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

Presentation to NGA Federal Facilities Task Force: EM Radioactive Waste Disposition

Doug Tonkay
Acting Deputy Assistant Secretary for Waste & Materials Management
Office of Environmental Management

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Topics

- Radioactive Waste Overview
- Reprocessing Waste
- Transuranic (TRU) Waste
- GTCC Low-Level Radioactive Waste (LLW)
- LLW/Mixed LLW (MLLW)

DOE Radioactive Waste Overview

- Authority for management of all DOE generated waste is under authority of the Atomic Energy Act of 1954 (AEA), as amended.
  - DOE has unique waste streams because of its historic and current missions.
  - DOE Order 435.1, *Radioactive Waste Management*, with associated Manual, provides policy and requirements for DOE Waste Management.
- Clear distinction exists between DOE and non-DOE waste in the Low-Level Waste Policy Amendments Act of 1985.
  - States and regional disposal compacts are responsible for disposal of non-DOE and non-naval decommissioning LLW.
  - DOE does not accept LLW/MLLW from non-DOE generators, unless there is a documented DOE nexus or a national security rationale, in accordance with our eligibility criteria.

DOE Radioactive Waste Class Definitions

DOE Radioactive Waste Class Definitions Are Defined by Federal laws.

- **High-Level Waste** - highly radioactive material from reprocessing spent nuclear fuel.

  Atomic Energy Act of 1954 (AEA), as amended (AEA); Nuclear Waste Policy Act of 1982 (NWPA), as amended

- **Transuranic Waste** - man-made elements above atomic number 92; > 100 nanocuries per gram of waste of alpha-emitting isotopes with $t_{1/2}$ > 20 years.

  AEA; Waste Isolation Pilot Plant Land Withdrawal Act

- **Low-Level Waste -** not high-level radioactive waste, spent nuclear fuel, transuranic waste, or by-product material.

  NWPA; Low-Level Radioactive Waste Policy Amendments Act of 1985

- **Uranium Mill Tailing -** by-product material…naturally occurring radioactive material and uranium ore mill tailings.

  Uranium Mill Tailings Radiation Control Act of 1978

Greater-Than Class C Waste

GTCC LLW

- Radionuclide concentrations that exceed the limits for Class C LLW given in 10 CFR 61.55.
- Generated by activities of Nuclear Regulatory Commission (NRC) and Agreement State licensees, and it cannot be disposed of in currently licensed commercial LLW disposal facilities.
- Includes activated metals from the decommissioning of nuclear reactors, disused or unwanted sealed sources, and other waste (e.g., contaminated equipment, debris, etc.)
- Federal government is responsible for the disposal of GTCC LLW.

GTCC-like Waste

- *The use of the term "GTCC-like" is not intended to and does not create a new DOE classification of radioactive waste.*
- Term used in DOE NEPA analyses.
- Refers to radioactive waste that is owned or generated by DOE and has characteristics sufficiently similar to those of GTCC LLW such that a common disposal approach may be appropriate.
- Consists of DOE LLW and non-defense-generated TRU waste that has no identified path for disposal at the present time – primarily non-defense TRU waste from DOE's West Valley Demonstration Project (WVDP) in New York.

Regulatory Responsibilities and Disposition Paths

Waste Class	Regulatory Responsibilities	Disposition Path
HLW	• DOE for disposal • U.S. Environmental Protection Agency (EPA) disposal standards • NRC licenses	Geologic repository
GTCC LLW	• DOE for disposal • NRC regulates disposal	• No formal decision currently • DOE National Environmental Policy Act (NEPA analyses evaluated disposal at WIPP and land disposal facilities • NRC Commission authorized staff to issue a new proposed rule that consolidates and integrates criteria for licensing the disposal GTCC LLW and 10 CFR Part 61, LLW Disposal rulemaking activities
TRU Waste	• DOE for disposal • EPA certification • New Mexico permit	WIPP, DOE owned/operated
LLW (NRC has sub-classes)	• DOE for DOE disposal facilities • NRC Agreement State for commercial facilities • EPA/State permit if mixed	DOE or commercial near-surface disposal facilities

Waste Disposal Considerations

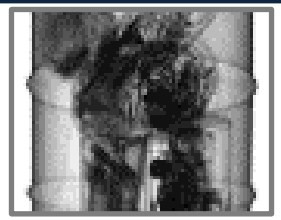
- DOE's Radioactive Waste Management Manual 435.1-1 has the current "tiered" policy on treatment, storage, and disposal:

  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.

Disposal Facility: Waste Acceptance Program

Waste Characterization



- Identify composition/ properties to comply with applicable storage, treatment, handling, transportation, and disposal requirements.
- Process knowledge; nondestructive examination; nondestructive assay; sampling & analysis.

Disposal Options Analysis

Based on waste classification (e.g., LLW, TRU, etc.), disposal facility Waste Acceptance Criteria (WAC), DOE policies, and other considerations.

Waste Certification

- Demonstrates to facility licensee that waste meets WAC.
- Detailed waste profile; waste characterization records, quality assurance, inspection, etc.

Package, Transport, and Disposal

- Comply with U.S. Dept. of Transportation/NRC packaging/shipping requirements.
- Shipping documentation/ authorization.
- Inspections.

