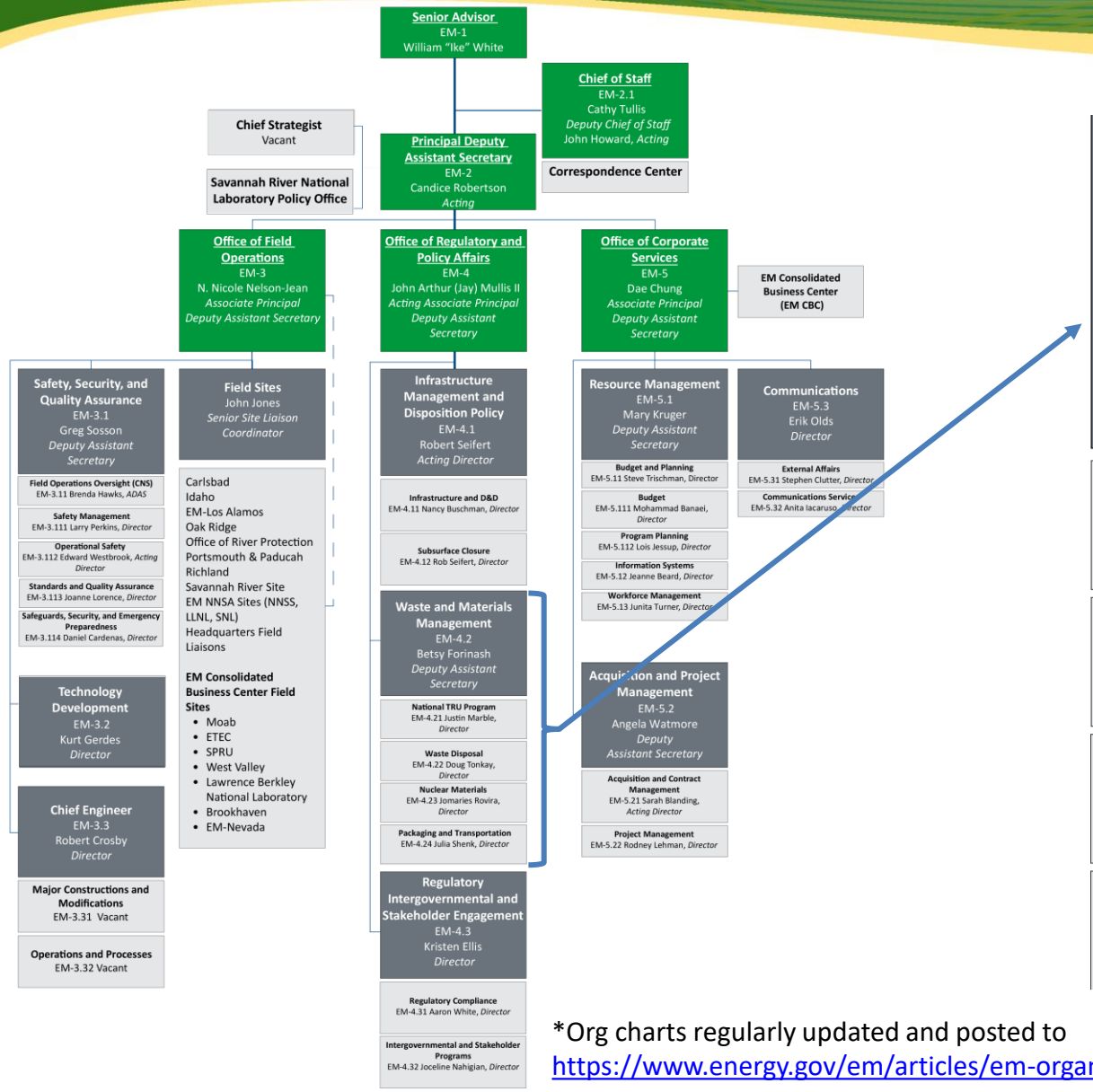
DOE/EM Waste Management Update
Low Level Radioactive Waste Forum

October 12, 2022
Baltimore, Maryland

EM HQ Organization* (September 19, 2022)



