in early 2023.

Relationship to Other Sites in the Complex

Idaho National Laboratory's relationships with other DOE sites are critical to completing the requirements of the 1995 Settlement Agreement around waste shipments, removal of transuranic waste, treatment and removal of high-level waste streams and transfer of spent nuclear fuel from wet storage into dry storage. The WIPP is particularly important given the need to remove transuranic waste from Idaho. In addition to high-level waste and spent nuclear fuel stored and generated on-site, Idaho National Laboratory stores the damaged reactor from Three Mile Island and spent nuclear fuel from Navy vessels and foreign research reactors. Disposal of high-level waste and spent nuclear fuel from Idaho National Laboratory depends on future decisions regarding permanent geologic disposal. The Idaho National Laboratory plays a key role in treating mixed low- level waste and transuranic waste from around the complex.

Low-level waste and mixed low-level waste cleanup at Idaho National Laboratory relies on onsite disposal, the Nevada National Security Site (NNSS) and commercial sites around the country providing an avenue for the ultimate disposal of legacy waste. According to DOE EM estimates, more than 35,000 m^3 of LLW and 3,500 m^3 of mixed LLW will be sent from Idaho to the NNSS for disposal between 2018 and 2050.[64]

[63] U.S. Department of Energy. (2021, December 29). *DOE-Idaho Buried Waste Project Marks Major Accomplishment Ahead of Schedule* [Press release]. Retrieved from https://www.energy.gov/em/articles/doe-idaho-buried-waste-project-marks-major-accomplishment-ahead-schedule.
[64] Applied Research Center, Florida International University. (n.d.). Welcome to WIMS: Waste Information Management System. Retrieved from http://www.emwims.org.

KENTUCKY

Paducah Gaseous Diffusion Plant

Background

The Paducah Gaseous Diffusion Plant sits on a 3,556-acre site located in rural western Kentucky, ten miles west of Paducah. For more than 60 years, the Paducah Gaseous Diffusion Plant enriched uranium, first supporting the nation's nuclear weapons program and then producing fuel for commercial nuclear power plants. Enrichment operations ended in July 2013, and the facility, now referred to as the Paducah Site, transitioned to the United States (U.S.) Department of Energy's Office of Environmental Management (DOE) in 2014.[65]

FIGURE 10: Aerial view of Paducah Gaseous Diffusion Plant. Photo courtesy of state of Kentucky.

Cleanup at the site is driven by the 1998 Federal Facilities Agreement (FFA) between DOE, U.S. Environmental Protection Agency (EPA) Region 4 and the Commonwealth of Kentucky's Energy and Environment Cabinet (Kentucky). The three parties to the FFA annually revisit and update the Site Management Plan to prioritize building demolition and environmental cleanup of the Paducah Site.[66] The current date projected to complete all of the remaining demolition and environmental cleanup activities is 2065.[67]

Major Accomplishments

DOE EM worked with EPA and Kentucky to achieve the following outcomes:

- Removal of 8,167 gallons of trichloroethylene (TCE) from groundwater and soils from multiple actions; including ~4,325 gallons captured and removed by two groundwater pump-and-treat-systems. The pump-and-treat systems have been in operation for over 27 years and combined have treated more than 4.87 billion gallons of groundwater;[68]
- Depleted uranium hexafluoride (DUF6) conversion facility has converted over 53,000 metric tons (as of November 30, 2022) of DUF6 inventory at its Paducah facility since operations began in 2011.[69] The

[65] U.S. Department of Energy, Portsmouth/Paducah Project Office, Paducah Site. Reference: https://www.energy.gov/pppo/paducah-site.
[66] Kentucky Energy and Environment Cabinet, (2022) Paducah Site. Reference: https://eec.ky.gov/Environmental-Protection/Waste/hazardous-waste/Pages/paducah-gaseous-diffusion-plant.
[67] Paducah Strategic Vision: 2022-2032. Reference: https://www.energy.gov/em/articles/paducah-strategic-vision-2022-2032.
[68] U.S Department of Energy, Reference: PGDP Federal Facility Agreement Semiannual Progress Report for the Second Half of FY2021 (DOE/LX/07-2468/V2).
[69] U.S. Department of Energy, Office of Environmental Management - Paducah by the Numbers (September 2022). Reference: https://www.energy.gov/em/articles/paducah-numbers.

current estimated completion date to convert the remaining inventory at the current design process rate is 2057;[70]

- A total of 143 inactive facilities, trailers, and structures have been demolished which represents more than 478,000 square feet in area;[71]
- In total, 68.5 million pounds (~34,000 tons) of contaminated metal and 8.2 million cubic feet (ft^3) of waste were disposed;[72, 73] and
- As of late 2022, DOE removed ~3.4 million pounds of hazardous refrigerant (R-114) from the Paducah Site.

Site-Specific Issues

In August 2017, DOE, EPA Region 4 and Kentucky signed a memorandum of agreement to re-sequence all the environmental remediation work at the Paducah Site to concentrate on the C-400 cleaning building, the main source of two 4-mile-long trichloro-ethylene groundwater contamination plumes. A year-long subsurface investigation of the C-400 Building and sur- rounding area wrapped up in January 2022. The comprehensive investigation focused on defining the type and distribution of contamination present around and under the C-400 Building. The anticipated timeline for public release of near-term C-400 documents in January 2023 for the Remedial Investigation/Feasibility and 2023 for the public comment period for the Proposed Plan for cleanup of the C-400 area.[74] Field Work initiated in March 2022 on an enhanced in-situ bioremediation cleanup at the northeast corner of the C-720 "Machine Shop" building (referred to as SWMU 211-A). After this remedial work, the vast majority of remaining remediation projects are not scheduled for decades into the future.[75]

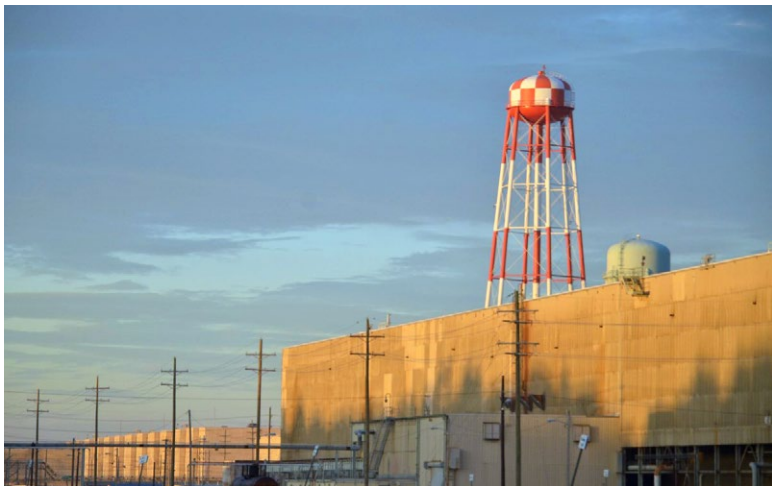

FIGURE 11: Paducah Gaseous Diffusion Plant. Photo courtesy of state of Kentucky.

Since DOE resumed control of the Paducah Gaseous Diffusion Plant in October 2014, limited resources were realigned to support reducing operational costs and deactivation activities. More than 500 structures/systems will eventually undergo deactivation and demolition. The estimated volume of waste material that requires disposal from deactivation and demolition operations is about 3.6 million cubic yards.[76] As deactivation and demolition operations progress, it is anticipated that opportunities will arise to address contamination previously considered inaccessible (underneath buildings and near critical infrastructure). Since deactivation began, more than 100,000 gallons of PCB oil, 371,000 gallons of

[70] Paducah Strategic Vision: 2022-2032. Reference: https://www.energy.gov/em/articles/paducah-strategic-vision-2022-2032.
[71] U.S. Department of Energy, Office of Environmental Management - Paducah by the Numbers (September 2022). Reference: https://www.energy.gov/em/articles/paducah-numbers.
[72] U.S. Department of Energy, Office of Environmental Management - Paducah by the Numbers (September 2022). Reference: https://www.energy.gov/em/articles/paducah-numbers.
[73] Paducah Site Environmental Remediation. Reference: https://www.energy.gov/pppo/Paducah-site/Paducah-environmental-remediation.
[74] Paducah Strategic Vision: 2022-2032. Reference: https://www.energy.gov/em/articles/paducah-strategic-vision-2022-2032.
[75] 2022 Site Management Plan – Annual Revision, Paducah Gaseous Diffusion Plant, December 16, 2021 (DOE/LX/07-2473&D2). Reference: https://www.emcbc.doe.gov/SEB/osms/Documents/Document%20Library/Site%20Management%20Plan%20FY%202022%20D2.pdf.
[76] Paducah Site Environmental Remediation. Reference: https://www.energy.gov/pppo/Paducah-site/Paducah-environmental-remediation.

lubrication oil and 8.5 million pounds of refrigerant have been removed from the process buildings.[77] A detailed deactivation project scope and Life Cycle Baseline (timeline) is available as an appendix to the annual Site Management Plan.[78]

Relationships to Other Sites in the Complex

- Portsmouth and Paducah are managed out of the Portsmouth Paducah Project Office (PPPO), located in Lexington, Kentucky;
- Portsmouth, Ohio, and Oak Ridge, Tennessee, also had gaseous diffusion plants, and while Tennessee's buildings are demolished, Portsmouth is in process and Paducah is beginning to prepare for demolition;[79]
- Portsmouth, Ohio, and Oak Ridge, Tennessee, also receive federally appropriated funding from the Uranium Enrichment Decontamination and Decommissioning Fund (UED&D) which was established in The Energy Policy Act of 1992;
- Paducah has the longest offsite groundwater contaminant plumes in the entire DOE EM Complex; and
- Portsmouth also has large inventory of DUF6 cylinders and an on-site conversion facility.

[77] U.S. Department of Energy, Office of Environmental management. (n.d.). DOE Paducah site tour. Reference: https://www.emcbc.doe.gov/SEB/PGDP%20Deactivation/Documents/Site%20Tours/DOE%20Paducah%20Site%20Tour-deactivation%20Task%20Order.pdf.
[78] 2022 Site Management Plan – Annual Revision, Paducah Gaseous Diffusion Plant, December 16, 2021 (DOE/LX/07-2473&D2). Reference: https://www.emcbc.doe.gov/SEB/osms/Documents/Document%20Library/Site%20Management%20Plan%20FY%202022%20D2.pdf.
[79] Paducah Site Environmental Remediation. Reference: https://www.energy.gov/pppo/Paducah-gdp-shutdown-and-deactivation.

MISSOURI

Kansas City Plant, Weldon Spring Site

Background

Missouri is home to one former site, the Kansas City Plant, and one long-term stewardship (LTS) site, the Weldon Spring Site. The state also hosts the current U.S. Department of Energy (DOE)-National Nuclear Security Administration (NNSA) Kansas City National Security Campus.

FIGURE 12: Kansas City National Security Campus. Photo courtesy of U.S. Department of Energy.

The former Kansas City Plant occupied 136 acres of the 309-acre Bannister Federal Complex in Kansas City, Missouri. The Kansas City Plant's mission — to manufacture nonnuclear components for defense purposes — ended in August 2014, and the facility was relocated to the new Kansas City National Security Campus in south Kansas City.[80] U.S. Navy and DOE-NNSA operations at the Bannister Federal Complex released hazardous materials, primarily chlorinated solvents and polychlorinated biphenyls, into the environment.[81] DOE-NNSA identified historic radioactive contamination and characterized and remediated it to an unrestricted release. DOE-NNSA developed a request for early transfer and, following the Governor's approval, transferred the entire Kansas City Plant and the portion of the Bannister Federal Complex west of the railroad tracks to Bannister Transformation & Development LLC on November 15, 2017.[82] Bannister Transformation & Development has now assumed the responsibility for completing corrective action and site remediation under the Resource Conservation and Recovery Act (RCRA), while DOE is responsible financially for the cost of site remediation and for long term stewardship, maintenance, and operations of remedial actions.

DOE's new Kansas City National Security Campus facility continues the mission of the Kansas City Plant, manufacturing non-nuclear components for defense purposes. The facility was designed to prevent accidental releases of contaminants to the environment. Many of the same materials that were used at the Kansas City Plant continue to be used at the new facility.

DOE's Office of Legacy Management (LM) currently manages the Weldon Spring Site as an LTS site. Located 30 miles west of St. Louis, the site served a variety of missions for the U.S. Army and DOE's parent agencies (the U.S. Atomic Energy Commission and others) from 1941 to 1984 that involved both explosive ordnance and nuclear materials. The DOE portion of the operations, listed on the National Priority List in 1987, was a plant that converted processed uranium ore concentrates to pure uranium trioxide and other products.