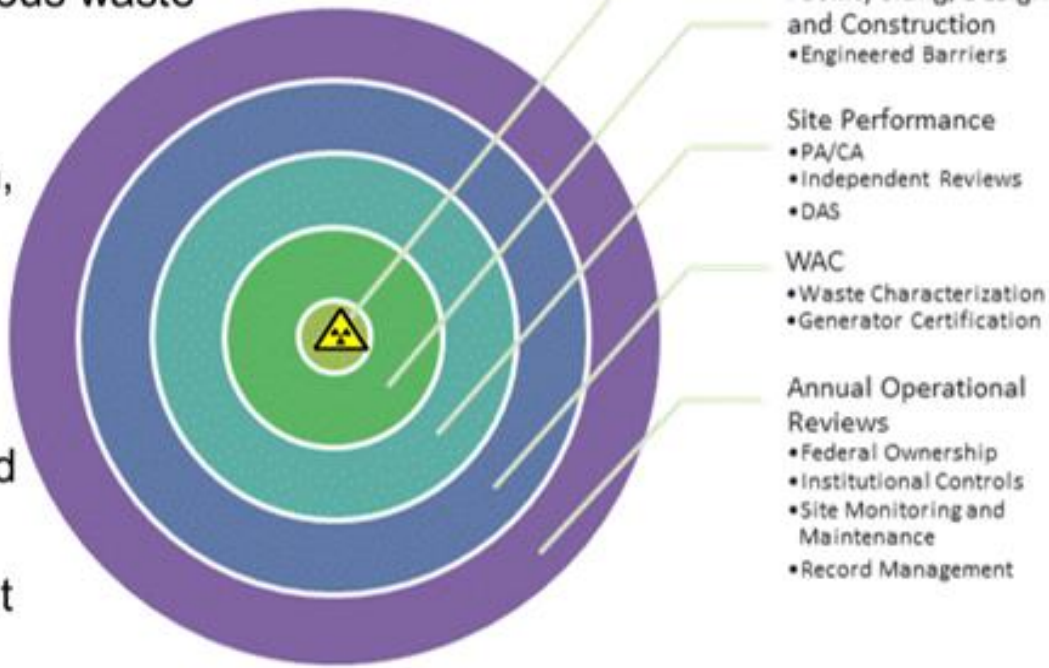
Oversight

Commercial Facilities: NRC, Agreement State, Other State/Federal Agencies.

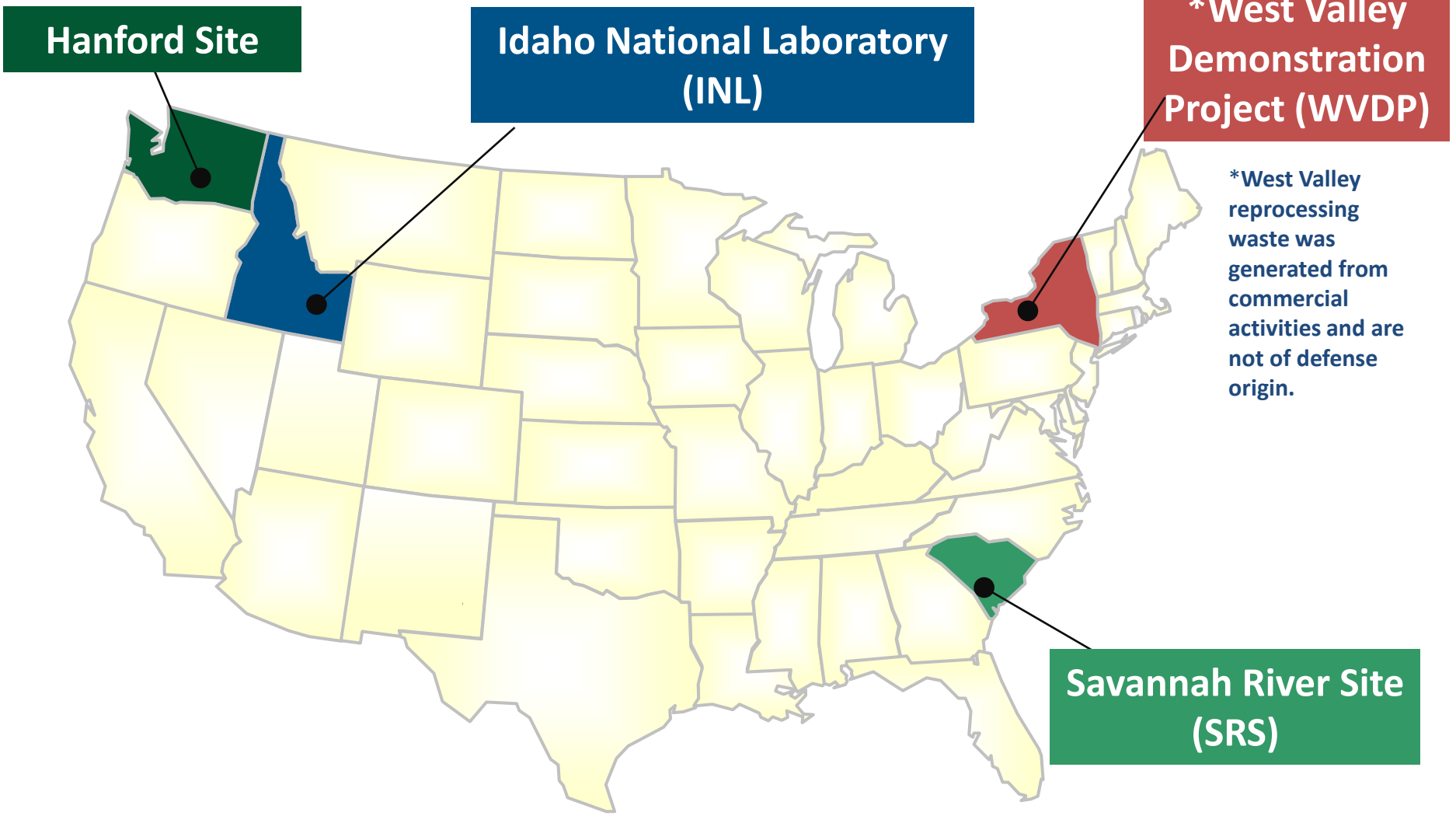
DOE Facilities: Regulatory; DOE-HQ Program Offices; DOE-HQ Independent Oversight; DOE Site/Field Office; Contractor; External Independent Oversight (Defense Nuclear Facilities Safety Board, Govt. Accountability Office, etc.).

Disposal Facility Defense In Depth

- Multiple layers of protection
- Site-specific waste acceptance criteria (WAC) and rigorous waste generator certification
- WAC can also be specific to facility design, container and waste forms
- Federal ownership and necessary buffer zones until site can be released
- Commitment to continuous improvement with PA reviews and maintenance, including monitoring



DOE Reprocessing Waste Locations



*West Valley reprocessing waste was generated from commercial activities and are not of defense origin.