Waste and Materials Management
EM-4.2
Betsy Forinash
Deputy Assistant Secretary

National TRU Program
EM-4.21 Justin Marble, *Director*

Waste Disposal
EM-4.22 Doug Tonkay, *Director*

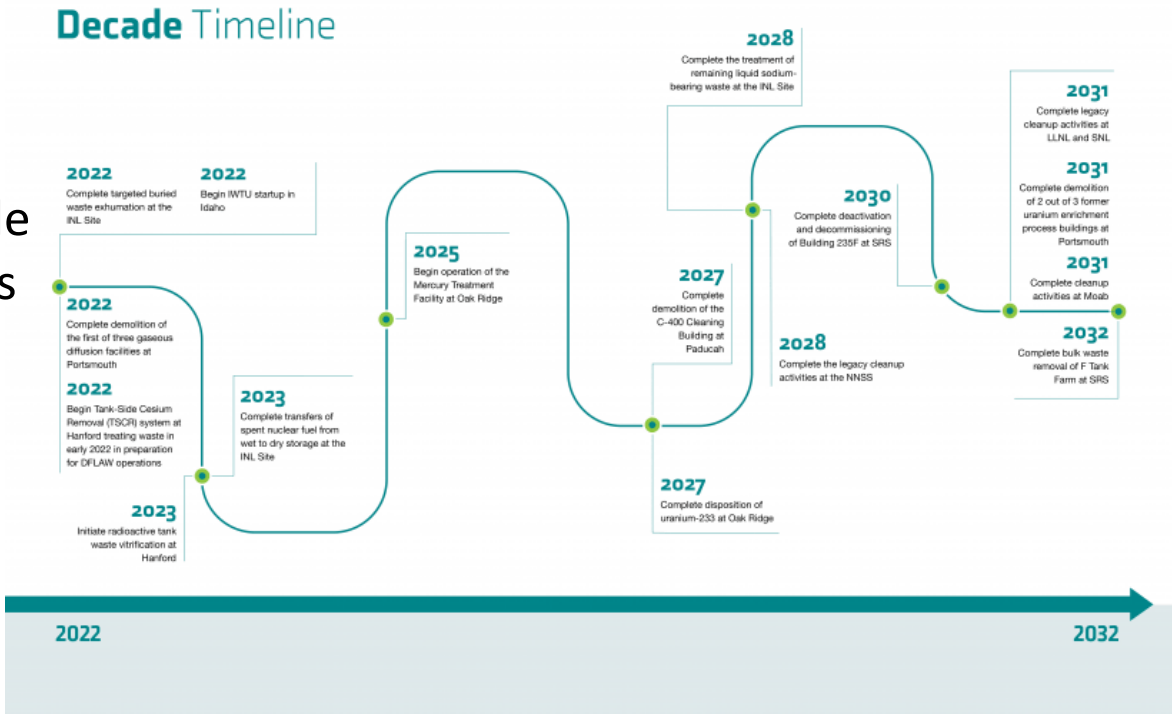
Nuclear Materials
EM-4.23 Jomaries Rovira, *Director*

Packaging and Transportation
EM-4.24 Julia Shenk, *Director*

*Org charts regularly updated and posted to https://www.energy.gov/em/articles/em-organization-chart

DOE/EM Strategic Planning includes Waste Management

1. **EM Program Plan,** outlining a decision roadmap the cleanup program will use as a guide over the next two decades (released September 22, 2022)
2. **EM Strategic Vision: 2022–2032** (updated in late 2021)
3. **Calendar 2022 Priorities List**



Checkout the [Office of Environmental Management | Department of Energy] website at: https://www.energy.gov/em/office-environmental-management

EM CY22 Mission and Priorities

https://www.energy.gov/em/em-mission-priorities

EM CY22 MISSION AND PRIORITIES

U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

MISSION STATEMENT:
To complete the safe cleanup of the environmental legacy brought about from decades of nuclear weapons development and government-sponsored nuclear energy research.

PRIORITY #1: ACHIEVE SIGNIFICANT CONSTRUCTION MILESTONES

- Complete cold commissioning of the first WTP melter at Hanford
- Begin construction of K-East Reactor Cocooning Enclosure at Hanford
- Begin construction of the AMC Facility at Savannah River
- Complete all concrete placements for SDU-9 at Savannah River
- Complete construction of New Filter Building for SSCVS at WIPP