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[80] U.S. Department of Energy, National Nuclear Security Administration. (2013, February). *Draft environmental assessment for the transfer of the Kansas City Plant, Kansas City, Missouri*. Retrieved from https://www.energy.gov/sites/prod/files/EA-1947-DEA-2013.pdf.
[81] Missouri Department of Natural Resources. (n.d.). Bannister Federal Complex. Retrieved from https://dnr.mo.gov/env/hwp/fedfac/bfc.htm.
[82] Missouri Department of Natural Resources. (n.d.). Bannister Federal Complex. Retrieved from https://dnr.mo.gov/env/hwp/fedfac/bfc.htm.

Two other sites in the St. Louis area of Missouri are currently being cleaned up by the U.S. Army Corp of Engineers under the Formerly Utilized Sites Remedial Action Program. Once these sites have been remediated, they will be transitioned back to DOE LM for long term stewardship.

Major Accomplishments

DOE has worked with Missouri to achieve the following outcomes:

- At the Kansas City Plant, DOE carried out environmental restoration activities at 43 release sites or areas of concern that posed a potential threat to human health and the environment. Operational oversight was accomplished through an Agreement in Principle,[83] which allows for a day-to-day state presence at the site, enabling the state to serve as an independent party that can assist in answering the public's questions about the operation without causing security concerns. In 2014, the RCRA post-closure permit for the Kansas City Plant was expanded to include the entire Bannister Federal Complex, which the U.S. General Services Administration and DOE-NNSA jointly owned and managed prior to the transfer of the 235 acres west of the railroad tracks. DOE-NNSA, with state concurrence, transferred the entire Kansas City Plant to Bannister Transformation & Development LLC on November 15, 2017; and
- Cleanup at Weldon Spring began in 1984 and continued in phases until the completion in 2001 of a 45-acre disposal cell in an area formerly occupied by chemical plant production buildings. The disposal cell contains approximately 1.48 million cubic yards of contaminated materials.[84] Leachate from the disposal cell is collected, treated and discharged off-site. A native prairie has been established around the disposal cell that provides erosion control and educational opportunities through a viewing platform at the peak of the disposal cell. The site also offers public trails and a new interpretive center that preserves the site's history.

Site-Specific Issues

At the Weldon Spring Site, a long-term surveillance plan details a groundwater monitoring program, a sitewide inspection process and institutional controls that must be maintained in perpetuity.[85] The presence of residual contamination requires institutional and engineering controls that must be inspected regularly and maintained. Now that the site has been in LTS for an extended period, the state has noted some ongoing concerns regarding assumptions made in early groundwater assessment documents compared with actual site conditions that DOE must address.

As demolition activities finish, environmental cleanup, management, and economic redevelopment continue at the former Kansas City Plant. State oversight and coordination with the developer and DOE-NNSA maintain progress and ensure regulatory compliance and overall success. Transferring LTS responsibilities to DOE's Office of Legacy Management is under consideration.

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[83] U.S. Department of Energy. (2013, October). Record of categorical exclusion (CX) determination. Retrieved from https://kcnsc.doe.gov/docs/default-source/cx-determinations/ne- pa-mdnr-aip.pdf?sfvrsn=b628f49f_2.
[84] U.S. Department of Energy, Office of Legacy Management. (2011, September). *Weldon Spring site fourth five-year review* (Report No. LMS/WEL/S07406). Retrieved from https://www. lm.doe.gov/Weldon/Fourth_Five-Year_Review.pdf.
[85] U.S. Department of Energy, Office of Legacy Management. (2011, September). *Weldon Spring site fourth five-year review* (Report No. LMS/WEL/S07406). Retrieved from https://www. lm.doe.gov/Weldon/Fourth_Five-Year_Review.pdf.

Relationship to Other Sites in the Complex

The Kansas City Plant previously provided all the nonnuclear components for the nuclear complex's weaponry. As a result, although the Kansas City Plant/Bannister Federal Complex site was transferred to a private entity through the early transfer process, NNSA will continue its mission at the Kansas City National Security Campus.

Weldon Spring was one of the first sites to be remediated and transferred to DOE LM. As more sites begin to transition from active DOE EM work to remediation to long term stewardship, Weldon Spring has served as a guide for how to consider and address the long-term issues at a site even before a remedy has been chosen. It has also showcased how including an on-site information source through an interpretive center helps educate current and future generations about what occurred at the site.

NEVADA

Nevada National Security Site

Background

The Nevada National Security Site (NNSS) — formerly known as the Nevada Test Site — occupies approximately 1,350 square miles in southeastern Nye County, about 65 miles northwest of Las Vegas. The NNSS is larger than Rhode Island and comprises more than 40 percent of all U.S. Department of Energy (DOE) land holdings.[86] As a DOE defense program site, the primary mission of the NNSS is to help ensure the security of the United States and its allies by supporting the stewardship of the nuclear deterrent, providing emergency response capability and training and contributing to key nonproliferation and arms control initiatives. The site also has a role in National Nuclear Security Administration nuclear nonproliferation programs, nuclear emergency response capabilities and other federal projects.[87]

FIGURE 13: Nevada National Security Site Revegetation Efforts. Photo courtesy of U.S. Department of Energy.

Several regulatory agreements currently guide cleanup and disposal activities at the site. A 1999 Agreement in Principle identified activities that Nevada and DOE would undertake to work cooperatively to assure citizens of Nevada that the public's health and safety as well as the environment are protected. The Agreement in Principle and its later revisions afford Nevada the opportunity to provide input into the evaluation of the waste sent to the NNSS for disposal.[88] Nevada also engages with DOE EM on the review of low-level waste (LLW) transportation protocols and notifications, and coordinates with NNSS on emergency planning and response exercises.[89]

The 1996 Federal Facility Agreement and Consent Order (FFACO) governs remediation of historical contamination and stipulates a process to ensure that DOE and the U.S. Department of Defense thoroughly investigate and complete corrective actions for contaminated sites on the NNSS and DOE sites on and around the Tonopah Nevada Test. The NNSS also has a Resource Conservation and Recovery Act Part B permit that includes authorization to dispose of mixed LLW generated at the NNSS and other DOE sites. The permit, which was modified in 2018 to add a second mixed LLW cell,[90] is currently in the Nevada permit renewal process and undergoing review by the Nevada Division of Environmental Protection.

[86] Nevada National Security Site. (n.d.). About the NNSS. Retrieved from https://www.nnss.gov/pages/about.html.
[87] Nevada National Security Site. (n.d.). About the NNSS. Retrieved from https://www.nnss.gov/pages/about.html.
[88] Nevada Division of Environmental Protection. (n.d.). Agreement in principle (AIP). Retrieved from https://ndep.nv.gov/uploads/documents/14524CD-FY21-26_AIP_FINAL_signed.pdf.
[89] National Nuclear Security Administration. (2016, November). *Nevada National Security Site waste acceptance criteria* (Report No. DOE/NV—325-16-00). Retrieved from https://www.nnss.gov/docs/docs_RWM/NNSSWAC_DOE_NV--325-22-00.pdf.
[90] Nevada National Security Site. (2018, September). *Environmental report 2017*. Retrieved from http://www.nnss.gov/docs/docs_LibraryPublications/2017%20NNSSER.pdf.

Major Accomplishments

Since the FFACO was signed in 1996, DOE EM has made significant progress in addressing the remediation process in several categories of contaminated sites:

- Industrial site restoration addresses facility deactivation and demolition, historical infrastructure remediation efforts and conventional weapons cleanup, including unexploded ordnance. The FFACO identified more than 2,000 such sites; to date, all but nineteen sites have been addressed, meeting specific protective closure criteria that enable DOE to close the site with use restrictions;[91]
- At the underground test areas, where underground nuclear tests contaminated groundwater, Nevada has approved the closure of three corrective action units, Frenchman Flat, Yucca Flat and Rainier Mesa/Shoshone Mountain, moving them into long-term monitoring. Nevada and DOE formally established use restrictions, regulatory boundaries, and a long-term monitoring strategy for each of these corrective action units. The remaining two underground test areas, with a total of 82 corrective action sites, are expected to move into the closure stage in the 2030 timeframe;[92]
- Soil sites contain contamination from historical nuclear detonations, safety experiments, nuclear reactor development, nuclear rocket development and hydronuclear experiments. To date, all 143 soil sites have either been clean-closed or closed in place with monitoring and use restrictions through a process to which the state and DOE have agreed;[93]
- The two Nevada off-site areas — Project Shoal and the Central Nevada Test Area (CNTA) — were transferred to the DOE Office of Legacy Management (DOE LM) in 2006. The surface unit at Project Shoal was clean-closed and has no monitoring requirements. Post closure monitoring is required for the CNTA surface unit. Nevada has approved moving the ground water units at the Project Shoal and CNTA sites into the closure stage; therefore, moving them into long-term monitoring;[94] and
- In September 2020, DOE EM transferred 70 legacy corrective action sites on and around the Tonopah Test Range to DOE LM. Ten of the 70 corrective action sites require post-closure monitoring, which is now conducted by DOE LM.

Site-Specific Issues

Although the NNSS has a relatively small DOE EM cleanup budget (approximately $76 million in FY2022, or just over 1 percent of all DOE cleanup funds), the site contains significant contamination in surface soils and groundwater. Contamination of groundwater is an area of focus for the state of Nevada at both the NNSS and the Nevada off-site locations; nearly 30 percent of more than 828 underground nuclear tests conducted at the site were performed near groundwater.[95] Nevada will continue to establish regulatory boundaries for each groundwater unit based on model-generated contaminant boundaries or potential flow paths. If radionuclide levels ever exceed established levels at those boundaries, Nevada will require DOE EM to submit a plan to meet specific groundwater unit objectives.

Nevada has identified the following priorities associated with low-level radioactive waste management at the NNSS and is working with DOE EM and other partners across the complex on these matters:

1. Waste disposal predictability and forecasting;
2. Appropriate waste classification and management based on actual waste characteristics rather than origin;

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[91] Nevada National Security Site. (2022, September). *Environmental report 2017*. Retrieved from https://www.nnss.gov/docs/docs_LibraryPublications/Nevada%20National%20Security%20Site%20Environmental%20Report%202021,%20Summary%20-%20Final.pdf.
[92] Ibid.
[93] Andres, C. (2023, January 13). *Federal Facility Agreement and Consent Order (FFACO) quarterly report* [Memorandum]. Retrieved from https://ndep.nv.gov/uploads/land-doe-ffacoaip-docs/FY23_Q2.pdf.
[94] Ibid.
[95] Nevada National Security Site. (n.d.). Groundwater characterization. Retrieved from https://www.nnss.gov/pages/programs/em/GroundwaterCharacterization.html.

3. Enhanced waste verification of waste being accepted at NNSS for permanent disposition;
4. Ongoing potential incident planning and outreach to local stakeholders; and
5. Increased focus on waste characterization from the point of generation at off-site DOE facilities for disposal at the NNSS.

Relationship to Other Sites in the Complex

The NNSS is currently the only DOE-owned disposal site available for off-site disposal of DOE-generated low-level, mixed low-level and classified waste (in contrast to the Waste Isolation Pilot Plant in New Mexico, that accepts defense-generated transuranic waste). DOE designated the NNSS and Hanford as the two regional disposal sites for off-site LLW and mixed LLW from throughout the complex in 2000: however, a moratorium is in place on most new waste shipments to Hanford until the Waste Treatment Plant is in full operation.[96] NNSS receipt of waste is conducted in accordance with the facility waste acceptance criteria and a waste profile review process that includes state review.

Nevada and DOE had agreed in the past several years to engage in discussions on any potential changes to the NNSS Waste Acceptance Criteria (WAC) or LLW classification in general.[97] Beginning in 2019, DOE EM began updating the 2016 WAC. The State of Nevada participated in review of the updates. The revised WAC was published on March 22, 2022. Discussions on potential changes to the LLW classification system continue.

For many years, there has been an increase in interactions between the State of Nevada and DOE in regard to NEPA documents identifying the NNSS as a potential waste disposal site and engagement with the DOE sites shipping wastes to the NNSS, evidenced by an increase in the number of site visits conducted and development of tools to track individual waste streams and waste characteristics.

The NNSS will continue to generate LLW into the future through its ongoing active mission. DOE will manage and dispose of the vast majority of waste on-site, with the exception of a small quantity of newly-generated transuranic waste currently stored at the site that will ultimately be shipped to the Waste Isolation Pilot Plant in New Mexico.

[96] U.S. Department of Energy. (n.d.). *Hanford annual site environmental report for calendar year 2017.* Retrieved from https://msa.hanford.gov/files.cfm/DOE-RL-2018-32_Rev0_UP- DATED.pdf.
[97] National Nuclear Security Administration. (2016, November). *Nevada National Security Site waste acceptance criteria* (Report No. DOE/NV—325-16-00). Retrieved from https://www.nnss.gov/docs/docs_RWM/NNSSWAC_Nov%202016.pdf.

NEW MEXICO

Los Alamos National Laboratory, Sandia National Laboratories, the Waste Isolation Pilot Plant

Background

New Mexico hosts three major U.S. Department of Energy (DOE) sites: Los Alamos National Laboratory, Sandia National Laboratories and the Waste Isolation Pilot Plant (WIPP).