Reprocessing Waste Inventories

Site	Inventory	Treatment Status	Key Facilities
Hanford	• 56 million gallons of tank waste	In Progress (Direct-Feed Low-Activity Waste (DFLAW))	• 177 Tanks • Waste Treatment and Immobilization Plant • DFLAW (Tank Side Cesium Removal System, LAW Facility (melter)) • Integrated Disposal Facility (LAW)
INL	• 900,000 gallons of sodium-bearing waste • 4,400 cubic meters of calcine	In Progress	• 3 Tanks • Integrated Waste Treatment Unit • Bin sets 1-6 (calcine storage)
SRS	• 34 million gallons of tank waste • >4,200 glass canisters in storage • >27.65 million gallons of saltstone produced (disposed onsite)	In Progress	• 43 Tanks • Glass Waste Storage Buildings • Defense Waste Processing Facility • Salt Waste Processing Facility • Saltstone Production Facility • Saltstone Disposal Units
WVDP	• 278 glass canisters	Completed	• Dry Cask Storage Area

Reprocessing Waste –Classification Approaches

Key Attributes	Tank Waste Classification Approaches[1]		
	Waste Incidental to Reprocessing Evaluation	2005 NDAA Section 3116	HLW Interpretation
Where Applicable?	▪ Hanford ▪ West Valley Demonstration Project ▪ Idaho Site[2] ▪ Savannah River Site (SRS)[2]	▪ Idaho Site ▪ SRS	▪ Currently, SRS Defense Waste Processing Facility Recycle Wastewater (8-gallons)
Examples of Application	▪ Hanford WM Area-C Tank Farm (ongoing) ▪ Hanford Vitrified Low-Activity Waste (ongoing) ▪ Hanford Test Bed Initiative (3-gallons) (2016) (2,000-gallon analysis ongoing) ▪ WVDP Concentrator Feed Makeup Tank and Melter Hold Tank (2013) ▪ WVDP Melter (2012)	▪ SRS H Tank Farm (2014) ▪ SRS F Tank Farm (2012) ▪ SRS Saltstone Disposal Facility (2006) ▪ Idaho Nuclear Technical and Engineering Center Tank Farm Facility (2006)	▪ SRS DWPF Recycle Wastewater (8-gallons) ▪ SRS Contaminated Process Equipment (proposed/analysis ongoing)
Regulatory Oversight	▪ Must comply with all applicable state and federal regulations ▪ Optional NRC consultation	▪ Must comply with all applicable state and federal regulations ▪ Requires NRC consultation	▪ Must comply with all applicable state and federal regulations ▪ NRC consultation not required –DOE to maintain its strong relationship with NRC, and continue that relationship in the future

[1] A fourth approach is Waste Incidental to Reprocessing (WIR) citation under DOE Manual 435.1-1, Radioactive Waste Management Manual, Chapter II, Section B.(1). This approach is not shown in the table. It allows a limited number of secondary solid waste items to be excluded from HLW (e.g., contaminated clothing, tools, and equipment).

[2] For the Idaho Site and SRS, the WIR evaluation approach applies to tank waste that is transported from Idaho and South Carolina, respectively; 2005 NDAA Section 3116 applies when tank waste at these two sites is disposed in-state.

Reprocessing Waste –Classification Approaches (cont'd)

Key Difference: HLW interpretation does not require removal of radionuclides from reprocessing wastes that already meet existing regulatory requirements for safe disposal as LLW without any radionuclide removal. All three approaches require compliance with disposal facility performance objectives for protection of worker, public health and the environment.

Key Attributes	Tank Waste Classification Approaches		
	Waste Incidental to Reprocessing Evaluation	2005 NDAA Section 3116	HLW Interpretation
Key Technical Criteria	▪ Remove key radionuclides to the maximum extent technically and economically practical ▪ Comply with requirements comparable to Nuclear Regulatory Commission (NRC) 10 CFR 61, Subpart C performance objectives ▪ Comply with Atomic Energy Act of 1954 ▪ Comply with DOE Manual 435.1-1 low-level radioactive waste (LLW) or transuranic waste requirements ▪ Requires a solid physical form ▪ Comply with 10 CFR 61.55; or meets alternative requirements	▪ Remove highly radioactive radionuclides to the maximum extent practical ▪ Comply with 10 CFR 61, Subpart C performance objectives ▪ Requires State-approved closure plan or permit ▪ If regulatory concentration limits exceeded, requires plans developed by DOE in consultation with the NRC ▪ NRC and State shall monitor disposal actions ▪ Cannot be applied to waste transported out of state	▪ Comply with 10 CFR 61.55 and meets the performance objectives of a disposal facility; or, ▪ Meets the performance objectives of a disposal facility as demonstrated through a performance assessment

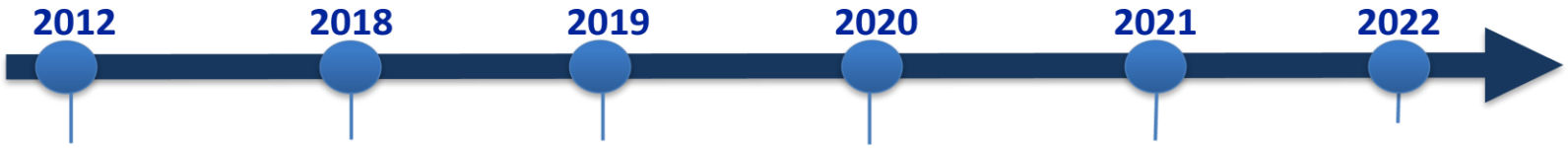
HLW Interpretation

A tool in the "waste management policy toolbox" that, where implemented, allows DOE to dispose of defense reprocessing waste in accordance with its radiological characteristics and not solely by source.

