



U.S. DEPARTMENT OF
ENERGY

OFFICE OF
**ENVIRONMENTAL
MANAGEMENT**

Department of Energy (DOE) Radioactive Waste Management

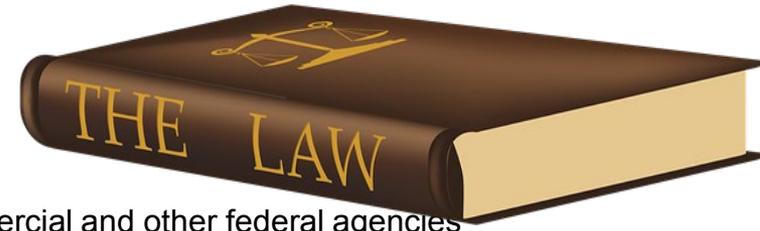
Overview for Site Specific Advisory Boards

October 2020

- Legislative History
- Material and Waste Definitions
- DOE Self-Regulation and Oversight
- Generator Responsibilities
- Receiving Facilities Responsibilities
- Waste Specifics

Legislative History

- **Atomic Energy Act of 1954 (AEA)**
 - Established Atomic Energy Commission (AEC) to regulate nuclear materials
- **Energy Reorganization Act of 1974**
 - Divided the AEC into:
 - Nuclear Regulatory Commission (NRC) - regulates commercial and other federal agencies
 - Energy Research and Development Administration (DOE-1977) – regulates weapons development, nuclear research, etc.
- **Nuclear Waste Policy Act of 1982**
 - DOE to provide disposal of high-level waste (HLW) and spent nuclear fuel (SNF)
- **Low-Level Radioactive Waste Policy Amendments Act of 1985**
 - States dispose of Low-Level Waste (LLW) generated within their borders; also allows for multi-state compacts
 - Federal Government dispose of US Navy decommissioning LLW, atomic-weapon related LLW, and Greater-than-Class C waste (GTCC) LLW
- **Waste Isolation Pilot Plant (WIPP) Land Withdrawal Act**
 - Provides definition for defense transuranic (TRU) waste.
 - Enables DOE to dispose of defense TRU waste at WIPP.



| Waste Class | Regulatory Responsibilities | Disposition Path |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High-Level Waste (HLW) | <ul style="list-style-type: none"> • DOE for disposal • U.S. Environmental Protection Agency (EPA) disposal standards • NRC licensing | Geologic repository |
| Greater-than-Class C (GTCC) Low-Level Radioactive Waste | <ul style="list-style-type: none"> • DOE for disposal • NRC regulates disposal | Geologic repository <u>unless</u> proposals for disposal in a disposal site licensed pursuant to 10 CFR 61 are approved by NRC; NRC currently looking at near-surface disposal |
| Transuranic (TRU) Waste | <ul style="list-style-type: none"> • DOE for disposal • EPA certification • New Mexico permit | Waste Isolation Pilot Plant (WIPP), DOE owned/operated; Waste materials generated by atomic energy defense activities only |
| Low-Level Waste (LLW) | <ul style="list-style-type: none"> • DOE for disposal • NRC Agreement State for commercial facilities • EPA/State permit if mixed waste | DOE or commercial near-surface disposal facilities |

 – NRC and DOE waste class

 – NRC waste class

 – DOE waste class

Source Material

- Uranium or thorium in any physical or chemical form or ores which contain $\geq 0.05\%$ uranium, thorium

Special Nuclear Material (SNM)

- Plutonium, enriched uranium and any material artificially enriched

By-product Material

- (1) Any radioactive material produced or made radioactive by exposure to process of producing or using SNM
- (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium ore

These are **NOT** radioactive wastes – DOE O 435.1-1 is not applicable

* - for complete definitions see DOE M 435.1-1, attachment 2

Radioactive Waste

Any discarded material, including solid, liquid, semisolid, or contained gaseous material that must be managed for its radioactive content. Has no programmatic use.



INL packing LLW debris and PPE for disposal

High-Level Radioactive Waste (HLW)

- (A) The highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid materials derived from such liquid waste that contains fission products in sufficient concentrations; and
- (B) other highly radioactive material that the Nuclear Regulatory Commission determines by rule requires permanent isolation

Transuranic Radioactive (TRU) Waste

Waste containing more than 100 nanocuries (nCi/g) of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: 1) HLW; 2) waste that DOE and EPA agree does not need the degree of isolation of such disposal; or 3) waste that NRC has approved for disposal

| | | | | | | |
|-------------------------------|----------------------------------|----------------------------------|----------------------------------|-------------------------------|----------------------------------|------------------------------------|
| 92 U Uranium 238.029 | 93 Np Neptunium 237.048 | 94 Pu Plutonium 244.064 | 95 Am Americium 243.061 | 96 Cm Curium 247.070 | 97 Bk Berkelium 247.070 | 98 Cf Californium 251.080 |
|-------------------------------|----------------------------------|----------------------------------|----------------------------------|-------------------------------|----------------------------------|------------------------------------|

Low-Level Radioactive Waste (LLW)

Radioactive waste that is **NOT**: HLW, SNF, TRU waste, byproduct material or naturally occurring radioactive material (NORM)

Mixed Waste

Radioactive waste with a hazardous component regulated under the Resource, Conservation and Recovery Act (RCRA)

Toxic Substances Control Act (TSCA)

Radioactive waste containing polychlorinated biphenyls (PCBs) or asbestos regulated under TSCA

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Disposal sites regulated under CERCLA must also meet DOE 435.1 LLW disposal performance objectives; EPA and States are involved in CERCLA LLW and TRU waste management