FIGURE 14: TRU waste shipment to WIPP. Photo courtesy of U.S. Department of Energy.

Los Alamos National Laboratory (LANL), located 25 miles northwest of Santa Fe, was established in 1942 to develop the first atomic bomb. It still serves as a key center for weapons and basic science research. The site spans more than 40 square miles and is dissected by canyons several hundred feet deep that drain into the Rio Grande River. The regional aquifer beneath the plateau is the sole water supply for the laboratory and the communities of Los Alamos and White Rock.[98]

Sandia National Laboratories (SNL) began operating as Z Division in 1945 on Sandia Base in Albuquerque to support LANL's efforts to build the first atomic bomb. The lab is located within Kirtland Air Force Base and shares its northern boundary with the city of Albuquerque. The regional aquifer in the Albuquerque Basin serves the nearly 1 million people who live in Albuquerque and its surrounding communities. Like LANL, SNL has contributed to groundwater contamination of its regional aquifer, with at least four groundwater plumes identified.[99]

WIPP, located 26 miles east of Carlsbad, was authorized by Congress in 1979 as the nation's first (and remains the only) underground repository for the permanent disposal of the nation's defense-related transuranic waste (waste that contains manmade elements heavier than uranium on the periodic table, generally protective clothing, tools and equipment).[100] WIPP is operated under a repository certification from the U.S. Environmental Protection Agency and a hazardous waste facility permit issued by the New Mexico Environment Department (NMED). The latter document requires that DOE EM use robust characterization procedures at each generator site across the complex before WIPP can receive waste.[101] DOE EM requires strict compliance with the waste analysis plan and waste acceptance criteria in the WIPP permit.

[98] Los Alamos National Laboratory. (n.d.). Our history. Retrieved from https://www.lanl.gov/about/history-innovation/.
[99] Sandia National Laboratories. (2022). History. Retrieved from https://www.sandia.gov/about/history/index.html.
[100] Waste Isolation Pilot Plant. (n.d.). History. Retrieved from https://wipp.energy.gov/historytimeline.asp.
[101] New Mexico Environment Department. Hazardous Waste Bureau: WIPP. Retrieved from https://www.env.nm.gov/hazardous-waste/wipp/.

Major Accomplishments

In New Mexico, WIPP, LANL and SNL have all had recent successes:

- **WIPP reopening and more stringent reviews:** After being shut down for almost three years following the radiation incident of 2014, the NMED held a facility-wide inspection in late 2016 to clear the way for WIPP to resume operations. Part of this inspection was to verify that the enhanced facility emergency response processes and training and the more stringent reviews for waste coming to WIPP required by the settlement agreement and stipulated final order were being implemented.[102] WIPP reopened on January 9, 2017 and has received more than 7,000 containers in over 300 shipments since reopening. DOE EM is currently reviewing options for properly storing more than 400 containers of problematic LANL waste. In addition, DOE EM has submitted several permit modifications for WIPP. WIPP is currently undergoing the 10-year permit renewal process. The current permit, which expired in December 2020, remains in effect and enforceable. The anticipated completion of the permit renewal process is Spring of 2023.

- **WIPP/LANL:** In January 2016, the NMED and DOE signed a settlement agreement to address the 2014 events. They agreed to:
  - Enhanced waste characterization review and process;
  - Enhanced facility maintenance and site emergency response; and
  - Funding of various supplemental environmental projects.

- **Supplemental environmental projects at WIPP and Los Alamos National Laboratory:** The settlement agreement and stipulated final order included the completion of supplemental environmental projects for both LANL and WIPP.[103] Funding was provided for WIPP for the following projects: road repairs along the WIPP transportation route in southern New Mexico; triennial independent reviews of environmental regulatory compliance and operations at WIPP (the first of which has already been completed); enhanced training for local emergency responders; and the creation of a state-of-the art emergency operations center in Carlsbad, New Mexico. Projects at the LANL include potable waterline upgrades, watershed enhancement, storm water monitoring, independent reviews of environment regulatory compliance and operations at LANL, and road projects in the Los Alamos area.

- **LANL chromium plume cleanup:** The NMED and DOE EM are partnering on the chromium plume cleanup at LANL as part of the settlement agreement signed in 2016.[104] For the federal fiscal year 2021, DOE EM completed 13 of the 18 milestones on time;[105] five milestones which remained in dispute were not submitted by DOE EM. The NMED and LANL agreed upon 19 milestones for fiscal year 2022.

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[102] U.S. Department of Energy, Carlsbad Field Office. (2016, June 3). *Class 2 permit modification request. Revise the RCRA Contingency Plan and associated emergency response personnel training and active room ventilation flow rate: Waste Isolation Pilot Plant, Carlsbad, New Mexico* (WIPP Permit No. NM4890139088-TSDF). Retrieved from https://www.env.nm.gov/ wipp/documents/160603.pdf.
[103] U.S. Department of Energy. (2016, January 22). *U.S. Department of Energy and New Mexico finalize $74M in settlement agreements for nuclear waste incidents of 2014.* Retrieved from https://www.energy.gov/articles/us-department-energy-and-new-mexico-finalize-74m-settlement-agreements-nuclear-waste.
[104] New Mexico Environment Department. (2016, January 22). *Settlement agreement and stipulated final order.* Retrieved from https://www.env.nm.gov/OOTS/documents/LANLSASFO- FINAL1_22_16.pdf.
[105] New Mexico Environment Department. (2012, January). Los Alamos National Laboratory Compliance Order on Consent Public Information Meeting – FY2022 Milestones (Appendix B). Retrieved from https://www.env.nm.gov/hazardous-waste/wp-content/uploads/sites/10/2022/01/HWB-LANL-NMED-Presentation-Appendix-B-Public-Meeting_1-6-2022.pdf B-M.

- **Sandia National Laboratories:** In the past three years, Sandia National Laboratories has achieved corrective action complete status for 32 solid waste management units and areas of concern, which included industrial septic systems, drain fields, surface impoundments, open dumps, and firing and burn sites. This accomplishment has reduced the overall management of sites from close to 300 sites in the 1990s to six areas requiring corrective action; these six sites are undergoing continuing characterization and remedy efforts. In 2021, NMED approved the 5-Year Review of the Mixed Waste Landfill.

Site-Specific Issues

Efforts to modify how the volume of nuclear waste is recorded at WIPP continue. In December 2017, DOE published a modification to WIPP's permit with the NMED in an attempt to change the way storage is tracked so that air and empty space in waste containers are not counted against waste storage capacity.[106] The New Mexico Environment Department approved the permit modification in January 2019.

[106] New Mexico Environment Department. (n.d.). WIPP—permit page. Retrieved from https://www.env.nm.gov/hazardous-waste/wipp-permit-page/.

NEW YORK

West Valley Demonstration Project

Background

The West Valley Site (formally known as the Western New York Nuclear Service Center) is located approximately 25 miles south of Buffalo, New York. Pursuant to the federal West Valley Demonstration Project Act of 1980, the U.S. Department of Energy (DOE) is conducting a high-level waste (HLW) solidification and decommissioning demonstration project in cooperation with the New York State Energy Research and Development Authority (NYSERDA). DOE has operational responsibility for approximately 167 acres of the larger 3,330-acre Western New York Nuclear Service Center, all of which NYSERDA owns.[107]

FIGURE 15: Aerial view of the West Valley Site. Photo courtesy of U.S. Department of Energy.

From 1966 to 1972, Nuclear Fuel Services, Inc., a private company, reprocessed 640 metric tons of spent nuclear fuel to recover uranium and plutonium under agreements with the state of New York and the U.S. Atomic Energy Commission (AEC). Additionally, the facility operated under a license issued by AEC beginning in 1966. Approximately 600,000 gallons of HLW liquid and sludge resulted from reprocessing,[108] making West Valley one of only four sites in the DOE Office of Environmental Management cleanup complex with HLW — the other sites are the Idaho National Laboratory, Hanford and Savannah River — and the only site where DOE receives a state contribution for HLW vitrification and storage. Sixty percent of the spent fuel reprocessed at West Valley came from the N-Reactor at Hanford. The majority of the plutonium and all the uranium recovered at West Valley were transferred back to AEC.[109]

The Nuclear Waste Policy Act requires the federal government to bear the disposal costs of HLW resulting from atomic energy defense activities. Also, the DOE facility for disposal of transuranic (TRU) waste, the Waste Isolation Pilot Plant (WIPP) in New Mexico, only accepts defense TRU waste. However, DOE considers West Valley a "commercial facility," despite the historical record indicating that a significant portion of the radioactive material coming to West Valley and most of the recovered material leaving West Valley was used for atomic energy defense activities, as defined under the Nuclear Waste Policy Act of 1982.[110] DOE's commercial designation for West Valley leaves the West Valley TRU waste currently without a viable disposal path. It may also strand the solidified HLW at West Valley as a result of DOE's insistence that the state pay a HLW disposal fee that could reach billions of dollars.

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[107] U.S. Environmental Protection Agency. (2017, September 14). Hazardous waste cleanup: Western New York Nuclear Service Center in West Valley, New York. Retrieved from https://www.epa.gov/hwcorrectiveactionsites/hazardous-waste-cleanup-western-new-york-nuclear-service-center-west-valley.

[108] U.S. Government Accountability Office. (1980, July 28). *Nuclear issues at Western New York Nuclear Service Center*. Retrieved from https://www.gao.gov/products/112946.

[109] U.S. Department of Energy. (n.d.). 9. Plutonium acquisitions. Retrieved from https://www.osti.gov/opennet/forms?formurl=document/pu50yrs/pu50yc.html.

[110] U.S. Department of Energy, Office of Civilian Radioactive Waste Management. (2004, March). *Nuclear Waste Policy Act as amended*. Retrieved from https://www.energy.gov/sites/prod/ files/edg/media/nwpa_2004.pdf.

Under the West Valley Demonstration Project Act of 1980, DOE is responsible for five activities:[111]

- Solidify the high-level radioactive waste;
- Develop containers suitable for permanent disposal of the solidified HLW;
- Decontaminate and decommission the HLW tanks, facilities used in the solidification, and material and hardware used in connection with the project in accordance with such requirements as the U.S. Nuclear Regulatory Commission may prescribe;
- Dispose of low-level waste (LLW) and TRU waste; and
- Transport the solidified HLW to a federal repository for permanent disposal.

In 2002, after completing solidification of the HLW through vitrification, the West Valley Demonstration Project shifted its focus to decontamination and decommissioning efforts. DOE and NYSERDA jointly issued an Environmental Impact Statement (EIS) in 2010 and are conducting the decommissioning work in phases.[112] Phase 1, which will be completed by 2030, involves removal of the main plant process building, vitrification facility, contaminated lagoons, the source area of a strontium-90 groundwater plume, and several ancillary facilities. To remove the main plant process building, the vitrified HLW that was stored inside the building was relocated to a new, on-site HLW dry-cask storage facility in 2016. The HLW vitrification facility was demolished in 2017-18. Demolition of the main plant process building is expected to begin in late 2022.

The Phase 2 decommissioning decision will be made through a supplemental EIS in 2025 and will identify the decommissioning approach for the HLW tanks, the non-source area of the groundwater plume and two radioactive waste disposal facilities.[113]

Aside from the HLW issue and pursuant to intergovernmental agreements reached over the years, NYSERDA pays a 10 to 50 percent share for cleanup costs.[114]

Major Accomplishments[115, 116]

DOE has worked with New York to achieve the following outcomes:

- Completion of the solidification of 600,000 gallons of HLW through vitrification;
- Transfer of the 278 canisters of HLW glass from the main plant process building to a new, on-site, interim dry-cask storage pad;
- Deactivation and demolition of the HLW vitrification facility;
- Removal of multiple miles of piping and process vessels from the site facilities;
- Shipment of more than two million cubic feet of low-level radioactive waste to off-site disposal facilities;
- Installation of an interim remedial measure to address the North Plateau Sr-90 groundwater plume;

[111] U.S. Nuclear Regulatory Commission. (2018, November 2). West Valley Demonstration Project. Retrieved from https://www.nrc.gov/info-finder/decommissioning/complex/wv.html.
[112] U.S. Nuclear Regulatory Commission. (2018, November 2). West Valley Demonstration Project. Retrieved from https://www.nrc.gov/info-finder/decommissioning/complex/wv.html.
[113] U.S. Department of Energy, Office of NEPA Policy and Compliance. (n.d.). EIS-0226-S1: Decommissioning and/or long-term stewardship at the West Valley Demonstration Project and Western New York Nuclear Service Center. Retrieved from https://www.energy.gov/nepa/eis-0226-s1-decommissioning-andor-long-term-stewardship-west-valley-demonstration-proj- ect-and.
[114] New York State Energy Research and Development Authority. (2019). West Valley Demonstration Project. Retrieved from https://www.nyserda.ny.gov/Researchers-and-Policymakers/ West-Valley/West-Valley-Demonstration-Project.
[115] New York State Energy Research and Development Authority. (2019). West Valley Demonstration Project. Retrieved from https://www.nyserda.ny.gov/Researchers-and-Policymakers/West-Valley/West-Valley-Demonstration-Project.
[116] U.S. Nuclear Regulatory Commission. (2018, November 2). West Valley Demonstration Project. Retrieved from https://www.nrc.gov/info-finder/decommissioning/complex/wv.html.