- HLW, as defined in the Atomic Energy Act of 1954, as amended, and the Nuclear Waste Policy Act of 1982, as amended, is properly interpreted to mean that not all radioactive wastes from nuclear fuel reprocessing are HLW, and that some reprocessing wastes can be classified as non-HLW based on the radiological characteristics of the waste.
- Under DOE's HLW interpretation, a reprocessing waste may be determined to be non-HLW if the waste meets either of the following two criteria:
  - I. Does not exceed concentration limits for Class C LLW as set out in 10 CFR 61.55 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.
- Waste meeting either of these criteria could be classified based on its radiological content and disposed of in accordance with the disposal facility waste acceptance criteria; allowable radionuclide content; waste form and packaging; and required waste generator certifications and approvals.
- While developing waste disposition plans, and before any waste disposal decisions are made, DOE will work closely with state and federal regulators to ensure compliance with applicable requirements and regulatory agreements.

HLW Interpretation – Key Milestones

- Current efforts focused on completion of NEPA Analysis of 2nd Waste Stream, i.e., *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 is proceeding deliberatively with proactive stakeholder engagement throughout the HLW interpretation process.



2012

President Obama's *Blue Ribbon Commission on America's Nuclear Future* issued report advocating risk-based approach to waste classification (January 6, 2012).

2018

Draft HLW interpretation for public comment (October 10, 2018, 83 FR 50909).

2019

- Supplemental HLW interpretation, including categorical responses to public comments (June 10, 2019 (84 FR 26835).
- Draft EA for the Commercial Disposal of DWPF Recycle Wastewater from SRS for public comment (December 10, 2019, 84 FR 67438).
- Informational meeting and webinar (December 17 and 19, 2019).

2020

- Final EA, FONSI, and Technical Documents for Commercial Disposal of DWPF Recycle Wastewater from SRS (August 10, 2021, 85 FR 48236).
- DOE shipped a small quantity of SRS DWPF recycle wastewater to commercial facility for stabilization and disposal (September 2020).

2021

- HLW interpretation incorporated into DOE directives (January 19, 2021, 86 FR 5173).
- Notice to prepare Draft EA for Commercial Disposal of SRS Contaminated Process Equipment (January 19, 2021, 86 FR 5175).
- Assessment of the HLW interpretation (December 21, 2021, 86 FR 72220).
- Draft EA for Commercial Disposal of SRS Contaminated Process Equipment for public comment (December 21, 2021, 86 FR 72217).

2022

- Informational webinar (January 11, 2022).
- End of 45-day public comment period on Draft EA for Commercial Disposal of SRS Contaminated Process Equipment (February 4, 2022).

Waste Isolation Pilot Plant – Status

WIPP Land Withdrawal Act (Public Law 102-579) allows for 175,564 cubic meters of TRU waste to be disposed at WIPP

- Panels 1 – 6 have been filled and sealed
- Currently emplacing waste in the last available room in Panel 7

  Mining of Panel 8 is complete and outfitting and certification is underway

  Approximately 40% of total waste volume emplaced
  - CH 70,716 m^3
  - RH 361 M^3

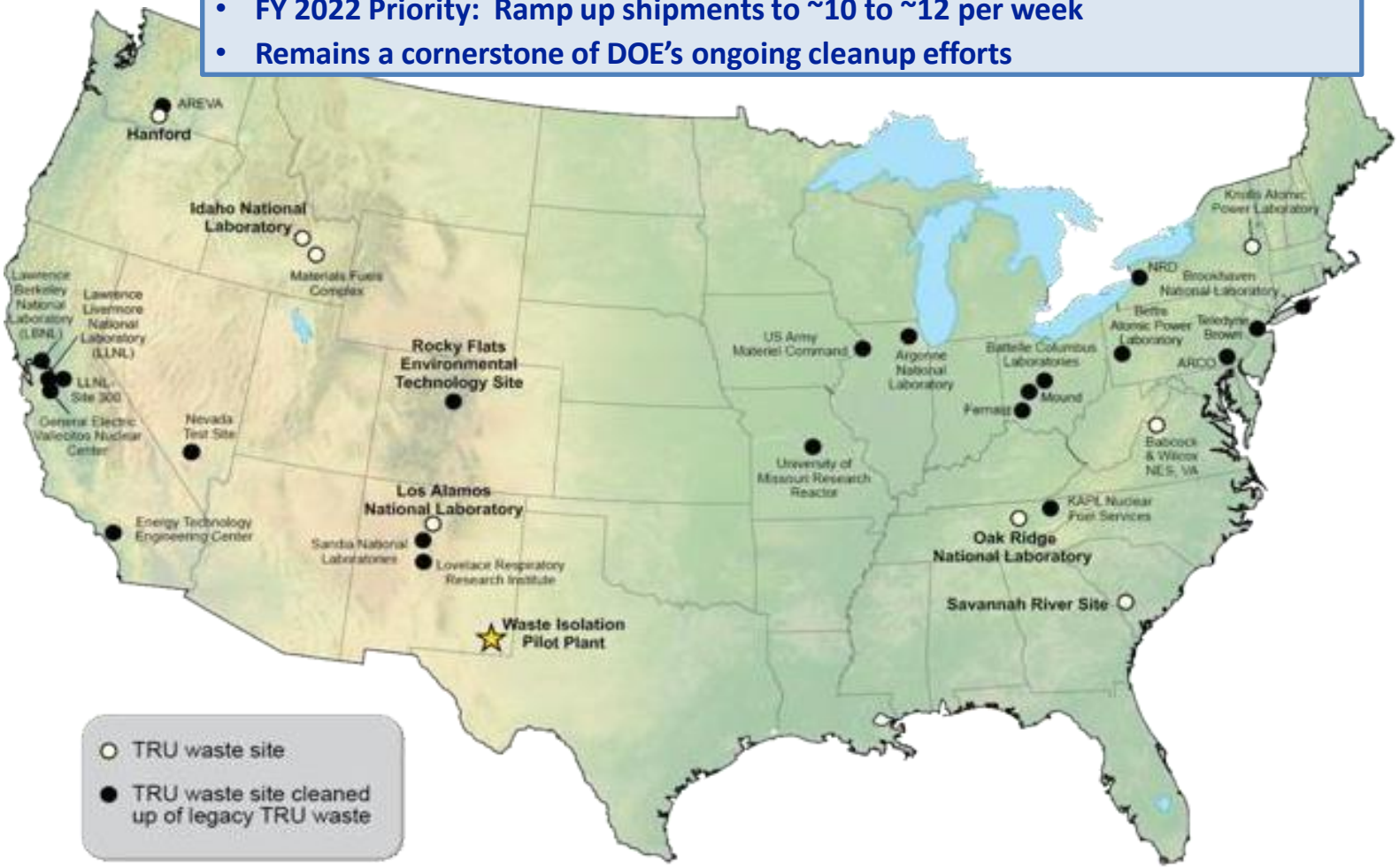
  Waste emplacement status as of March 2022