PRIORITY #2: EXECUTE KEY CLEANUP PROJECTS

- Begin tank waste pre-treatment at Hanford through TSCR operations
- Complete processing of 100 sodium-bearing waste containers at the IWTU at Idaho
- Complete all Subsurface Disposal Area buried waste remediation at Idaho
- Treat 4 million gallons of tank waste at Savannah River
- Complete demolition of the X-326 process building at Portsmouth
- Begin hot cell processing of the high-activity uranium-233 inventory at Oak Ridge
- Install equipment to support Los Alamos transuranic waste removal from WCS
- Complete 30 shipments of transuranic waste from Los Alamos to WIPP
- Complete 50 Percent of West Access Drift Mining at WIPP
- Begin demolition of Main Plant Process Building at West Valley
- Complete demolition of remaining ancillary support facilities at West Valley
- Complete removal of a cumulative 13M tons of material from the Moab site
- Disposition 1 million pounds of hazardous refrigerant from Paducah
- Begin demolition of the TCC and EMAD facilities at Nevada
- Begin demolition of Building B251 at Lawrence Livermore National Laboratory
- Complete remediation of the D1G Ditch Area at Naval Reactors' Kesselring Site

EM By the Numbers - Examples

Updated May 2022

By the Numbers
Hanford Site

The Hanford Site sits on 580 square miles of desert in southeastern Washington state, adjacent to the Columbia River. From 1943 to 1987, chain reactions inside Hanford's nine nuclear reactors changed uranium's chemical composition by exposing it to extra neutrons, producing plutonium that went into nuclear weapons used during World War II and was stockpiled during the Cold War.

Hanford's last reactor was shut down in 1987, but 44 years of plutonium production at the site generated millions of tons of solid waste and contaminated soil, as well as billions of gallons of contaminated liquids. In 1989, the Energy Department's mission to cleanup waste at Hanford began.

29B gallons of contaminated groundwater have been treated in facilities along the Columbia River and in the center of the Hanford Site.

9 reactors will be cocooned or preserved at the Hanford Site. Six reactors have been cocooned, a seventh is being cocooned, and an eighth will be cocooned. B Reactor has been preserved as part of the Manhattan Project National Historical Park.

1,354 waste sites, including hundreds along the Columbia River's south shores, have been remediated – or cleaned of pollution and contaminants – to ensure continued protection of human health and the surrounding environment.

1,936 radioactive capsules stored at the Waste Encapsulation Storage Facility will be moved to safer and stable dry storage.

951 facilities, many contaminated, have been demolished, including the Plutonium Finishing Plant.

18.7M tons of soil and debris disposed of in the Environmental Restoration Disposal Facility, an engineered and regulated landfill, covering an area of 107 acres – ~52 football fields.

18 underground waste tanks have been emptied using multiple retrieval technologies, with more than 3 million gallons of waste retrieved.

380K gallons of liquid waste from Hanford's large underground tanks has been treated and is staged for vitrification, or immobilization in glass, when the Waste Treatment and Immobilization Plant begins operations.

100% - or about 2,300 tons - of the site's spent fuel, a type of radioactive waste, has been removed from areas along the Columbia River and placed in safe, secure dry storage.

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Updated May 2022

By the Numbers
Idaho National Laboratory

The Idaho National Laboratory (INL) site, an 890-square-mile DOE site located in the high desert of eastern Idaho, was established in 1949 on land once used as a Naval gunnery range. The Idaho Cleanup Project is addressing contamination from legacy wastes generated from World War II-era conventional weapons testing, government-owned research and defense reactors, spent nuclear fuel reprocessing, laboratory research, and defense missions at other DOE sites. The project is focused on safely remediating the INL site, including dispositioning transuranic (TRU) waste, managing spent nuclear fuel, and treating high-level radioactive waste to protect the underlying aquifer and comply with federal and state agreements.

99% spent nuclear fuel transferred from cooling pools to safe, secure dry storage. Transfers on track for FY2023 completion.

4,400 cubic meters of dry, high-level waste stored in bin sets – stainless steel vessels inside of concrete silos. The granular, calcined waste came from processing 9 million gallons of liquid waste. The waste will be further processed and packaged to meet repository acceptance criteria.

By 2028 complete transuranic waste shipping and commence closure and demolition of the remaining Radioactive Waste Management Complex facilities.

220 spent nuclear fuel types totaling 268 metric tons of heavy metal managed. Spent fuel will be packaged to meet repository acceptance criteria.

>61,000 cubic meters of transuranic and mixed low level waste shipped offsite for disposal.

900,000 gallons of sodium bearing liquid radioactive waste to be converted to a dry granular form using the Integrated Waste Treatment Unit.

>10,350 cubic meters transuranic waste packaged from the completed exhumations at the subsurface disposal area.