- Stabilization of the Nuclear Regulatory Commission-licensed disposal area to limit water infiltration into the disposal holes and trenches; and
- Effective and collaborative relationships with stakeholders, including local governments and the Seneca Nation of Indians.

Site-Specific Issues

DOE's commercial designation for West Valley leaves the site's TRU waste without a viable disposal path and may also strand the solidified HLW at West Valley because of DOE's insistence that the state pay a HLW disposal fee that could potentially be billions of dollars.[117] Historical records show that activities were conducted at the site that meet the definition of "atomic energy defense activities" under the Nuclear Waste Policy Act of 1982. In 2020, the federal Government Accountability Office (GAO) conducted an evaluation of the issues surrounding the disposal of the West Valley Transuranic wastes, and concluded that "Congress should consider taking action to indicate how DOE should proceed with the disposal of West Valley's transuranic waste and, if necessary, to amend the appropriate federal legislation to create a legal pathway for its disposal."[118]

Relationship to Other Sites in the Complex

The West Valley Demonstration Project's relationships with other DOE EM sites are critical to completing the requirements of the West Valley Demonstration Project Act. These relationships include WIPP for the disposal of TRU waste and the Nevada National Security Site for the disposal of LLW. Ultimate disposal of the HLW stored on-site depends on decisions by DOE and the federal government about the establishment of a HLW repository for permanent geologic disposal.

[117] House Committee on Energy & Commerce. (2018, May 18). *Tonko remarks at nuclear waste legislative hearing* [Press release]. Retrieved from https://energycommerce.house.gov/ newsroom/press-releases/tonko-remarks-at-nuclear-waste-legislative-hearing.
[118] U.S. Government Accountability Office. (2021, January 13). *Congressional Action Needed to Clarify a Disposal Option at West Valley Site in New York*, (Report No. GAO-21-115). Retrieved from https://www.gao.gov/products/gao-21-115.

OHIO

Portsmouth, Fernald, Mound

Background

Ohio has three major U.S. Department of Energy (DOE) sites: Portsmouth, Fernald and Mound. Both Fernald and Mound successfully closed and transitioned to the DOE Office of Legacy Management (DOE LM) in 2006 as a result of the Accelerated Cleanup Program.

Portsmouth, also known as the Portsmouth Gaseous Diffusion Plant, is a 3,700-acre site located in southern Ohio. The facility was used to enrich uranium for fuel and weapons until 2001. The process of enriching uranium creates a co-product, depleted uranium hexafluoride (DUF6), that needs to be converted to a more stable chemical that can be reused, stored or disposed of. Portsmouth currently operates a depleted uranium hexafluoride conversion facility, similar to the facility at Paducah, Kentucky. Large building complexes remain at the site and are undergoing deactivation and decommissioning as well as remediation of soil and ground water contamination.[119]

Fernald, now named the Fernald Preserve, is a 1,050-acre site located in southwest Ohio. It is a former uranium foundry that produced high-quality uranium metals for the nuclear weapons complex. Following years of cleanup, DOE EM declared closure of the site in 2006.[120] Ongoing activities at the site include continuing groundwater remediation, surveillance and monitoring of the on-site disposal facility, institutional controls implementation and other aspects of the remedy. In 2008 Ohio settled litigation regarding natural resource damage that focuses primarily on contamination and lost use of a portion of the Great Miami Buried Valley Aquifer.[121]

Mound, a 306-acre site located in Miamisburg in southwestern Ohio, operated as an integrated research, development and production facility performing work in support of DOE's weapons and energy programs. DOE LM manages the site. Ongoing activities include groundwater remediation, groundwater monitoring and the implementation and monitoring of institutional controls (U.S. EPA defines institutional controls as non-engineered instruments, such as administrative and legal controls, that help minimize the potential for human exposure to contamination, protect the integrity of the environmental cleanup remedy, or both).[122]

Major Accomplishments

DOE EM has worked with Ohio to achieve the following outcomes:

- In 2015 at Portsmouth, DOE EM finalized records of decision for the Process Buildings and Complex Facilities Decontamination and Decommissioning Evaluation Project and the Site-Wide Waste Disposition Evaluation Project. These decisions selected demolition of existing structures and

[119] U.S. Department of Energy, Portsmouth/Paducah Project Office. (n.d.). Portsmouth. Retrieved from https://www.energy.gov/pppo/portsmouth-site.
[120] U.S. Department of Energy, Office of Legacy Management. (n.d.). Fernald Disclosure Project: About Fernald. Retrieved from https://www.energy.gov/lm/fernald-preserve-ohio-site.
[121] Ground Water Consortium. (2013). Great Miami Buried Valley Aquifer information page. Retrieved from http://gwconsortium.org/gmbva-information-page.php.
[122] U.S. Department of Energy, Office of Legacy Management. (n.d.). *Mound, Miamisburg, Ohio* [Fact Sheet]. Retrieved from https://www.energy.gov/lm/mound-ohio-site.

disposal of materials that met waste acceptance criteria in an on-site disposal facility. Construction of the first three cells of the on-site disposal facility was completed in 2021, with waste placement operations ongoing since 2022. The X-231-B Landfill Excavation was completed in 2022 for use as engineered fill at the On-Site Waste Disposal Facility. Structural demolition of the large X-326 uranium-enrichment Process Building was completed on June 10, 2022, with the overall X-326 Demolition project about 70% complete as of December 2022.[123] In 2018, Ohio EPA's Director issued final findings and orders for the Comprehensive Environmental Response, Compensation, and Liability Act actions to restore natural resources supporting removal of landfills and plumes within the perimeter road;[124]

- Following remediation, DOE EM restored the Fernald site to native habitats, using the post-excavation topography to determine habitat type. The site is now a park focused on wildlife and managed by DOE LM. A visitor center opened in 2008.[125] More than 4,500 acres have been protected, with conservation easements and simple fee acquisitions within the watersheds surrounding the site as part of the natural resources damage settlement;[126] and
- Since the Mound site became available for transfer in 2011, more than half of the original 306 acres have been transferred to new ownership. Currently, the Mound site has 16 businesses operating on the property with nearly 390 employees.[127] In 2014, DOE EM implemented an enhanced monitored natural attenuation field demonstration at Mound in an effort to transition the active groundwater pump-and-treat system to a more passive, monitored, natural attenuation remedy. The demonstration involved injections of edible oils to create in-place treatment zones. The demonstration was completed in August 2018 and on-going ground water monitoring indicates that concentrations of volatile organic compounds (VOCs) are decreasing, and the plume is not expanding. Based on the results of the enhanced attenuation field demonstration, DOE is scheduled to submit a Proposed Plan for Amendment of Operable Unit 1 Record of Decision in 2022. The proposed plan will address residual VOC contamination in Operable Unit 1 and Parcel 9. DOE's preferred alternative to address residual VOC contamination in ground water is enhanced attenuation with monitoring. The preferred alternative for vapor intrusion is preemptive measures or actions to mitigate exposure. Both alternatives include institutional controls.

Relationship to Other Sites in the Complex

- Portsmouth and Paducah, Kentucky are managed out of the Portsmouth Paducah Project Office (PPPO), located in Lexington, Kentucky;
- Portsmouth, Paducah, Kentucky and Oak Ridge, Tennessee, all had gaseous diffusion plants, and while Tennessee's buildings are demolished, Portsmouth is in process and Paducah is beginning to prepare for demolition; and
- Portsmouth, Paducah, Kentucky and Oak Ridge, Tennessee, also receive federally appropriated funding from the Uranium Enrichment Decontamination and Decommissioning Fund (UED&D) which was established in The Energy Policy Act of 1992.

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[123] U.S. Department of Energy, Portsmouth/Paducah Project Office. (n.d.). Portsmouth regulatory approach. Retrieved from https://www.energy.gov/pppo/portsmouth-cleanup.
[124] U.S. Department of Energy, Portsmouth/Paducah Project Office. (n.d.). Ohio EPA director's final findings and orders for CERCLA actions to restore natural resources. Retrieved from https://www.energy.gov/pppo/downloads/ohio-epa-director-s-final-findings-and-orders-cercla-actions-restore-natural.
[125] U.S. Department of Energy, Office of Legacy Management. (2014, July 10). *Fernald Preserve attracts 50,000 visitors*. Retrieved from https://www.energy.gov/lm/fernald-preserve-visitors-center.
[126] Ohio Environmental Protection Agency. (2018, June). *Fernald Natural Resource Trustees 2017 annual report to the public*. Retrieved from https://epa.ohio.gov/static/Portals/30/FFS/docs/doe/fernald/2020NRTAnnualReportFINAL.pdf.
[127] D Bush, J. (2018, June 7). Mound Business Park grows to 16 tenants, more companies likely on the way. *Dayton Business Journal*. Retrieved from https://www.bizjournals.com/dayton/news/2018/06/07/mound-business-park-grows-to-16-tenants-more.html.

SOUTH CAROLINA

Savannah River Site

Background

The Savannah River Site (SRS) complex covers 310 square miles in South Carolina's Aiken, Allendale and Barnwell counties. It was constructed during the early 1950s to produce special radioactive isotopes (plutonium-239 and tritium) to produce nuclear weapons. After the Cold War, greater emphasis at SRS was placed on cleanup, but the site remains a major defense installation, with a continuing mission to process and purify tritium, uranium and plutonium. Savannah River is home to H Canyon, the only facility of its kind in the nation for processing nuclear materials. Because of past operations, more than 500 potentially contaminated sites and 14 groundwater contamination plumes exist at SRS.[128] Currently, the site's annual cleanup budget is about $1.4 billion. A consent order between the U.S. Department of energy (DOE) and the state addresses legacy mixed waste storage and treatment under the Federal Facilities Compliance Act. A Federal Facilities Agreement (FFA) among South Carolina, the U.S. Environmental Protection Agency and DOE addresses investigation and cleanup of contaminated sites at Savannah River.[129] In addition, relevant state statutes and regulations are applied to DOE EM cleanup activities, including treatment of high-level waste (HLW) and wastewater.

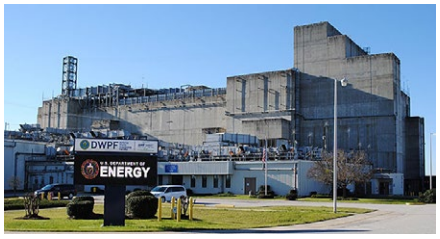

FIGURE 16: The Savannah River Site defense waste processing facility. Photo courtesy of U.S. Department of Energy.

Accomplishments

DOE EM has worked with South Carolina to achieve the following outcomes:[130]

- DOE EM has made progress in the treatment of approximately 35 million gallons of mixed hazardous and radioactive HLW and closure of the aging storage tanks. As of 2021, eight tanks have been operationally closed, which comprise a third of the total old-style tanks scheduled for closure. Since 1996, the Defense Waste Processing Facility has produced 16.4 million pounds of vitrified HLW incorporating over 62.4 million curies in over 4,250 canisters;[131]
- SRS successfully operated an interim salt disposition treatment facility from 2008 to 2019 to augment treatment of the HLW. By the end of operation of this facility, SRS processed 7.4 million gallons of radioactive salt waste.[132] Salt waste processing is an essential step in the closure of the HLW tanks because 90 percent of this waste is composed of salt waste. With the interim salt disposition treatment facility proving successful for removing radioactive components from salt waste, Savannah River completed construction of the large-scale salt waste processing facility

[128] U.S. Department of Energy, *Savannah River site* [Fact sheet] Document no. 20CC00295. Retrieved from https://www.srs.gov/general/news/factsheets/srs_overview.pdf.
[129] U.S. Department of Energy, Savannah River Site. (1993, August 16). *Federal facility agreement for the Savannah River Site* (Document No. 89-05-FF). Retrieved from https://www.srs. gov/general/programs/soil/ffa/ffa.pdf.
[130] U.S. Department of Energy, Savannah River Site. (n.d.). SRS news releases. Retrieved from https://www.srs.gov/general/news/releases.htm.
[131] U.S. Department of Energy, Savannah River Remediation. (2022, January 25). *Citizen's Advisory Board Update The Liquid Waste System: A Status*. Retrieved from https://cab.srs.gov/library/meetings/2022/ms/Liquid_Waste_Update.pdf.
[132] U.S. Department of Energy, Savannah River Site (2019, August 6). SRS news release. Retrieved from https://www.energy.gov/em/articles/srs-completes-interim-projects-prepares-salt-waste-processing-plant-startup.