Additional disposal panels are needed to accommodate the disposal volume in the LWA

- Replacement panels 11 and 12
- Additional panels will be needed to complete WIPP's mission

National TRU Program Accomplishments

- **Total number of TRU waste sites cleaned up to date: 22**
- **Total shipments (as of 04/09/2022): 13,077 traveling over 15.6 million miles**
- **FY 2022 Priority: Ramp up shipments to ~10 to ~12 per week**
- **Remains a cornerstone of DOE's ongoing cleanup efforts**



National TRU Program
Fiscal Year 2021 and 2022 Shipments

Site	Maximum Shipments in FY 2021	Actual Shipments in FY 2021	Maximum Shipments in FY 2022
LANL (EM and NNSA)	82	56	85
INL	150	100	280
OREM	8	22	16
SRS (EM and NNSA)	8 (EM only)	6 (EM only)	20
SQS (SNL, LLNL, ANL)	10	14	5
WCS	--	1	--
Total	258	199	406

* FY22 maximums are based on availability of certified TRU waste for shipment

National TRU Program – Total Completed Shipments

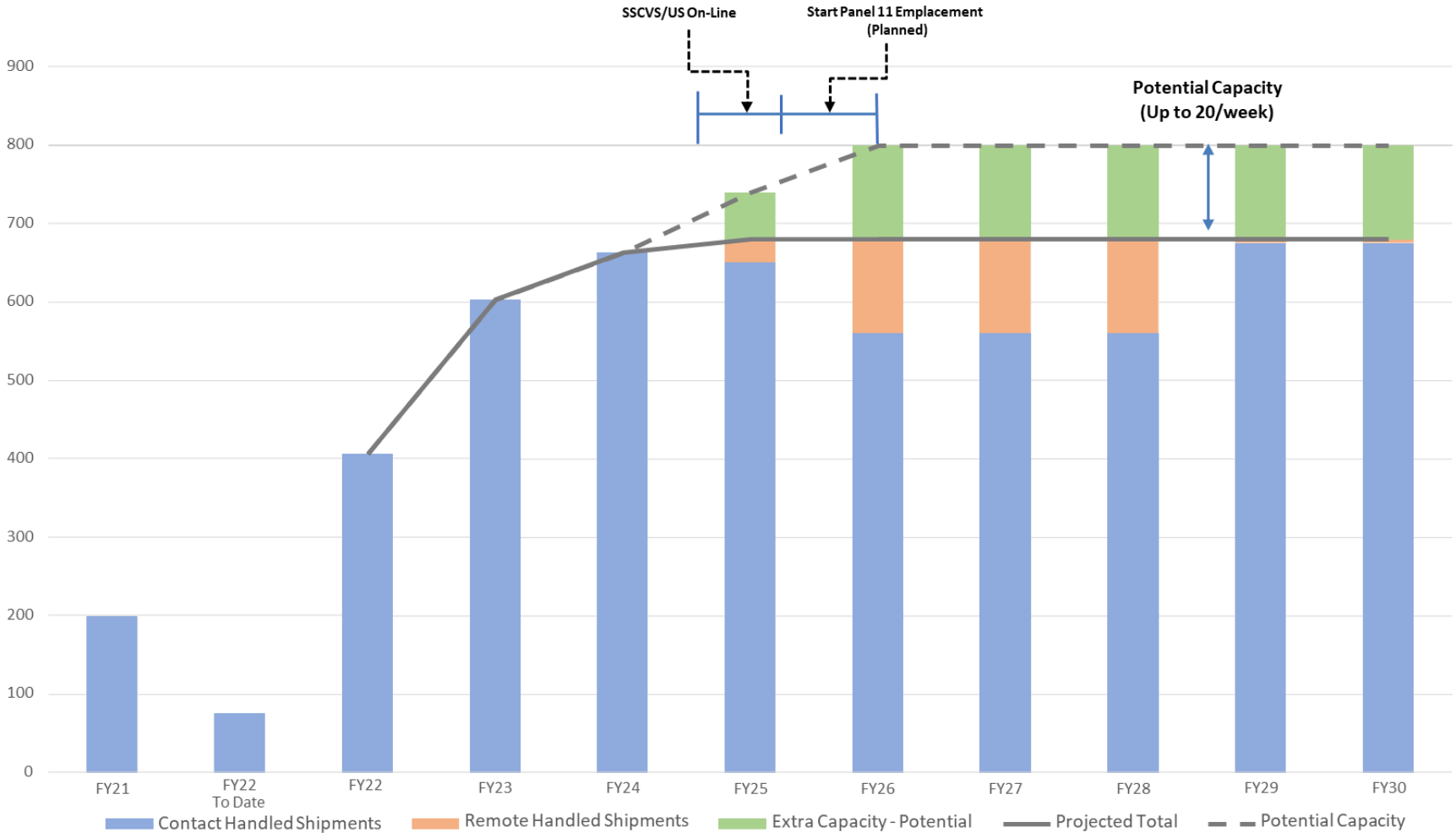
WIPP has been disposing of defense TRU waste since 1999.