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EM by the Numbers - Examples

Updated May 2022

By the Numbers
Los Alamos National Laboratory

Los Alamos National Laboratory (LANL), located in Los Alamos, New Mexico, was established in 1943 as Site Y of the Manhattan Project for a single purpose: to design and build an atomic bomb. It took just 20 months to detonate the world's first atomic bomb 200 miles south of Los Alamos at the Trinity Site on the Alamogordo bombing range. The Department of Energy's Environmental Management Los Alamos Field Office (EM-LA) investigates hazardous chemical and radioactive materials contamination as a result of past LANL operations and remediates sites where such materials are found above acceptable regulatory levels. This is known as the legacy cleanup mission.

Cleanup locations include sites of former LANL buildings, hillsides, canyon bottoms, and old landfills. Mission activities include surface and groundwater monitoring and remediation, removing contaminated soil, and decontaminating and decommissioning surplus process-contaminated buildings. Cleanup of contaminated sites follows the 2016 Compliance Order on Consent with the New Mexico Environment Department.

Additionally, EM-LA retrieves, remediates, packages, and disposes of radioactive waste. Most low level and mixed low-level waste is transported from LANL and disposed of in commercially licensed facilities, while transuranic (TRU) waste is disposed of at the Waste Isolation Pilot Plant, located in Carlsbad, New Mexico.

40
monitoring, extraction, and injection wells have been installed in and around the hexavalent chromium plume at LANL. These wells and associated infrastructure support characterization and migration of the plume via an interim measure.

2,100
potentially contaminated sites were originally identified for action, ranging from small spills to large landfills.

>1/2
of contaminated sites have been investigated and, if needed, remediated.

Over the next decade,
work at TA-54 will center on the processing and disposal of above-ground waste inventories, and the processing of retrievably stored below-grade transuranic waste.

124
locations at Middle DP Road Site were investigated and excavated. 4,457 cubic yards of contaminated soil and debris will be safely shipped offsite.

Over **595**
pounds of hexavalent chromium have been removed from the aquifer and ~338 million gallons of water have been treated (from start of chromium interim measure operations in October 2016).

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Updated May 2022

By the Numbers
Moab Uranium Mill Tailings Remedial Action Project

The Moab site is located about 3 miles northwest of the city of Moab in Grand County, Utah, and encompasses approximately 480 acres, of which about 130 acres are covered by a uranium mill tailings pile. In 1956, the Uranium Reduction Company constructed the Moab mill and operated it until 1962 when the assets were sold to Atlas Minerals Corporation. The milling product was a uranium concentrate called yellowcake, which was sold to the U.S. Atomic Energy Commission through December 1970 for use in national defense programs. Mill tailings are the remains from processing uranium ore. After 1970, production was primarily for commercial sales to nuclear power plants. Atlas ceased processing operations in 1984. The former mill site was transferred to DOE ownership in 2001 for cleanup and reclamation. Today, the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project is relocating mill tailings and other contaminated materials from the mill site and offsite vicinity properties to a disposal cell near Crescent Junction, Utah.

Between 2022-2032
DOE expects to ship approximately 4 million tons of uranium mill tailings to the Crescent Junction disposal site and accomplish closure at Moab.

In 2009
DOE began relocating tailings to the Crescent Junction disposal cell. Workers excavate and condition tailings in drying beds on top of the pile to reach optimal moisture content for disposal. Then, tailings are placed in steel containers with locking lids for transport by rail. A gantry crane transfers containers to and from the train at Moab.

1,400
tons of ore were processed daily on average during the operational lifetime of the mill.

42
extraction and freshwater injection wells protect surface water quality and recover ammonia, uranium, and other contaminants prior to discharge to the Colorado River.

>12.6M
tons of tailings have been shipped, amounting to 78% of the total tons.

Up to a **90 ft**
thick pile formed from tailings pumped to an unlined impoundment in the western portion of the property that accumulated over time.

16M tons
of mill tailings and contaminated soil were present when DOE assumed site ownership.

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EM by the Numbers – Examples

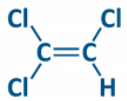
By the Numbers Portsmouth Site

Updated May 2022

In August 1952, the Atomic Energy Commission selected a tract of land in the Ohio Valley along the Scioto River in Pike County, Ohio, for the site of the Portsmouth Gaseous Diffusion Plant. In 1956, operations began to provide enriched uranium for national security purposes. The Portsmouth plant and its sister facility in Paducah, Kentucky, worked in tandem to enrich uranium. The extensive environmental cleanup program began at the 3,777-acre federal plant site in 1989 as a result of a Consent Decree signed between DOE and the state of Ohio and an Administrative Consent Order with DOE and the U.S. Environmental Protection Agency. Some key metrics related to the Portsmouth Site include:

>977.2M gallons
of groundwater from four onsite plumes have been treated and are currently managed by pump and treat and slurry wall technology.