(SWPF) and began hot operations at this facility on January 17, 2021.[133] As of January 18, 2022, SWPF has processed 2.3 million gallons of HLW;[134]
- Most of the legacy mixed transuranic (TRU) waste volume and mid-low-level waste (LLW) streams have been disposed of;
- At least 81 percent of 500 potentially contaminated sites at Savannah River have a cleanup decision in place in accordance with the FFA; and
- To save time and money, DOE EM and state regulators adopted an area closure approach rather than individual closures within the area. One example of area closure success is T Area in 2006, which included demolition of 28 buildings, off-site disposal of 91 cubic yards of soil and construction of a ten-acre geosynthetic cap. The project was completed in 36 months, which was 48 months ahead of the original schedule.

Site-Specific Issues

Activities with both cleanup and defense related production are ongoing at Savannah River, and their continuation and expansion are important to South Carolina. A significant focus of the cleanup is on treatment and closure of the HLW tanks. The 35 million gallons of liquid radioactive and toxic HLW stored in aging and degrading tanks represent the single largest environmental threat in South Carolina.[135] Other concerns for the site include soil and groundwater cleanup because SRS is in a humid area in which groundwater contamination can discharge relatively quickly into surface waters and subsequently the Savannah River.

In 1998, DOE designated SRS as the immobilization or conversion facility for much of the nation's surplus plutonium and began constructing the mixed-oxide fuel fabrication facility at SRS in August 2007. The facility was part of a nuclear nonproliferation agreement with Russia to dispose of 34 metric tons of weapons-grade plutonium by converting it into mixed-oxide fuel for use in commercial nuclear power plants. The mixed-oxide (MOX) facility was not completed due to cost overruns and technical barriers, and DOE terminated funding for construction completion, prompting a lawsuit by South Carolina which was settled in 2020. DOE is now pursuing downblending for plutonium disposition. DOE is required under the 2020 settlement agreement to remove plutonium from the state by January 1, 2037.[136]

In 2020, the National Nuclear Security Administration announced its decision to repurpose the uncompleted MOX facility to produce a minimum of 50 war reserve plutonium pits, per year, at the Savannah River Site for the nuclear weapons stockpile beginning in 2030.[137]

Relationship to Other Sites in the Complex

SRS will play a significant role in processing nuclear materials into the future including tritium processing, plutonium pit production and downblending of surplus plutonium. While it moves ahead with those missions, significant volumes of waste will continue to require treatment or disposal at other sites in the complex, including transporting TRU waste to the Waste Isolation Pilot Plant and spent nuclear fuel and vitrified HLW to a HLW repository that has yet to be sited or built. The vast majority of LLW (more than 55,000 cubic meters) at SRS will be disposed of on-site between 2015 and 2050, with the remainder destined for the Nevada National Security Site.[138]

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[133] U.S. Department of Energy, Savannah River Site. (2021, January 19). *SWPF Completes Hot Commissioning, Begins Full Radioactive Operations*. Retrieved from https://www.energy.gov/em/articles/swpf-completes-hot-commissioning-begins-full-radioactive-operations.
[134] Parsons (2022, February 16). Salt Waste Processing Facility SCDHEC Status Update in Quarterly Liquid Waste Meeting.
[135] AECOM. (2019). Savannah River remediation. Retrieved from https://www.aecom.com/ie/projects/savannah-river-site/.
[136] U.S. Nuclear Regulatory Commission. (2017, May 23). Backgrounder on mixed oxide fuel. Retrieved from https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/mox-bg.html.
[137] U.S. Department of Energy. (2020, November 5). DOE/EIS-0541: Record of Decision (November 2020). Retrieved from https://www.energy.gov/nepa/downloads/doeeis-0541-record-decision-november-2020.
[138] U.S. Department of Energy, Savannah River Site. (2015). *An overview of the Savannah River Site*. Retrieved from https://www.srs.gov/general/outreach/srs_info_pods/documents/ srs_overview_2015_web.pdf.

TENNESSEE

Oak Ridge Reservation

Background

The Oak Ridge Reservation in eastern Tennessee consists of three major U.S. Department of Energy (DOE) facilities: the Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex and the East Tennessee Technology Park (ETTP) (formerly the K 25 Gaseous Diffusion Plant). Separate DOE offices — the Office of Science, the National Nuclear Security Administration, and the DOE Office of Environmental Management, respectively — manage each facility. In the more than 80 years since the Oak Ridge Reservation was established, a variety of production and research activities have generated large quantities of radioactive, hazardous, and mixed wastes. Historical waste management practices contaminated more than 500 locations on and near the Oak Ridge Reservation.[139]

Several agreements embody the regulatory framework at Oak Ridge Reservation. The 1992 Federal Facilities Agreement established environmental cleanup as well as restoration procedures and milestones.[140] A 1995 Tennessee Department of Environment and Conservation commissioner's order addressed mixed-waste treatment and storage at all DOE facilities at Oak Ridge Reservation, as established in the Federal Facilities Compliance Act.[141] In addition, relevant state statutes and regulations are applied to DOE waste management and cleanup activities.

Major Accomplishments

DOE's cleanup mission, in coordination with the state, has made progress on several cleanup and disposal activities:

- First site in the world to remove an entire uranium enrichment complex;
- Industrial and recreational development move to the forefront as ETTP continues transformation;
- Former Bulk Shielding Reactor demolition completed;
- Old Criticality Experiment Lab demolition completed;
- Processing and shipping inventory of legacy transuranic waste for permanent disposal;
- Molten Salt Reactor Experiment cleanup and life extension upgrades;
- Uranium-233 being processed to disposal-ready form;
- Liquid and Gaseous Waste Operations system improvements extend life of system;
- Biology Complex demolition completed;
- Mercury Treatment Facility under construction; and
- Preparing many more buildings for demolition at ORNL and Y-12, including former research reactors, uranium processing facilities, isotope and fission development laboratories, and support buildings.

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[139] U.S. Environmental Protection Agency. (2018, October 23). Superfund site: Oak Ridge Reservation (USDOE): Oak Ridge, TN, cleanup activities. Retrieved from https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0404152.

[140] U.S. Department of Energy, Office of Environmental Management. (n.d.). Federal facility agreement (FFA) signed at Oak Ridge. Retrieved from https://www.energy.gov/em/downloads/federal-facility-agreement-ffa-signed-oak-ridge.

[141] U.S. Department of Energy, Office of Environmental Management. (1995, September 26). Oak Ridge Reservation compliance order, September 26, 1995. Retrieved from https://www.energy.gov/sites/prod/files/em/2001_Agreements/ORR_CO_9-26-1995.pdf.

Site-Specific Issues

Tennessee's primary concern is to ensure the protection of the health, safety and environment for its citizens given that Oak Ridge Reservation has an abundance of surface water and complex groundwater pathways. Tennessee, DOE and the U.S. Environmental Protection Agency are working together with stakeholders to address concerns about the proximity of the public to contaminated surface water and waste burials at DOE facilities in areas of abundant rainfall, shallow groundwater tables and karst hydrogeology.

Specific issues for the site include:

- Uncertainty regarding the long-term effectiveness of the hydrologic isolation of the Melton Valley burial grounds, where maintenance activities have been steadily increasing with downgradient trench issues and water levels inside the capped areas;
- One hundred miles of rivers and streams affected by historical site activities, including 250,000 curies of radioactive waste discharged into surface streams and 339,000 pounds of mercury discharged into East Fork Poplar Creek and the Clinch and Tennessee rivers;[142]
- Hundreds of acres of buried waste, including deep well injections, containing millions of pounds of uranium and several million curies of radioactivity;
- Hundreds of surplus facilities in deteriorating condition, some heavily contaminated with mercury and radionuclides;
- The need for characterization and evaluation of the extent of groundwater contamination, including delineation of exit pathways;
- The need for adequate characterization and segregation of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste necessary to maximize the available on-site waste disposal capacity;
- Selecting a protective CERCLA waste disposal option to support future cleanup, including limits on the types and volumes of waste disposed on-site;
- Treatment and disposal for highly radioactive salts in the fuel drain tanks of the Molten-Salt Reactor Experiment which contain well over 1.5 million curies of radioactive waste;
- Lack of sufficient CERCLA project milestones to ensure a steady pace of cleanup; and
- In addition to the issues above, current funding levels planned by DOE for Oak Ridge Reservation will extend the projected cleanup completion date.

Relationship to Other Sites in the Complex

A Record of Decision was signed in October 1999 to construct an on-site CERCLA waste disposal facility at Oak Ridge Reservation.[143] This facility is now about 83 percent full, and DOE EM and its regulators signed another Record of Decision in 2022 to construct a second on-site disposal facility for CERCLA cleanup waste. Even with this new on-site disposal option, off-site disposal alternatives are necessary for other waste streams, including TRU waste destined for the Waste Isolation Pilot Plant. Approximately 1.7 million kilograms of remote-handled TRU waste sludge and 930,000 kilograms of remote-handled mixed low-level aqueous waste stored in tanks at ORNL will require on-site treatment and eventual off-site disposal of the final form.

[142] U.S. Environmental Protection Agency. (2018, October 23). Superfund site: Oak Ridge Reservation (USDOE) Oak Ridge, TN, cleanup activities. Retrieved from https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0404152.
[143] U.S. Environmental Protection Agency. (1999, November 2). *EPA Superfund record of decision: Oak Ridge Reservation* (USDOE) EPA ID: TN1890090003, OU 13, Oak Ridge, TN (Report No. EPA/ROD/R04-00/028 2000). Retrieved from https://semspub.epa.gov/work/HQ/186989.pdf.

A 1993 consent order issued by the Tennessee Department of Environment and Conservation modified storage and treatment permits for out-of-state waste from DOE-owned facilities, and the Toxic Substances Control Act Incinerator was used to treat DOE complex wide liquid and solid LLW contaminated with polychlorinated biphenyls. In addition, Tennessee assisted New York by accepting low-level liquid waste from the Separations Process Research Unit for treatment and disposal. The agreement was in place for three years (May 30, 2012 to May 30, 2015) to allow for an on-site treatment facility constructed at the Separations Process Research Unit.

TEXAS

Pantex Plant

Background

The Pantex Plant was originally built by the U.S. Army in 1942 on 18,000 acres in the Texas Panhandle, 17 miles northeast of Amarillo in Carson County, Texas. The Army used the site to load and pack conventional artillery shells and bombs in support of World War II. Today, the Pantex Plant is the nation's primary facility for the final assembly, dismantlement, and maintenance of nuclear weapons. The NNSA also selected Pantex as the High Explosive (HE) Center of Excellence to develop, test, and fabricate high explosives components.[144]

Operations at Pantex are primarily conducted on 2,000 acres of the 18,000-acre site. There are approximately 650 buildings and Pantex maintains its own water treatment, sewage, and steam generating plants. Five wind turbines on the site generate enough power to support more than 60 percent of the Pantex Plant's annual energy needs.[145] In April 2018, a new administrative and support facility named the John C. Drummond Center was opened at Pantex. The three-wing complex accommodates approximately 1,100 administrative, technical and management staff who have been relocated from the aging 1950's era facilities at the Pantex Plant as part of the modernization of the nuclear security infrastructure.[146] Eventually the vacated buildings on the plant site will be deactivated and demolished.

Historical operations at the Pantex Plant resulted in contamination of the soil and a perched aquifer beneath the site. A Record of Decision was issued in 2008 with concurrence of the Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) to address cleanup of the legacy contamination. The remedial action established in the ROD and the Compliance Plan in the Hazardous Waste Permit includes pump and treat and in situ bioremediation technology for the cleanup of perched groundwater, as well as soil vapor extraction (SVE) for cleanup of non-aqueous phase liquids in soils. Results of the remedial actions are evaluated quarterly and annually and documented in progress reports to the EPA and TCEQ. Pantex also conducts five-year reviews to evaluate the remedies and determine if changes are needed to meet the cleanup goals and protectiveness of people and the environment.147 The Agreement in Principle between the State of Texas and DOE supports the cleanup of the Pantex Plant and provides environmental oversight to protect human health and safety, and the environment around the Pantex Plant.[148]

[144] Pantex. (2019). Pantex history. Retrieved from https://pantex.energy.gov/about/history.
[145] Pantex. (2019). About. Retrieved from https://pantex.energy.gov/about.
[146] Farris, J. (2018, April 6). Pantex unveils new administrative building. *Amarillo Globe-News*. Retrieved from https://www.amarillo.com/news/20180406/pantex-unveils-new-administrative-building.
[147] Babcock & Wilcox, Technical Services Pantex, LLC, & Sapere Consulting, Inc. (2008, September). *Record of decision for groundwater, soil and associated media. Pantex plant, Carson County, Texas*. Retrieved from https://pantex.energy.gov/sites/default/files/016005.pdf.
[148] Further information about the agreement in principle is available at Office of the Texas Comptroller of Public Accounts. (n.d.). Pantex: Agreement in principle. Retrieved from https://comptroller.texas.gov/programs/seco/programs/pantex/aip.php.