Shipments received as of April 9, 2022. Source: https://wipp.energy.gov/shipment-information.asp

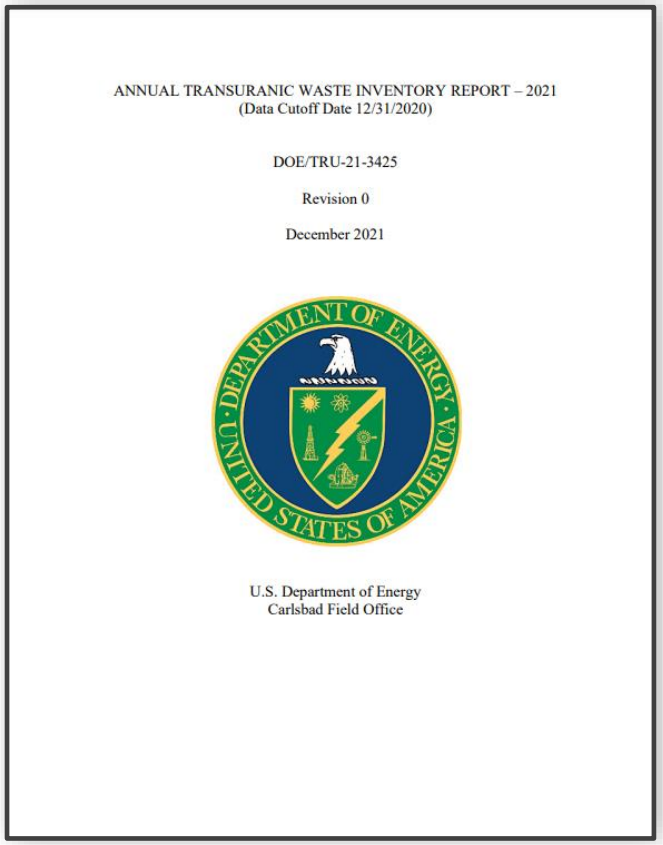
Site	Shipments	Loaded Miles
Argonne National Laboratory	197	338,213
Bettis Atomic Power Laboratory	5	10,955
GE Vallecitos Nuclear Center	32	44,800
Idaho National Laboratory	6,651	9,255,408
Los Alamos National Laboratory	1,511	516,762
Lawrence Livermore National Laboratory	38	64,224
Nevada National Security Site	48	57,312
Oak Ridge National Laboratory	246	330,378
Rocky Flats Environmental Technology Site	2,045	1,446,444
Hanford Site	572	1,034,176
Sandia National Laboratories	10	2,856
Savannah River Site	1,688	2,532,728
Waste Control Specialists	34	3,400
Total to WIPP	13,077	15,637,656

National TRU Program Shipping Projections

Shipping Projections Aligned with Additional WIPP Capabilities



Annual TRU Waste Inventory Report 2021



ANNUAL TRANSURANIC WASTE INVENTORY REPORT – 2021
(Data Cutoff Date 12/31/2020)

DOE/TRU-21-3425

Revision 0

December 2021

U.S. Department of Energy
Carlsbad Field Office

Available at:
https://wipp.energy.gov/Library/TRUwaste/ATWIR-2021_CBFO_Final.pdf

- **Emplaced (~70,100 m^3):** TRU waste that has been disposed in the WIPP repository, in above-ground storage at the WIPP, or in temporary storage at a designated storage location.
- **WIPP-bound (~42,600 m^3):** TRU waste that is stored and projected to be generated up through CY 2033.
- **Potential (~9,840 m^3):** TRU waste that requires resolution of a regulatory or other constraint before it may be considered for disposal at WIPP, including waste that is stored and projected to be generated up through CY 2033.
- **Projected Beyond CY 2033 (~78,700 m^3):** WIPP-bound and potential TRU waste that is projected to be generated after CY 2033 up through CY 2083.

"The combination of these four categories of TRU waste volume estimates total approximately 201,000 m^3. Under the WIPP LWA, the WIPP is authorized to dispose of 6.2 million cubic feet (175,564 m^3) of TRU waste…Based on historical trends, the total inventory, including TRU waste projected to be generated up through CY 2083, is likely to be overestimated by as much as 26.8 percent, which would result in actual total volume well below the LWA capacity limit for the WIPP." [2021 ATWIR, Pg. 44]

GTCC LLW Disposal Status

- **New Development (April 2022)** – NRC Commission approved the staff's recommendation to:
  - issue new proposed rule that consolidates/integrates criteria for licensing the disposal of GTCC waste and 10 CFR Part 61, "Low-Level Radioactive Waste Disposal," rulemaking activities, and
  - provide for Agreement State licensing of those GTCC waste streams that meet the regulatory requirements for near-surface disposal and do not present a hazard such that the NRC should retain disposal authority.

- NRC Draft Regulatory Basis (July 2019):

  "…the NRC staff found that a majority of GTCC waste are both potentially suitable for near-surface disposal and could be regulated by an Agreement state."

- DOE continues to monitor NRC developments and the Energy Policy Act of 2005 requirement to "await action by Congress."