37,843 pounds
of trichloroethylene (TCE), a degreasing solvent used during production years to clean uranium enrichment process equipment, have been removed from groundwater.



Over the next 10 years
the Portsmouth team will complete deactivation and demolition of the X-333 process building, the second of three massive buildings at the site.

135,000 cubic yards
of debris from the successful demolition of the X-326 Building in the summer of 2022 will be placed into the On Site Waste Disposal Facility by the end of the calendar year.

>215,000
cubic yards of soil from legacy groundwater plumes have been excavated for consolidation into the On Site Waste Disposal Facility.

>1,964,000 square feet
of buildings demolished, eliminating contamination sources, improving worker safety, and reducing surveillance and maintenance costs.

>26M pounds
of excess materials were diverted from landfills as a result of recycling. The Southern Ohio Diversification Initiative is the community reuse organization for the site through which the materials were successfully repurposed.

>33,940 metric tons
of depleted uranium hexafluoride (DUF6) have been converted by the DUF6 conversion plant at Portsmouth. It is the mission of EM's two DUF6 plants in Ohio and Kentucky to convert DOE's 800,000-metric-ton inventory of DUF6 into a more stable chemical form for beneficial use or other disposition.

626 converters
All of the large **'000 converters** in the X-333 process building have been size reduced as part of the deactivation effort in preparation demolition.

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By the Numbers Savannah River Site

Updated May 2022

The Savannah River Site was constructed in the 1950s to produce the basic materials necessary in the fabrication of nuclear weapons, primarily tritium and plutonium-239. Five reactors were also built in an effort to produce these materials for our nation's defense programs. In 1951, the Savannah River Laboratory was created to support these efforts.

22.7M
gallons of material, including decontaminated salt solution, transferred to the Saltstone Production Facility, resulting in more than 31 million gallons of saltstone produced.

1/3
of the U.S. weapons grade plutonium was produced at Savannah River Plant from 1953 to 1988.

>4,300
canisters of glassified radioactive waste produced at the Defense Waste Processing Facility since it began operations in 1996.

341 miles
of pre-tensioned wire strand was used to wrap the wall of SDU 8. The tank's wall was designed to expand outward as the Saltstone Disposal Units are filled, and the wire strand ensures the structural integrity of the tank wall is maintained while waste is being added.

2 of 5
reactors deactivated and decommissioned (P and R). Two of the remaining SRS nonoperational reactors (L and K) have been retrofitted to allow for nuclear material storage. The third non-operational reactor (C) is used for training.

>3,300
Spent Nuclear Fuel Bundles are stored in L Basin, which provides safe underwater storage of SNF from Foreign and Domestic Research Reactor programs.

8 waste tanks
have been operationally **closed to date.**

20 years
The Accelerated Basin De-inventory (ABD) project will reduce the time needed to de-inventory SRS's L Area Disassembly Basin of spent nuclear fuel (SNF) by 20 years. ABD will use the H Canyon chemical separations facility to dissolve SNF and then, instead of processing it further into low enriched uranium, send it through SRS's liquid waste program to be vitrified and safely stored onsite until a federal repository is identified. ABD also represents a lifecycle cost reduction of more than $4B.

By 2028
the Surplus Plutonium Disposition project in K Area will have expanded the capacity to dilute surplus plutonium oxide. Following waste characterization activities, the diluted plutonium will be packaged for shipment to the Waste Isolation Pilot Plant (WIPP) for geological repository disposal.

374
out of 460 cubic meters of legacy transuranic waste remains. All remaining SRS legacy transuranic waste will disposed of at WIPP. The solid waste program continues to characterize, store and disposition all newly site-generated wastes in compliance with applicable regulations and requirements.

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EM by the Numbers - Examples

By the Numbers
Waste Isolation Pilot Plant

Updated May 2022

The Waste Isolation Pilot Plant (WIPP) is a Department of Energy facility designed to safely isolate defense-related transuranic (TRU) waste from people and the environment. WIPP, which began waste disposal operations in 1999, is located 26 miles outside of Carlsbad, New Mexico. Waste temporarily stored at sites around the country is shipped to WIPP and permanently disposed in rooms mined out of an ancient salt formation 2,150 feet below the surface. TRU waste destined for WIPP consists of clothing, tools, rags, debris, residue and other disposal items contaminated with radioactive elements – mostly plutonium.