Accomplishments

All soil remedies are performing as designed. Interim early actions included removal of more than 25,000 cubic yards of contaminated soil, construction of landfill covers, deactivation and decommissioning of facilities at major release areas, lining ditches near a major release area in Zone 12, and construction and operation of soil vapor extraction systems in Zone 11 and the Burning Grounds.[149] Only the Burning Ground SVE was carried forward into the final remedial action established in the ROD. The SVE systems have removed more than 21,200 pounds of volatile organic compounds (VOCs) since startup. Data indicates that the Burning Ground SVE is nearing the end of remediation. Pantex is currently developing information to move towards shutdown of the remedial action system.

Pantex operates 76 extraction wells and one injection well from two pump and treat systems that are capable of treating at least 550 gallons per minute of perched groundwater contaminated with Hexahydro-1,3,5-Trinitro-1,3,5-Triazine and chromium. These systems are designed to remove and treat groundwater to reduce the saturated thickness (the distance between the water table and the base of the aquifer) of the perched aquifer and to remove contaminant mass. The reduction in thickness will significantly reduce the migration of contaminants both vertically and horizontally to prevent them from migrating to the Ogallala Aquifer, which provides significant groundwater for agricultural, municipal and industrial development across the Great Plains.[150] The pump and treat systems at Pantex have treated over 3.1 billion gallons of impacted perched water with about 14,200 pounds of contaminants removed by 2021. In addition, since 2005, Pantex has beneficially used about 1.7 billion gallons of the treated water. Saturated thickness is declining by about 1 ft/year in areas under the influence of the pump and treat systems.[151] Four in-situ bioremediation (ISB) systems have been installed for the Pantex Remedial Action in locations where the confining layer of the perched aquifer is more permeable, the saturated thickness is too low (<15 ft) to be pumped efficiently, or where ISB is effective in treating multiple contaminants of concern. The two oldest systems have treated high explosives, trichloroethene (TCE), hexavalent chromium and perchlorate where they are near or below safe drinking levels throughout the systems. Pantex is continuing to refine injection to fully treat areas that have demonstrated only partial treatment. The third system is located at the southeast edge of USDOE/NNSA-owned property to prevent further offsite migration of high explosive contaminants.[152]

Site-Specific Issues

Since issuance of the ROD, Pantex has evaluated the effectiveness of the remedial actions and found the plume of high explosive compounds in the perched groundwater continued to move to the southeast. In 2008, approximately 2.5 sections of land (i.e., 1,526 acres) were purchased from former Pantex neighbors to provide Pantex with ready access for perched groundwater monitoring and remedial action, as needed. To better control the continued southeast movement, Pantex installed wells to conduct pump testing in an area of sufficient saturated thickness and then installed an additional line of extraction wells on the purchased property in 2015 and 2016 to limit further movement to the southeast. Additionally, to better understand the extent of contamination, monitor wells were installed in 2016 and 2017 in the southeast portion of the purchased property. Results indicated the plume had moved through a channel, or buried stream feature, to offsite property. Due to the limited saturated thickness, a new line of ISB injection

[149] U.S. Environmental Protection Agency. (2018, October 23). Superfund site: Pantex plant (USDOE), Pantex Village, TX, cleanup activities. Retrieved from https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0604060.
[150] Pantex. (2017, August). Pantex environmental restoration: *Perched groundwater pump and treat systems*. Retrieved from https://pantex.energy.gov/sites/default/files/P&T-factsheet_2018.pdf.
[151] Consolidated Nuclear Security. (2018, June). *Pantex quarterly progress report: Remedial action progress*. Retrieved from https://pantex.energy.gov/sites/default/files/1Q2018_pantex_progress_report.pdf.
[152] Pantex. (2018, October). *Pantex environmental restoration: In situ groundwater bioremediation systems*. Retrieved from https://pantex.energy.gov/sites/default/files/ISB-factsheet_2018.pdf.

wells was also installed at the property boundary to halt further movement of the plume to offsite property. Nutrients and other chemicals are injected to stimulate microbe growth, which breaks down the contaminants.[153]

Further well drilling in 2019 delineated the plume extent. A new offsite ISB system was designed to address the contamination found on the neighboring properties. Installation of infrastructure for Phase 1 and 2 of the Offsite ISB is complete and the 1st injection into the system was completed in October 2021. Phase 3 construction will begin in 2022, with Phase 4 beginning in 2023. Funding for this additional work will continue to be requested through the NNSA Long-Term Stewardship program to address the issues to the southeast of the site.

Relationship to Other Sites in the Complex

Consolidated Nuclear Security, LLC (CNS) manages and operates the Pantex Plant and the Y-12 National Security Complex in Tennessee under a single contract from the U.S. Department of Energy/NNSA. DOE ships low-level waste from Pantex to the Nevada National Security Sites.

[153] Pantex. (2018, October). *Pantex environmental restoration: Groundwater monitoring.* Retrieved from https://pantex.energy.gov/sites/default/files/GWMonitoring_Fact-Sheet_2018.pdf.

WASHINGTON and OREGON

Hanford Site

Background

Located in southeastern Washington along the Columbia River, the 586-square mile Hanford Nuclear Site was the first and primary plutonium production facility for the United States' nuclear weapons program. The site, which began operations in 1944, includes nine closed reactors, five chemical separations plants, plutonium processing facilities, hundreds of waste burial grounds, more than 60 square miles of contaminated groundwater and 177 underground high-level waste (HLW) tanks containing 56 million gallons of highly radioactive waste.[154] Between the start of operations in 1944 and the shutdown of the last reactor in the late 1980s, Hanford produced more than two-thirds of the nation's estimated 111 metric tons of plutonium.

FIGURE 17: N Reactor at Hanford. Photo courtesy of U.S. Department of Energy.

The production of plutonium generated large amounts of radioactive and chemically hazardous waste. Currently, Hanford houses more than 60 percent of the nation's high-level radioactive waste.[155]

Hanford is the world's largest single environmental cleanup project, with an annual cleanup budget of approximately $2.4 billion.[156] The shift from operations to cleanup came in 1989, when the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency and the Washington State Department of Ecology signed the Hanford Federal Facilities Agreement Consent Order, also known as the Tri-Party Agreement.[157] The Tri-Party Agreement outlines legally enforceable milestones for all aspects of cleanup at Hanford, including tank waste removal and treatment, mixed waste treatment and disposal, environmental restoration activities and low-level waste (LLW) disposal.

Major Accomplishments

Since 1989, much has been accomplished given the enormity and complexity of the contamination, including:

[154] Exchange Monitor. (n.d.). The Hanford Waste Treatment Plant: A 21st century solution to a 70-year-old problem. Retrieved from https://www.exchangemonitor.com/long-form-stories/the-hanford-waste-treatment-plant-a-21st-century-solution-to-a-70-year-old-problem/.
[155] Exchange Monitor. (n.d.). The Hanford Waste Treatment Plant: A 21st century solution to a 70-year-old problem. Retrieved from https://www.exchangemonitor.com/long-form-stories/the-hanford-waste-treatment-plant-a-21st-century-solution-to-a-70-year-old-problem/.
[156] Congressional Research Service. (2013, November 1). *Energy and water development: FY2014 appropriations*. Retrieved from https://fas.org/sgp/crs/misc/R43121.pdf.
[157] U.S. Department of Energy, Office of River Protection. (2019, January 21). Tri-party agreement. Retrieved from https://www.hanford.gov/page.cfm/TriParty.

- Cleanup and disposal of more than 17 million tons of contaminated soil and building debris, much of it from liquid waste sites, burial grounds, and nuclear facilities along the Columbia River corridor;
- Removal of spent nuclear fuel (SNF) from basins adjacent to the Columbia River;
- Shipment of more than 5,000 cubic meters of transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP);
- Shipment of all weapons-grade plutonium for consolidation to the Savannah River Site;
- Installation of extensive pump-and-treat systems and chemical barriers along the Columbia River corridor and in the Central Plateau to reduce groundwater contamination and prevent contaminated groundwater from entering the river;
- "Cocooning" of seven of the nine reactors to allow the radiation to decay. A seventh reactor was cleaned up and converted into a museum. The remaining two are on their way to interim safe storage or "cocooning;"
- Removal of most HLW from 17 aging single-shell underground waste storage tanks;
- Completing deactivation, decommissioning, decontamination, demolition, and placement of a soil cap over the Plutonium Finishing Plant, one of the most contaminated facilities in the DOE EM complex;
- Startup of pre-treatment of waste stored in underground storage tanks through the Tank Side Cesium Removal (TSCR) unit;
- Risk mitigation activities were completed for two tunnels storing radioactive and hazardous waste, and three underground liquid disposal structures in the Central Plateau; and
- Removal of highly radioactive sludge from a concrete basin in reactors near the Columbia River.

Site-Specific Issues

Washington and Oregon officials have sought assurance of adequate, long-term funding (through approximately 2070) to ensure that cleanup is completed, especially when work at most other sites is done. DOE EM estimates the remaining Hanford cleanup to cost well over $300 billion.[158] However, funding limitations put many cleanup milestones at risk and increase overall life cycle costs of cleanup.

Both the state of Washington's and neighboring Oregon's primary concern is the threat Hanford's legacy contamination poses to the Columbia River, which bisects the site. Much of Hanford's 56 million gallons of HLW is contained in 177 underground tanks: 149 single-shell tanks and 28 double-shell tanks. In the 1950s, the single-shell tanks began leaking into the surrounding soil. Currently all single-shell tanks are well past their design lives and have been stabilized by removing all free liquid, minimizing the chance of further leakage. Current remediation plans call for construction of multiple facilities, collectively referred to as the Waste Treatment Plant, to vitrify the HLW and low activity waste (LAW). The vitrified HLW will be stored onsite and eventually disposal of in a deep geologic repository and the vitrified LAW will be disposed of in a landfill at Hanford.[159] Oregon and Washington remain concerned about construction delays, cost overruns, and technical challenges plaguing the Waste Treatment Plant facilities as well as the slow pace of waste retrieval from Hanford's aging tanks.

The Waste Treatment Plant is not scheduled to begin full operations until 2036, and that date is considered at risk due to the aforementioned construction delays, cost overruns and technical challenges. In the meantime, DOE EM has begun to use a simplified and much smaller pretreatment facility, the tank-side cesium removal (TSCR) system. The TSCR system started operations in 2022. DOE EM is required to begin treating LAW by 2023, and many start up activities are being achieved to meet that goal.

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[158] U.S. Department of Energy, Richland Operations Office. (2022, January). *2022 Hanford lifecycle scope, schedule and cost report* (USDOE Doc. No. DOE/RL-2021-47). Retrieved from https://www.hanford.gov/files.cfm/2022_LCR_DOE-RL-2021-47_12-27.pdf.

[159] U.S. Department of Energy, Office of River Protection. (n.d.). *Hanford Vit Plant: Protecting the Columbia River*. Retrieved from https://www.hanfordvitplant.com/protecting-columbia-river.

Work is underway on several other important and expensive cleanup priorities, all of which have their own challenges. This work includes finishing interim safe storage of the KE and KW Reactors; transfer of 1,936 capsules of cesium and strontium from pool storage to dry storage; and removal of highly concentrated radioactive waste from beneath a hot cell in the 324 building, just a few miles from the city of Richland.[160]

Relationship to Other Sites in the Complex

Though much of Hanford's cleanup activities will occur on-site, waste and materials will need to be sent to other sites in the complex, including TRU waste to WIPP and spent nuclear fuel and vitrified HLW to a deep geologic repository. In 2000, DOE EM selected Hanford to receive potentially tens of thousands of shipments of LLW and mixed LLW from other DOE sites for disposal at the site; however, litigation initiated by the state of Washington resulted in a moratorium on most new waste shipments to Hanford until the Waste Treatment Plant is in full operation. That suit has, to date, effectively removed Hanford as an option for off-site waste disposal for other DOE sites.

[160] Oregon Department of Energy. (2014, September). *Hanford cleanup: The first 25 years*. Retrieved from https://www.oregon.gov/energy/safety-resiliency/Documents/Hanford%20 25%20Year%20Report.pdf.

Super Kukla Facility, Nevada Test Site. The Super Kukla nuclear reactor was constructed in 1964 in a remote area of the Nevada Test Site to explore the initial phase of a criticality, or nuclear chain reaction. Photo courtesy of Library of Congress, Prints & Photographs Division, HAER, Reproduction number HAER NEV,12-MERC.V,5-1

Conclusion

States affected by contamination from the nations' nuclear weapons complex activity have made a sustained commitment to achieving that cleanup over the coming years. States and DOE must work together to address challenges affecting multiple states in a holistic manner. The five major issues for states — jointly setting funding priorities, compliance with regulatory agreements, managing waste safely, improving communications and updating emergency response protocols — are interdependent. Budgets affect DOE's ability to meet its compliance obligations, waste management decisions drive costs, and the ability to meet milestones or manage waste effectively in the short term affects budgets and compliance in the long term. At the same time, a waste-disposal or budget decision at one site can affect cleanup progress at other sites across the complex. Communication processes and protocols are critical for resolving problems between states and DOE; for setting budget priorities, especially when compliance milestones are not on track; and for addressing emergencies.