Operating DOE & Commercial LLW Disposal Facilities Used by DOE

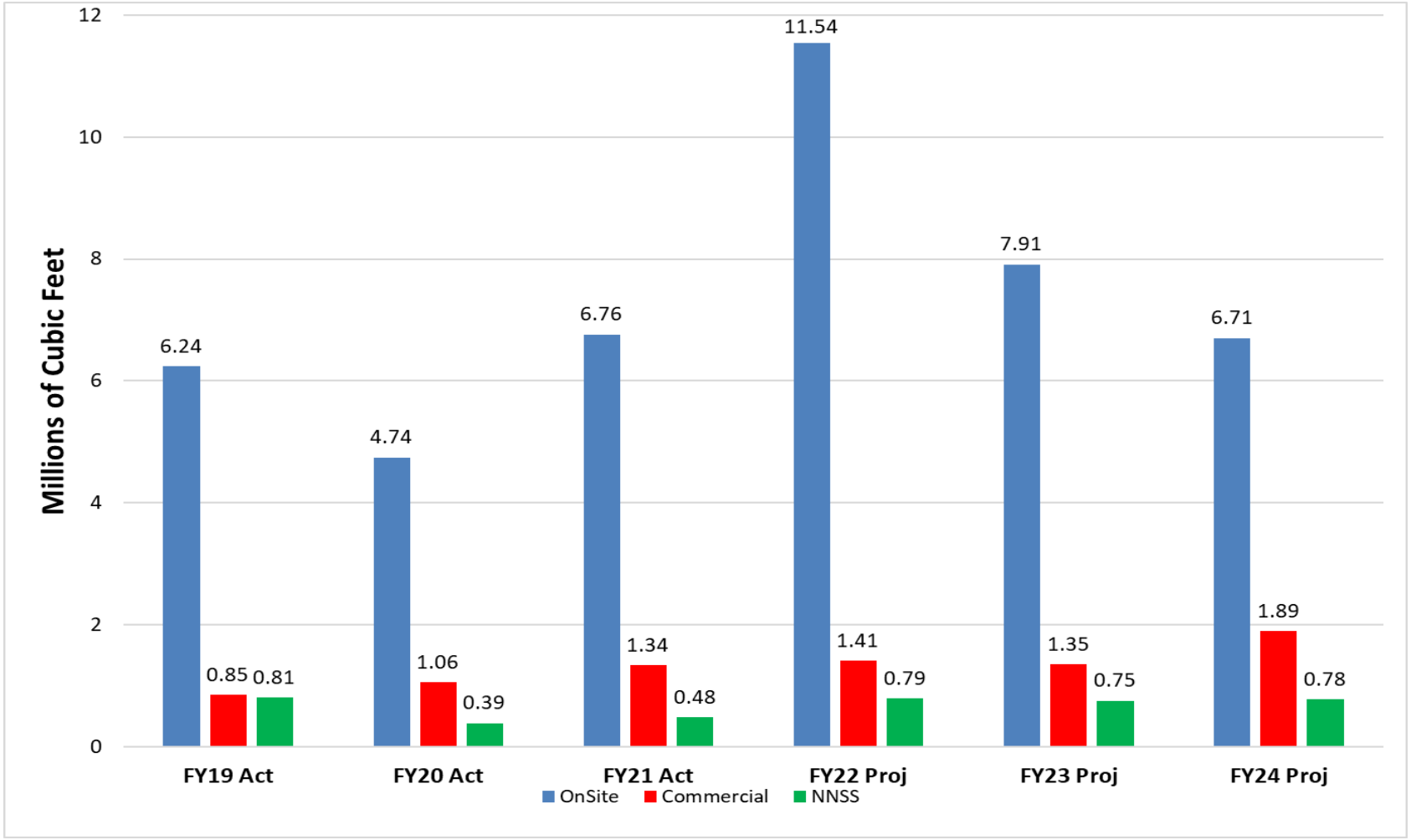
- All waste is disposed in accordance with each waste disposal facility's WAC.
- Each waste disposal site is licensed to dispose of specific waste types (see map below for examples).

Hanford Site
- Onsite LLW/MLLW and Naval Reactors LLW
- Integrated Disposal Facility awaiting commissioning (onsite vitrified low-activity waste and LLW)

★ DOE Disposal Facility ■ Commercial Disposal Facility

CERCLA – Comprehensive Environmental Response, Compensation and Liability Act; RCRA – Resource Conservation and Recovery Act