71,320 cubic meters of waste disposed in the underground mine (Total Land Withdrawal Act Volume).

2,150 feet depth to disposal rooms from the surface. By comparison, if WIPP were a building, it would be the second tallest in the world.

By the end of 2025 a set of key infrastructure projects will be completed, improving WIPP capabilities in mining and waste emplacement.

24 hours/day shipments are tracked and monitored around the clock by satellite.

13,099 shipments safely transported more than 15 million loaded miles.

7 waste disposal rooms in each disposal panel measuring 300 feet long, 33 feet wide and 13 feet high.

153,266 metric tons of salt mined in panel 8 and the west access drifts since 2018.

267,202 containers emplaced in the WIPP underground.

540,000 cubic feet per minute. WIPP's new permanent underground ventilation system will increase airflow.

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By the Numbers
West Valley Demonstration Project

Updated May 2022

The West Valley Demonstration Project (WVDP) is a radioactive waste management and decommissioning project, which is being conducted by the Department of Energy (DOE) at the site of the only commercial nuclear fuel reprocessing plant to have operated in the United States. The Western New York Nuclear Service Center and its facilities are owned by the New York State Energy Research and Development Authority. The mission of the DOE is to satisfy three mandates established by Congress in the WVDP Act of 1980.

DOE has completed the first mandate of the Act. The 278 canisters of vitrified high-level waste from the former spent fuel reprocessing plant have been removed from the Main Plant Process Building and placed into vertical storage casks. Demolition and waste disposition of the Vitrification Facility were completed in September 2018 and January 2019, respectively. The deactivation of the Main Plant Process Building continues, and is 96 percent complete. DOE continues to package and ship low-level waste from the WVDP site.

69 surplus facilities have been removed from the site.

2.8M cubic feet of low-level waste have been shipped off-site for disposal.

>7 miles of piping and over 50 tons of vessels and equipment have been removed from predominantly high-hazard areas of the former reprocessing plant.

By 2025 WVDP will focus on completing remaining facility decommissioning activities, including demolition of the last remaining major building – the former Main Plant Process Building.

~500 intermodals of project debris and soils shipped via rail for disposal since June 2021.

278 waste containers of vitrified high-level radioactive waste were removed from the storage cell in the former reprocessing plant, loaded into 56 vertical storage casks, and stored onsite awaiting a permanent repository.

27,918* cubic feet of WVDP transuranic waste are stored onsite pending availability of an off-site disposal facility.

** reduction due to reprocessing of the containers (was 28,049 in 2020).*

~36,000 square feet of asbestos-containing material was removed from the former reprocessing plant.

24M curies of radioactivity were solidified in 600 tons of glass contained in 275 stainless steel canisters.

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West Valley Demonstration Project

Main Plant Process Building Demolition

- In August 2022 employees safely completed removing over 98% of the radioactivity including more than seven miles of contaminated piping and over 50 tons of contaminated equipment. Liquid nitrogen — up to 60,000 pounds per square inch — was an aggressive, yet safe, cleaning application.

- In mid-September workers at the West Valley Demonstration Project began the demolition of the Main Plant Process Building in September 2022.

Expected to take 30 months

EM Efforts under the Justice40 Initiative

- The Justice40 Initiative is a requirement of Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*
- The Justice40 Initiative establishes a goal that 40% of the overall benefits of certain Federal investments flow to disadvantaged communities.
- On July 20, 2021, the Interim Implementation Guidance for the Justice40 Initiative was issued pursuant to Executive Order 14008. The guidance supports the Administration's comprehensive approach to advancing environmental justice.
- Federal agencies are directed to conduct robust stakeholder engagement and Tribal consultation as they implement the Justice40 Initiative.
- The focus of EM's environmental cleanup work under the Justice40 Initiative is soil and groundwater remediation.
- EM has been interacting with stakeholders on the Justice40 Initiative through presentations, listening sessions, conference calls, in-person and virtual meetings, and workshops.