The FFTF supports the idea that complex-wide decisions should have complex-wide input from states and intergovernmental groups, including tribes and local communities. These decisions should be made with a clear understanding and transparent communication of the complex-wide effects. It is important that states and DOE continue to address these issues simultaneously and in coordination so that cleanup can be accomplished safely, efficiently and as fully as possible. Governors will continue to lead the important state efforts to achieve cleanup in coordination with DOE.

Appendix A. The History of the Nuclear Weapons Complex and Its Environmental Legacy

In 1942, the United States began to develop nuclear weapons technology under the U.S. Army Corps of Engineers' Manhattan Engineer District, known as the Manhattan Project. During the Cold War era, the United States significantly expanded its nuclear weapons program into a vast research, production and testing network that, at its height between 1945 and 1990, spanned 107 sites and 35 states and came to be known as the "nuclear weapons complex" (see Figure A-1 on the following page). The nuclear weapons complex would eventually produce more than 70,000 nuclear warheads of 65 types.

With the end of the Cold War and the collapse of the Soviet Union, the mission at many of the weapons complex sites began to wind down. The federal government and states have since reckoned with the environmental legacy produced by decades of intense radiologic activities. Most sites in the complex are contaminated with radioactive or other hazardous materials, such as solvents or heavy metals, often compounded by decades of active use. The contamination is found in buildings as well as soil, groundwater and surface water within and surrounding the sites. In 1992, Congress passed the Federal Facilities Compliance Act (FFCA). The FFCA gave states additional regulatory and oversight authority and required that the U.S. Department of Energy's (DOE's) cleanup adhere to federal environmental laws. Today, the DOE Office of Environmental Management oversees the cleanup effort.

1942	United States began to develop nuclear weapons technology, known as the Manhattan Project
1990	Nuclear weapons complex expands throughout the Cold War to span 107 sites and 35 states
1991	End of the Cold War and beginning of nuclear weapons complex cleanup effort
1992	Federal Facilities Compliance Act passed to give states regulatory and oversight authority
1995	Development of site treatment plans for all sites in the weapons complex
1999	Waste Isolation Pilot Plant opens as nation's first underground geologic waste repository
2003	DOE established
2005	Rocky Flats completed; largest environmental cleanup in the United States to date
2022	15 sites undergoing cleanup with a budget of $7 billion

What was once an employment boom to state and local economies during the years of nuclear weapons research, testing and production is now an environmental burden, and states bear some of the responsibility for the long-term cleanup of that legacy. This effort is the largest environmental cleanup program in the world and presents the 12 states most directly involved with numerous technical, financial and policy challenges. The federal budget for the weapons cleanup program was $7.9 billion in FY2022 and averaged approximately $7 billion per year from 2018 to 2022—one of the largest amounts for any federal program, including annual Superfund environmental expenditures. The total estimated cleanup cost for DOE's environmental liabilities is between $334.7 billion and $378.9 billion (in 2018 dollars), with cleanup anticipated to last into 2075.[161]

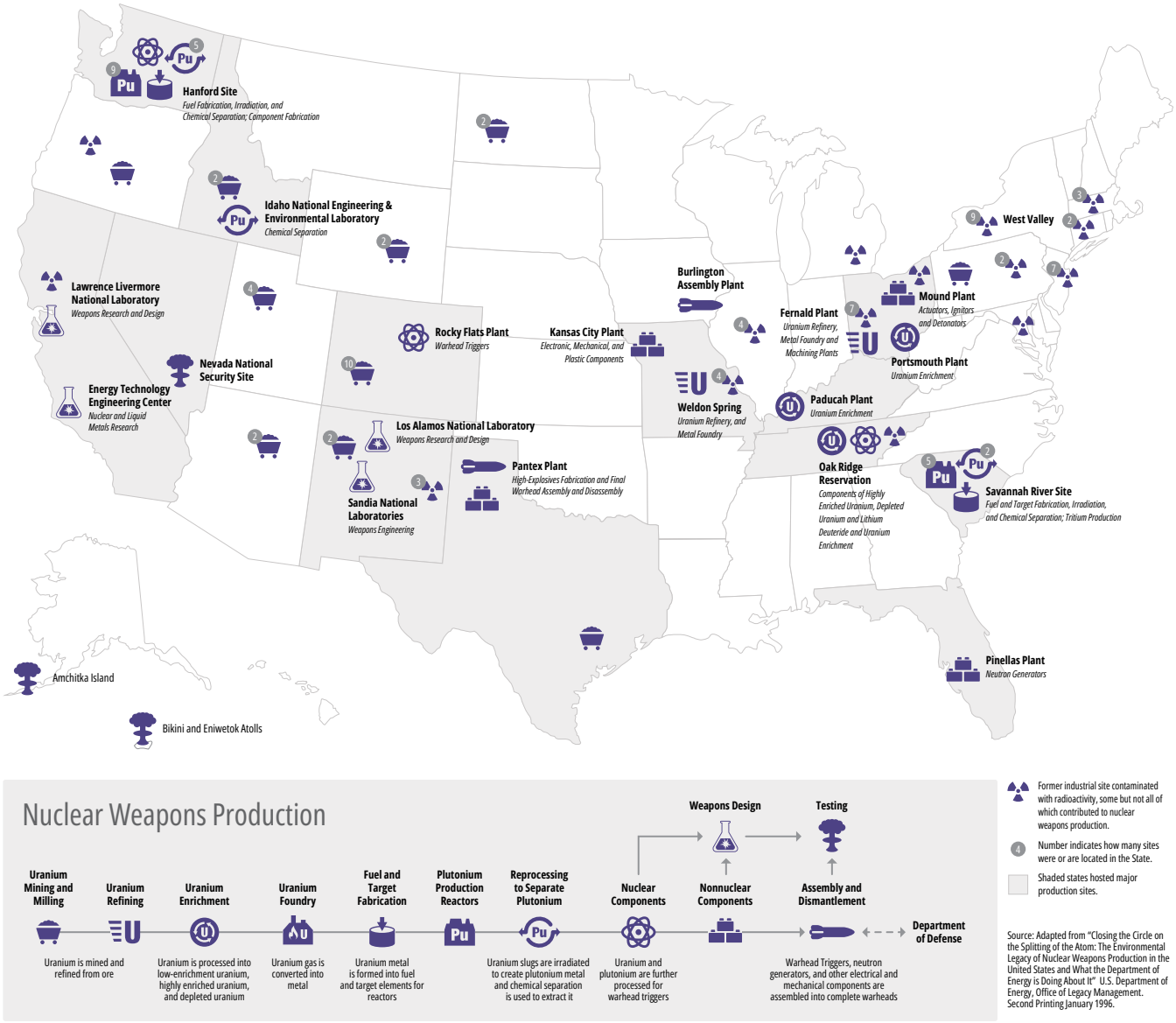

FIGURE A-1: Historic scope of the nuclear weapons complex at the height of its production capacity.

[161] Department of Energy, Office of the Chief Financial Officer, FY2022 *Congressional Budget Request - Volume 5, Environmental Management*. May 2021. DOE/CF-0176.

Appendix B. How Are Cleanup Decisions Made?

Federal Environmental Laws and Regulatory Authority

Since the 1980s, the U.S. Department of Energy's (DOE's) cleanup efforts have been subject to federal environmental laws and the regulatory authority of the U.S. Environmental Protection Agency (EPA) for certain activities. Many states have similar authority, partly through federal laws for clean water and hazardous waste that bestow oversight to the states. Cleanup decisions generally involve two main issues: the treatment of waste (through site treatment plans) and the disposal of waste (through processes that federal regulations determine). The following list provides an overview of the type of cleanup decisions made under each cleanup law:

Federal Facilities Compliance Act (FFCA) Site Treatment Plans. DOE, in close consultation with the states, completed treatment plans for each site in 1995. The plans are implemented under regulatory orders between DOE and the states and address only the treatment of radioactive waste. They do not directly address waste disposal. The development of the site treatment plans demonstrates successful collaboration between states and DOE.

National Environmental Policy Act (NEPA). NEPA governs the framework for many of DOE's waste management decisions. Within the NEPA framework, DOE uses environmental impact statements to make decisions and announces them in formal records of decision (RODs). DOE issued final RODs for its most common waste types, including high-level waste (HLW), transuranic (TRU) waste, low-level waste (LLW) and mixed LLW; those RODs are still in effect today. (See Appendix C for definitions of waste types):[162]

- RODs governing the management of HLW and TRU were issued in the late 1990s. HLW is intended to be disposed of in a yet-to-be-sited national geological repository, and defense TRU waste is disposed of at the Waste Isolation Pilot Plant in **New Mexico**.
- In 2000, DOE announced its final ROD for LLW and mixed LLW treatment and disposal sites. Each major site will treat its own LLW, while DOE continues (consistent with current practice and to the extent practicable) to dispose of on-site waste at sites that already have LLW disposal facilities (Hanford, the Idaho National Laboratory, the Los Alamos National Laboratory, the Nevada National Security Site [NNSS], the Oak Ridge National Laboratory [ORNL] and the Savannah River Site [SRS]). In cases where a site does not have on-site disposal capability or where specific waste does not meet waste acceptance

[162] "Transuranic waste" is waste that has been contaminated with alpha-emitting TRU radionuclides. Elements that have atomic numbers greater than that of uranium are called "transuranic" (that is, beyond uranium). Because of the elements' long half-life, TRU is disposed of more cautiously than LLW. TRU waste is generally a byproduct of weapons production and consists of protective gear, tools, residue, debris and other items contaminated with small amounts of radioactive elements (mainly plutonium).

criteria at the on-site disposal facility, DOE sometimes uses the NNSS for disposal of LLW. DOE also has the option of sending LLW to commercial, U.S. Nuclear Regulatory Commission-licensed or agreement state-licensed LLW disposal facilities.

- DOE uses the NNSS for disposal of waste from off-site locations.[163] Under federal hazardous waste law, DOE must secure permits from the state to operate mixed LLW facilities.

Corrective Actions and Hazardous Waste Management at Still-Operating Facilities Under the Resource Conservation and Recovery Act (RCRA). The FFCA of 1992 reaffirmed the principle that federal facilities are required to comply with all federal and state hazardous waste requirements. DOE manages waste defined as hazardous or mixed (that is, waste that has both hazardous and radioactive components) under RCRA rules, and such waste requires ongoing safe management as well as corrective action to address release into the environment. Most states are authorized to carry out the federal RCRA program and their own state-specific requirements in their states. States make site-specific decisions about cleanup under RCRA corrective action authority in consultation with DOE, EPA and the public.

Waste Disposal Decisions Based on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Various site-specific decisions under CERCLA, also known as the Superfund law, address the disposal of contaminated soil, groundwater and buildings. Such decisions are made at the local site level in conjunction with state regulators and EPA based on land uses that reflect local conditions and, to the extent possible, the preferences of local stakeholders. CERCLA decisions must analyze, as appropriate, the tradeoffs between disposal on-site, off-site at a DOE disposal facility and off-site at a commercial disposal facility.

DOE Directives System

Within DOE, a series of directives, guides, orders and manuals specifies the details that govern how DOE and its contractors are expected to conduct environmental cleanup activities within the legal and regulatory frameworks described above. The DOE Directives System establishes how DOE policies, requirements and responsibilities are developed and communicated. DOE directives are the primary means of establishing policies, requirements, responsibilities and procedures for DOE elements and contractors. Topics addressed by DOE directives range from budget formulation to managing international commitments to records management. DOE guides provide acceptable but not mandatory means for complying with requirements included in directives. Guides cover a range of topics, such as performance measurement and biosafety facilities. DOE orders (including DOE Order 435.1, discussed earlier in this document) establish management objectives and responsibilities; manuals establish detailed requirements for carrying out the responsibilities of the order.[164]

[163] Currently, most mixed LLW goes to the NNSS disposal facility. Some also goes to commercial sites, and some on-site waste goes to a special CERCLA cell at Idaho National Laboratory.
[164] For more information, see U.S. Department of Energy, Directives Program, Office of Management. (n.d.). Directives, guidance, and delegations. Retrieved from https://www.directives.doe.gov/.