Complex-wide LLW/MLLW Disposal Volume by Disposal Location



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

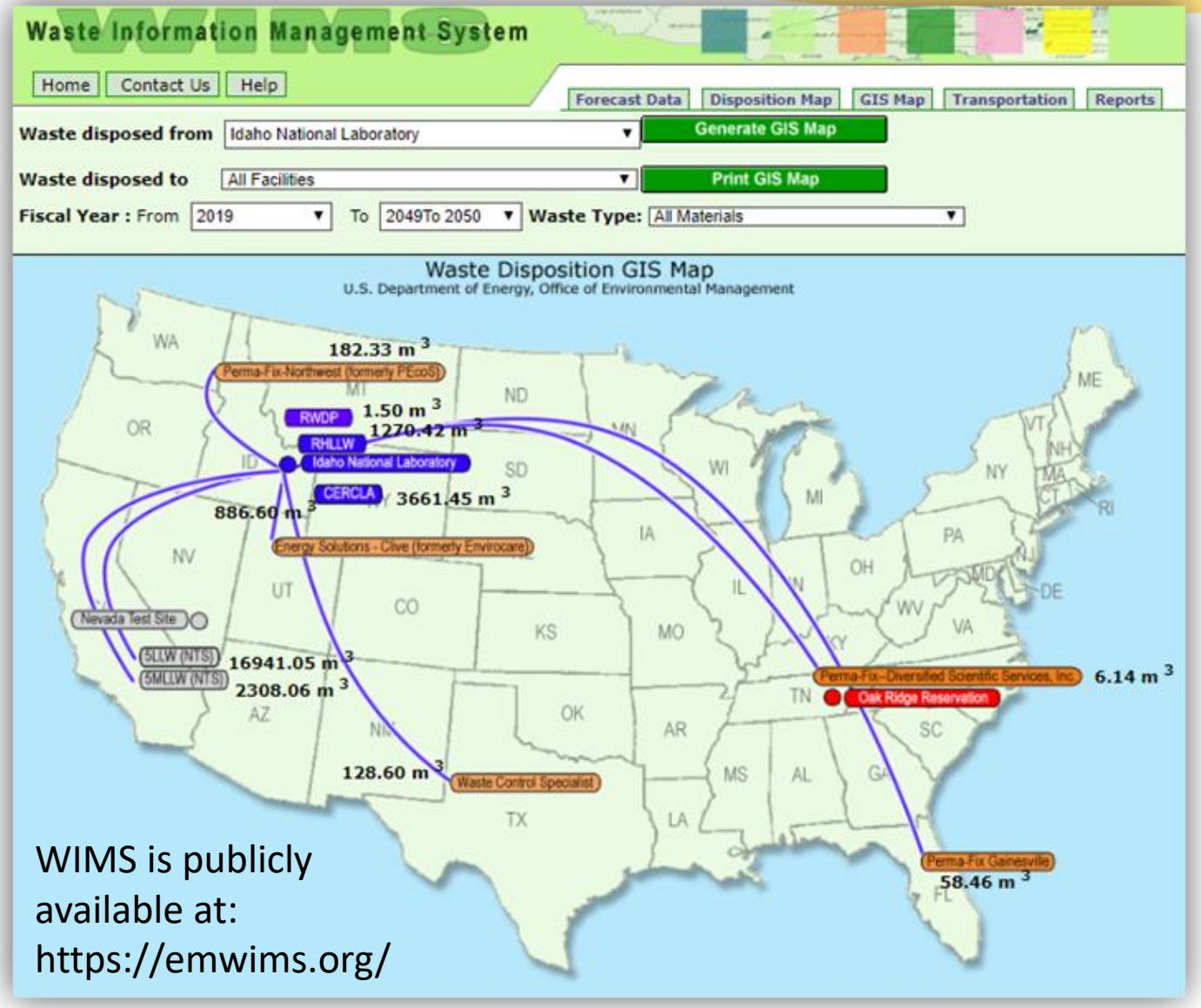
LLW/MLLW Disposal Considerations

- Sufficient LLW/MLLW disposal capacity exists at DOE and commercial facilities to support the EM cleanup mission.
- With very limited offsite DOE disposal options available, preservation of commercial disposal options remains crucial.
- EM will continue to apply integrated radioactive waste disposal strategies which consider environmental justice, climate change, and site equities to maintain the current and develop additional disposal options, ensuring a sustainable EM cleanup mission while fully protecting the public, workers, and the environment.

DOE LLW/MLLW Baseline Disposition Data

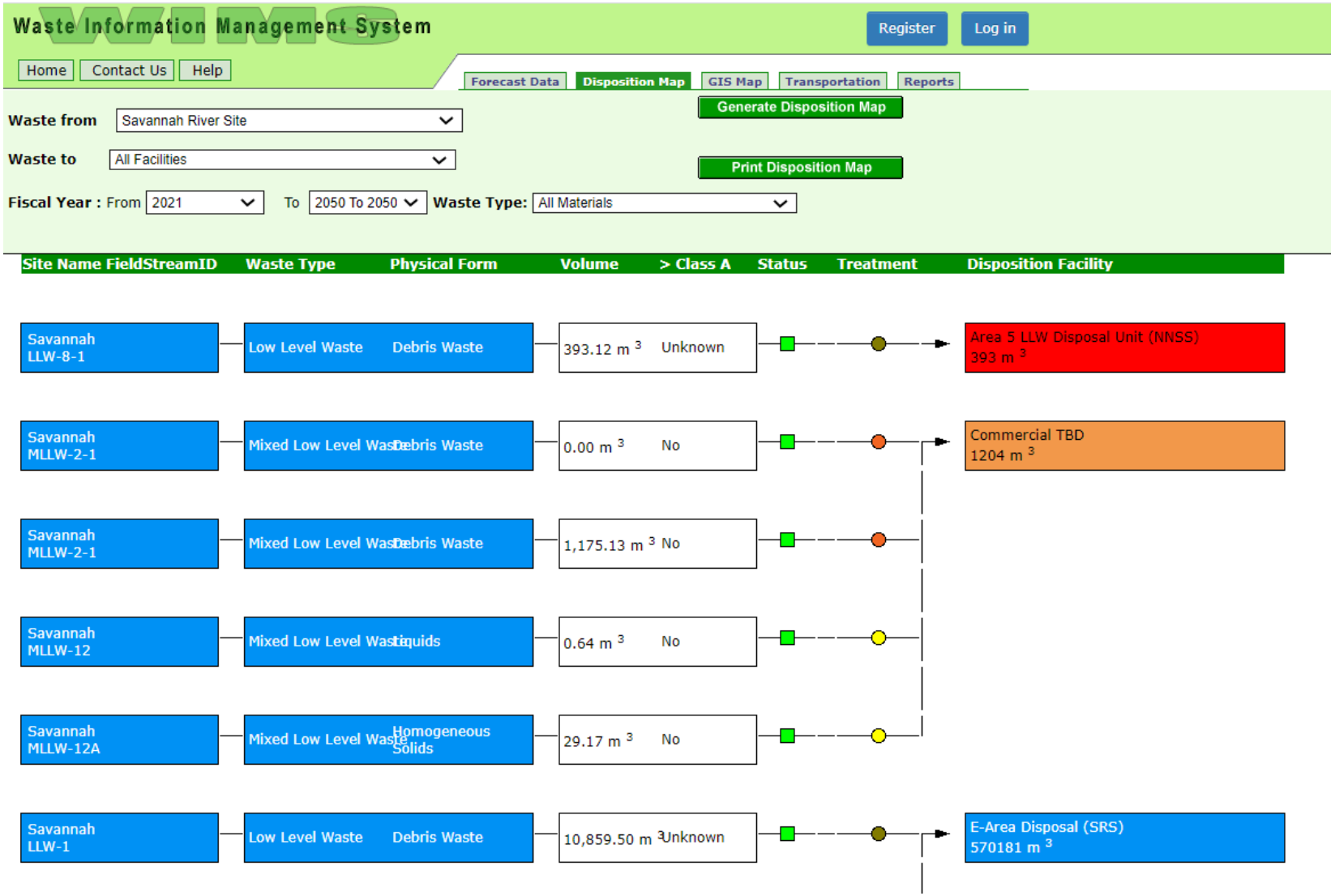
- Managed by EM/HQ personnel; coordinated with other DOE programs.
- Data call to all DOE sites occurs in the first quarter of each fiscal year.
- Compiled data provided to Florida International University for entry into EM WIMS.
- WIMS provides stakeholder accessible forecast data by fiscal year.
- Site inputs represent planned and budgeted program activities at the end of September 2021.
- Out-year data reflects uncertainty due to site funding adjustments, federal budget process, DOE priorities.

WIMS Example Screenshot



WIMS is publicly available at: https://emwims.org/

WIMS Example Screenshot (cont'd)



Potentially Challenging Waste Streams

- Treatment and disposal paths exist for the vast majority of DOE LLW and MLLW.
- Challenging LLW/MLLW streams are identified in a variety of forums, such as WIMS data base, DOE Site Treatment Plans, and Energy Facility Contractors Group Challenging Waste Subgroup.
- EM works to develop treatment and disposal paths for this waste through R&D efforts, procurements, and other initiatives.
- Current examples from WIMS data base include radioactive contaminated dioxin waste, tritiated oil/debris with mercury, miscellaneous reactive metals, and some non-organic debris liquids.

Questions?