Waste Disposal Considerations

- DOE's Radioactive Waste Management Manual (M435.1-1) has the current "tiered" policy on treatment, storage, and disposal:

  DOE waste shall be treated, stored, and in the case of low-level waste, disposed of at the site where the waste is generated, if practical, or at another DOE facility. If DOE capabilities are not practical or cost effective, exemptions may be approved to allow use of non-DOE facilities for the storage, treatment, or disposal of DOE radioactive waste …

- Waste disposal is always fully protective of worker and public health and the environment and in compliance with applicable Federal, state, and local requirements, with necessary permit(s), license(s), and approval(s) for the specific waste.
- Sufficient LLW/MLLW disposal capacity exists at DOE and commercial facilities to support the EM cleanup mission.

DOE Order 435.1 Update

- DOE Order 435.1, Radioactive Waste Management, and its Manual (M435.1-1) contains DOE's internal requirements to ensure DOE radioactive waste is managed in a manner that is protective of worker and public health and safety, and the environment
- DOE has begun working on updates to the Order and reconstituting the Guide
- Updates will incorporate lessons learned from more than 20 years of implementation and administrative changes
- DOE is committed to providing opportunities for stakeholders to provide feedback and stay informed about DOE's update effort

High-Level Radioactive Waste (HLW) Interpretation

- Current efforts focused on completion of National Environmental Policy Act Analysis of 2nd Waste Stream, i.e., *Draft Environmental Assessment for the Commercial Disposal of Savannah River Site Contaminated Process Equipment* (DOE/EA-2154), issued December 21, 2021, for 45-day public comment ending February 4, 2022
- DOE also issued a Federal Register Notice on December 21, 2021, affirming its HLW interpretation
- DOE is proceeding deliberatively with proactive stakeholder engagement throughout the HLW interpretation process
- A Final EA is being developed after consideration of public comments on the draft EA
- This will be followed by either a Finding of No Significant Impact (FONSI) or a determination to prepare an Environmental Impact Statement. If a FONSI, a technical evaluation and waste determination will also be issued and made available on the EM HLW interpretation website.

Depleted Uranium (DU)

- DOE issued a Record of Decision in June 2020 to disposition at one or more of the disposal sites evaluated in the Final DU Oxide Supplemental Environmental Impact Statement
  - Energy*Solutions* near Clive, Utah; Waste Control Specialists LLC (WCS) near Andrews, Texas, and DOE's Nevada National Security Site (NNSS) in Nye County, Nevada.
- DOE will only ship to the selected commercial site(s) if the facility is authorized to receive DU oxide. (WCS Federal Waste Facility is licensed)
- In July 2022, Energy*Solutions* submitted a license application to Utah Division of Waste Management and Radiation Control (DWMRC) for a Federal cell to dispose of DOE DU. DWMRC, began technical review in September 2022.
- Disposal timing is dependent on appropriations; funding was received in fiscal year (FY) 2022 to initiate infrastructure upgrades needed to achieve lifecycle shipping rates and complete a limited shipping campaign
- In FY 2022, the project recertified 40 gondola railcars (20 at each site) for near-term shipments, with each railcar capable of shipping six oxide cylinders
- Shipments of 10 rail cars to WCS from both Paducah and Portsmouth facilities as a "special train" are planned for FY 2023 (20 railcars in total)

Emerging Issue: Per- and Polyfluoroalkyl Substances (PFAS)

- **Deputy Secretary Memo (September 2021)**
  - Discontinues use of aqueous film forming foam (AFFF) except in emergencies
  - Suspends PFAS disposal unless approved on a case-by-case basis by the Head of Departmental Element (i.e., EM-1)
- **PFAS Strategic Roadmap (July 2022)**
  - Nearing release of an initial assessment that presents a first look of the presence of PFAS at DOE sites.
  - Developing internal guidance…to support the handling, storage, and disposal of PFAS-contaminated materials and wastes (March 2023)
- **NNSS Administrative Waste Acceptance Criteria (March 2022)**
  - Waste generator to include any PFAS information in the waste profile

NEW DOE PFAS website:
www.energy.gov/pfas

LLW/MLLW Data (MIMS and WIMS)