Appendix C. Waste Types and Definitions

	Waste Type	Destination
U.S. Department of Energy (DOE) waste	Low-Level waste (LLW) • Mixed • Not mixed	Nevada Nuclear Security Site (Nevada) Hanford (Washington)* On-site disposal** Licensed commercial disposal facility
	Transuranic (TRU) waste • Mixed • Not mixed	Waste Isolation Pilot Plant (New Mexico)
	High-Level waste (HLW) and spent nuclear fuel (SNF)	To be determined; by statute, must be disposed in a deep geologic repository
Commercial waste	Spent nuclear fuel (SNF)	To be determined; by statute, must be disposed in a deep geologic repository
	LLW: • Class A • Class B • Class C	State compact system or licensed commercial disposal facility
	Greater Than Class C (GTCC) LLW	To be determined. DOE has completed NEPA analysis of potential disposal alternatives and is awaiting action by Congress on the Department's 2017 Report to Congress prior to making a final decision on the disposal alternative or alternatives to implement.*** NRC is currently developing a licensing rule which will promulgate requirements for the near-surface disposal of GTCC waste.

* Not currently available for disposal of off-site waste.

** On-site disposal of DOE LLW (not mixed MLLW) occurs at Hanford, the Idaho National Laboratory, Los Alamos National Laboratory, the Oak Ridge Reservation and the Savannah River Site.

***In February 2016, DOE publicly issued the Final Environmental Impact Statement for the Disposal of Greater-Than-Class C (GTCC) Low-Level Radioactive Waste and GTCC-Like Waste (DOE/EIS-0375) that evaluated five alternatives for the disposal of GTCC waste. In October 2018, DOE issued the Environmental Assessment (EA) for the Disposal of GTCC and GTCC-Like Waste at Waste Control Specialists (WCS), Andrews County, Texas. These documents and the Department's 2017 Report to Congress are available at: https://www.energy.gov/em/waste-management/waste-and-materials-disposition-information/greater-class-c-low-level.

Definitions

Note: Definitions for DOE waste excerpted from DOE Order 435.1.

Low-level radioactive waste is radioactive waste that is not high-level radioactive waste, SNF, TRU waste, byproduct material, or naturally occurring radioactive material. Most LLW contains small amounts of radioactivity in large volumes of material. Some LLW, however, can contain significant levels of radioactivity. Low level does not necessarily indicate low hazard. Some DOE facilities dispose of LLW on-site.

Mixed waste contains source, special nuclear or byproduct material subject to the Atomic Energy Act of 1954, as amended, and a hazardous component subject to the Resource Conservation and Recovery Act of 1976. Mixed waste contains both radioactive and chemically hazardous materials.

Transuranic waste is radioactive waste that contains more than 100 nanocuries (3,700 becquerels) of alpha-emitting TRU isotopes per gram of waste, with half-lives greater than 20 years. TRU waste is generated primarily during the research, development and production of nuclear weapons. Most of the waste consists of items such as laboratory clothing, tools, glove boxes, rubber gloves and air filters contaminated with small amounts of plutonium and other radioactive elements. Some of these items will remain radioactive for tens of thousands of years. There are three exceptions to this definition:

- High-level radioactive waste;
- Waste that the Secretary of Energy has determined, with the concurrence of the administrator of the U.S. Environmental Protection Agency, does not need the degree of isolation that the 40 Code of Federal Regulations (C.F.R.) Part 191 disposal regulations require; and
- Waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 C.F.R. Part 61.

High-level waste is the highly radioactive waste material that results from reprocessing SNF, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations as well as other highly radioactive material that is determined, consistent with existing law, to require permanent isolation. HLW is highly radioactive and must be isolated from the environment for thousands of years. In 2021 DOE revised its interpretation of the statutory definition of HLW as laid out in DOE Order 435.1. The revision interprets the definition as follows:

DOE's interpretation of HLW is that reprocessing waste is non-HLW if the waste:

I. Does not exceed concentration limits for Class C low-level radioactive waste as set out in Section 61.55 of 10 C.F.R. and meets the performance objectives of a disposal facility; or
II. Does not require disposal in a deep geologic repository and meets the performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable requirements.

Under DOE's interpretation, waste that meets either of these criteria is non-HLW and can be classified and disposed of in accordance with its radiologic characteristics.[165]

Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by processing.

[165] For more information on the HLW definition see: https://www.energy.gov/em/high-level-radioactive-waste-hlw-interpretation.

Class A (Commercial Waste) is radioactive waste that contains the lowest concentration of radioactive materials, most of which materials have a half-life less than five years.

Class B (Commercial Waste) contains the next-lowest concentration of radioactive materials, a higher proportion of such materials with a longer half-life.

Class C (Commercial Waste) has the highest concentration of radioactive material that DOE can legally bury in an LLW disposal facility.

Greater-than-Class C waste contains a concentration of radioactive materials that exceeds the limits for Class C waste specified in 10 C.F.R. Part 61.55. All GTCC waste is the responsibility of the federal government and, under NRC's current regulations, must be disposed of in a geologic repository unless proposals for alternative disposal methods are approved by NRC pursuant to 10 C.F.R. Part 61.55(a)(iv) . Currently, no disposal facility exists for GTCC waste.

Appendix D. Acronyms

AEC	U.S. Atomic Energy Commission
AMWTP	Advanced Mixed Waste Treatment Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	Code of Federal Regulations
CIWG	Combined Intergovernmental Working Group
CNTA	Central Nevada Test Area
DOE	U.S. Department of Energy
DUF6	Depleted uranium hexafluoride
EIS	Environmental impact statement
EM	Office of Environmental Management
EPA	U.S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FFACO	Federal Facilities Agreement Consent Order
FFCA	Federal Facility Compliance Act
FFTF	Federal Facilities Task Force
ft3	Cubic feet
GTCC	Greater Than Class C
HLW	High-level waste
ISB	In situ bioremediation
LLW	Low-level waste
LM	Office of Legacy Management
LTS	Long-term stewardship
m3	Cubic meter
NEPA	National Environmental Policy Act
NGA	National Governors Association
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NRDA	Natural resources damage assessment
NYSERDA	New York State Energy Research and Development Authority
ORNL	Oak Ridge National Laboratory
RCRA	Resource Conservation and Recovery Act of 1976
ROD	Record of decision
SNF	Spent nuclear fuel
SRS	Savannah River Site
TCEQ	Texas Commission on Environmental Quality
TRU	Transuranic
TSA-RE	Transuranic Storage Area-Retrieval Enclosure
WIPP	Waste Isolation Pilot Plant

Appendix E. NGA Center for Best Practices Federal Facilities Task Force Principles and Associated Expectations for State–Department of Energy Engagement

The NGA Solutions: Center for Best Practices Federal Facilities Task Force (FFTF), established in 1993 with support from the U.S. Department of Energy (DOE) Office of Environmental Management, brings together Governor-appointed representatives from states affected by the ongoing cleanup of sites used in the production, testing, and assembly of the U.S. nuclear weapons stockpile. Recognizing that cleanup funding is not likely to be sufficient to meet all milestones in state–DOE compliance agreements for the foreseeable future, in December 2011 the FFTF set out to create, in consultation with DOE, a set of principles to guide how state regulators and DOE would jointly approach the planning and prioritization of cleanup work. The FFTF approved the following principles on May 2, 2012, at the FFTF Spring Meeting in Knoxville, Tennessee. FFTF states participating in the meeting were *Idaho, Kentucky, Missouri, Nevada, New Mexico, New York, Ohio, Oregon, South Carolina, Tennessee, Texas and Washington*. The principles were subsequently reviewed and re-affirmed by the FFTF in December 2017.

1. **States support a sustained, quality cleanup that protects human health, safety and the environment and complies with state–DOE agreements**

2. **Open and transparent communication between states and DOE is essential for achieving successful cleanup**

   Expectations:

   - Issues that have complex-wide implications should have complex-wide input and planning.
   - The Federal Facilities Task Force should serve as a forum for discussions of complex-wide issues.

3. **State participation is a critical element of the DOE budget process and the establishment of environmental priorities**

   Expectations:

   - States expect DOE site managers to engage states in prioritization of projects to provide early support to the federal budget process to jointly prioritize projects.
   - States expect DOE to provide detailed information about the current planning year and out-year budget plans, consistent with each state's existing Federal Facility agreement(s) and other applicable statutory requirements.
   - States support a "risk plus other factors" approach to priority-setting, as defined in the Final Report of the Federal Facilities Environmental Restoration Dialogue Committee.
   - States expect a role in determining how risk and other factors are considered.
   - States expect DOE to provide information about environmental and human health risks posed by DOE sites both individually and complex-wide, together with information to judge the impacts of schedule/milestone changes on risk and life-cycle costs from site to site.

4. **Proactive engagement between DOE and states is crucial when milestones or other commitments may be in jeopardy.**

   Expectations:

   - Generally, states expect to be assured, before considering a delay in a cleanup agreement, that DOE requests a fully compliant budget and makes a good-faith effort to meet all milestones or other commitments.
   - If DOE foresees any change (budgetary, technical, other) that it believes will adversely affect a milestone or other commitment, states expect DOE to initiate discussion with the host state (and adjacent state, if appropriate), well before failure to meet the commitment becomes unavoidable and in accordance with applicable Federal Facility Agreements.
   - In cases where one or more FFAs would be impacted by changes in another state's cleanup agreement, states will seek, with DOE's assistance, to develop a common understanding of the requested change and any positive and negative impacts to both states. Those cases may involve equity discussions between the affected states and between states and DOE.
   - States support a framework in which state-DOE discussions occur to determine if they can reach agreement on modification of milestones or other commitments. During the course of these discussions, states or DOE may also introduce other items for negotiation to offset a proposed altered commitment; such items may not necessarily be related to the proposed altered commitment, but determination of acceptable alternatives will be at the discretion of each state.

Appendix F. NGA Center for Best Practices Federal Facilities Task Force

The NGA Center for Best Practices established the Federal Facilities Task Force (FFTF) in 1993 to assist in the development of the initial Federal Facilities Compliance Act site treatment plans. The FFTF continues to support state efforts. The mission of the FFTF is to bring together Governor-designated representatives with U.S. Department of Energy (DOE) officials to examine critical technical, policy and budget issues and improve coordination of major program decisions on a range of issues related to radioactive material and waste, including:

> **Transparency in the DOE decision-making process, particularly for waste treatment and disposal decisions.**
>
> **A safe transportation and disposal system for all types of radioactive waste.**
>
> **Sufficient funding for DOE to meet annual milestones in state-DOE compliance agreements.**
>
> **Long-term stewardship at sites where cleanup to unrestricted levels is not possible.**

Governors of each participating state designate one or ideally two representatives to serve on the FFTF. Appointments typically include one policy and one technical or regulatory representative, but these selections are at the discretion of each Governor. Representatives usually come from one or more state agencies responsible for the oversight and regulation of hazardous waste, such as environmental protection, energy or natural resources departments. The 13 states that participate in the FFTF in 2023 are:

- California
- Idaho
- Kentucky
- Missouri
- Nevada
- New Mexico
- New York
- Ohio
- Oregon
- South Carolina
- Tennessee
- Texas
- Washington

List of Governors' Representatives as of March 2023

California

Steven Becker

Supervising Senior Engineering Geologist, Department of Toxic Substances Control

Idaho

Garrett Bright

Senior Hazardous Waste Permit Writer, Idaho Department of Environmental Quality

Mark Clough

1995 INL Settlement Agreement Coordinator, Idaho Department of Environmental Quality

Kentucky

Brian Begley

Registered Geologist Supervisor, Kentucky Division of Waste Management, Department of Environmental Protection

Joe Newberg

Deputy General Counsel, Office of Legal Services, Kentucky Energy and Environment Cabinet

Missouri

Branden Doster, P.E.

Federal Facilities Section Chief, Missouri Department of Natural Resources

Nevada

Christine Andres

Bureau of Federal Facilities Chief, Nevada Division of Environmental Protection

New Mexico

Vacant

New York

Paul Bembia

West Valley Site Management Program Director, New York State Energy Research and Development Authority

Ohio

Tom Schneider

Federal Facilities Program Administrator, Division of Environmental Response and Revitalization, Ohio EPA Southwest District Office

Melissa Storch

Assistant Chief, Division of Environmental Response and Revitalization, Ohio EPA

Oregon

Maxwell Woods

Assistant Director, Nuclear Safety and Emergency Preparedness Division, Oregon Department of Energy

South Carolina

Henry J. Porter

Chief, Bureau of Land and Waste Management, Department of Health and Environmental Control

Myra C. Reece

Director of Environmental Affairs, Department of Health and Environmental Control

Tennessee

Kristof Czartoryski

Environmental Consultant, Division of Remediation, Tennessee Department of Environment and Conservation

Colby Morgan

Deputy Director, Division of Remediation, Tennessee Department of Environment and Conservation

Texas

Denise Brooks

Program Specialist VII, Texas State Energy Conservation Office

Washington

David Bowen

Nuclear Waste Program Manager, Washington Department of Ecology

CLEANING UP AMERICA'S NUCLEAR WEAPONS COMPLEX

2023 Update for Governors

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