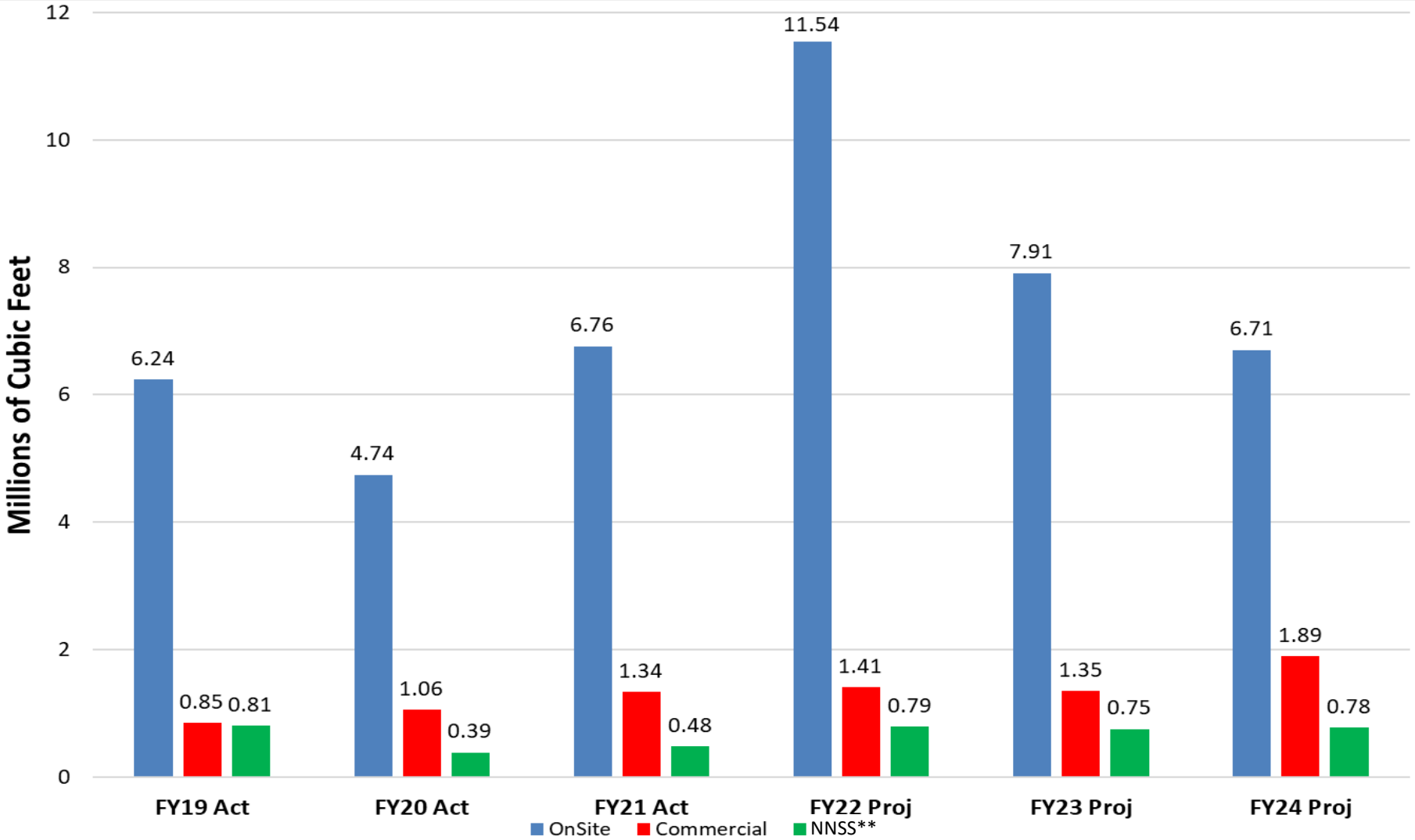
Manifest Information Management System (MIMS)

- MIMS is the public source for manifest data of non-DOE LLW shipped to commercial disposal facilities to meet the provisions in 42 U.S.C. 2021g(a).
- States/compacts are the primary stakeholders; data collected for 35 years.
- Data is available for currently operating commercial LLW disposal facilities and the closed Beatty, Nevada, site.
  - Barnwell (Atlantic Compact), EnergySolutions of Utah, Richland (Northwest Compact/Rocky Mountain Compact), and Waste Control Specialists (Texas Compact).
- Includes calendar year 2021 data from the 4 commercial facilities.
- Visit MIMS at: https: //mims.doe.gov

Waste Information Management System (WIMS)

- Includes DOE planned LLW/MLLW treatment/disposal forecast
- Annually updated and website maintained by Florida International University
- Out-year data reflects uncertainty due to site funding adjustments, federal budget process, DOE priorities.
- Visit WIMS at: https://emwims.org

DOE Complex-wide LLW/Mixed Low-Level Waste (MLLW) Disposal Volume* by Disposal Location



* Does not include waste labeled “unknown” or “other”

**"NNSS" represents waste generated outside of Nevada that was disposed at NNSS

Thank you for your Attention