Self-Regulated Authority Implementation

- The AEA authorizes DOE to regulate possession, use and safe disposal of radioactive materials
- This authority is implemented through the DOE directives system:
 - DOE Order (O) 435.1*, *Radioactive Waste Management* issued in 1999, provides the general objectives and applicability
 - DOE Manual (M) 435.1-1, *Radioactive Waste Management Manual* provides requirements for waste planning, generation, characterization and disposal facility design, operations, and closure
 - DOE Guide (G) 435.1-1 gives guidance for implementing the requirements
 - DOE Standard DOE-STD-5002-2017 – content and format for Disposal Authorization Statement and Tank Closure Documentation

Self-Regulated Authority/ Oversight

- **DOE Headquarters Program Offices**
 - Assess DOE Site/Field Office performance and provide oversight functions
- **DOE Headquarters Oversight**
 - Office of Health, Safety and Security (AU)
 - Office of Enterprise Assessment
 - Low-Level Waste Disposal Facility Federal Review Group (LFRG)
- **DOE Site/Field Office**
 - Assess contactor performance
 - Approve Radioactive Waste Management Basis (RWMBs) – DOE approval for radioactive operations
- **External Independent Oversight**
 - DNFSB, Government Accountability Office, etc.



- **Program Secretarial Officers**
 - Ensure Site(s) meet DOE M 435.1-1 requirements
- **Assistant Secretary for Environmental Management**
 - Maintain integrated complex-wide HLW, TRU waste, and LLW programs
 - Initiates or Recommends changes to Regulations and DOE Directives
- **Associate Principal Deputy Assistant Secretary (APDAS) for Regulatory and Policy Affairs (EM-4)**
 - Maintain data system for waste generation
 - Issue Disposal Authorization Statements (DAS) – DOE approval for LLW disposal facilities
 - Issue Authorization to Proceed with Closure – DOE approval to close tanks
 - Approve Records of Decisions and all other decision documents authorizing disposal
 - Establish a review panel for recommending compliance determinations and disposal/closure authorizations

Low-Level Waste Disposal Facility Review Group

- DOE M 435.1-1 panel to review LLW disposal facility performance
 - Comprised of Federal employees led by EM
- Ensures compliance and consistency of facility design, construction, operation, and closure.
- Qualified, experienced, and independent review teams

LFRG Members

Program Secretarial Offices

Office of Environmental Management (EM)
Office of Environment, Health, Safety, and Security (AU)
Office of Nuclear Energy (NE)
Office of Science (SC)
National Nuclear Security Administration (NNSA)

DOE Sites

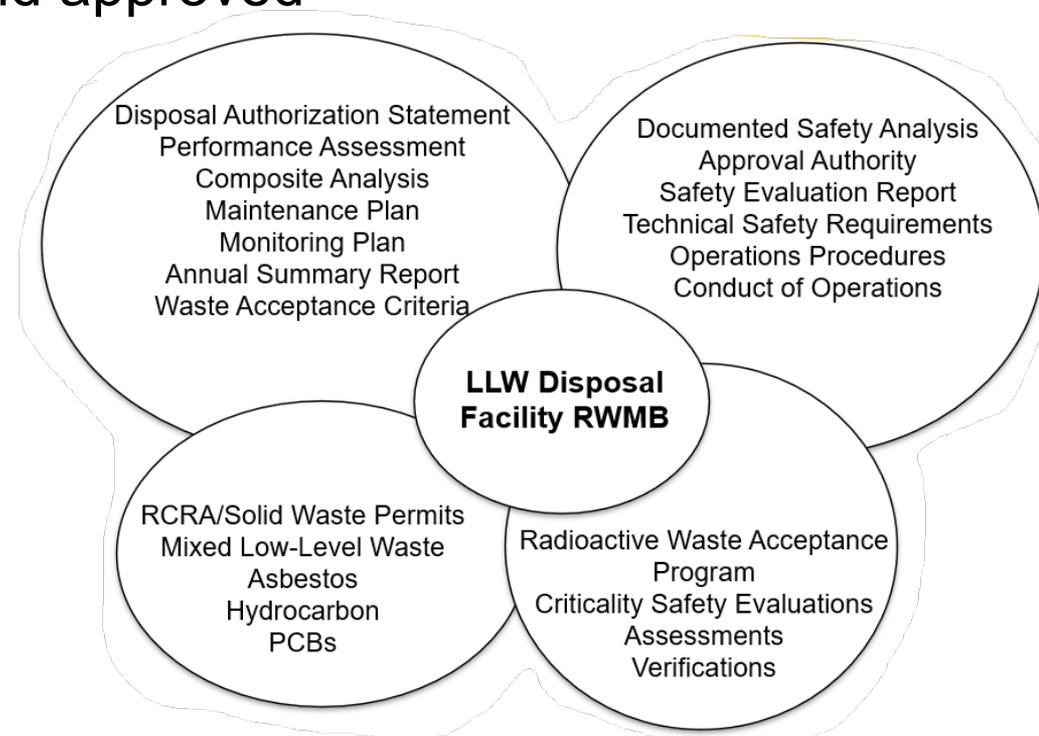
Hanford
Idaho National Laboratory
Los Alamos National Laboratory
Nevada National Security Site
Oak Ridge
Paducah
Portsmouth
Savannah River

Field Element Manager (FEM)

- Maintain Site-Wide Radioactive Waste Management Program
- Oversight – ensure radioactive waste management activities are conducted in accordance with RWMB and DOE M 435.1-1 requirements
- Approves RWMB and adds management conditions as necessary
 - Includes approval to generate no-path to disposal waste and notice to HQ
- Approves exemptions for non-DOE treatment, storage and/or disposal
- Approves “citation process” waste incidental to reprocessing (WIR) determinations and, in consultation with EM-HQ, approves “evaluation process” WIR determinations
- Ensures Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) disposal facilities meet the substantive DOE M 435.1 requirements

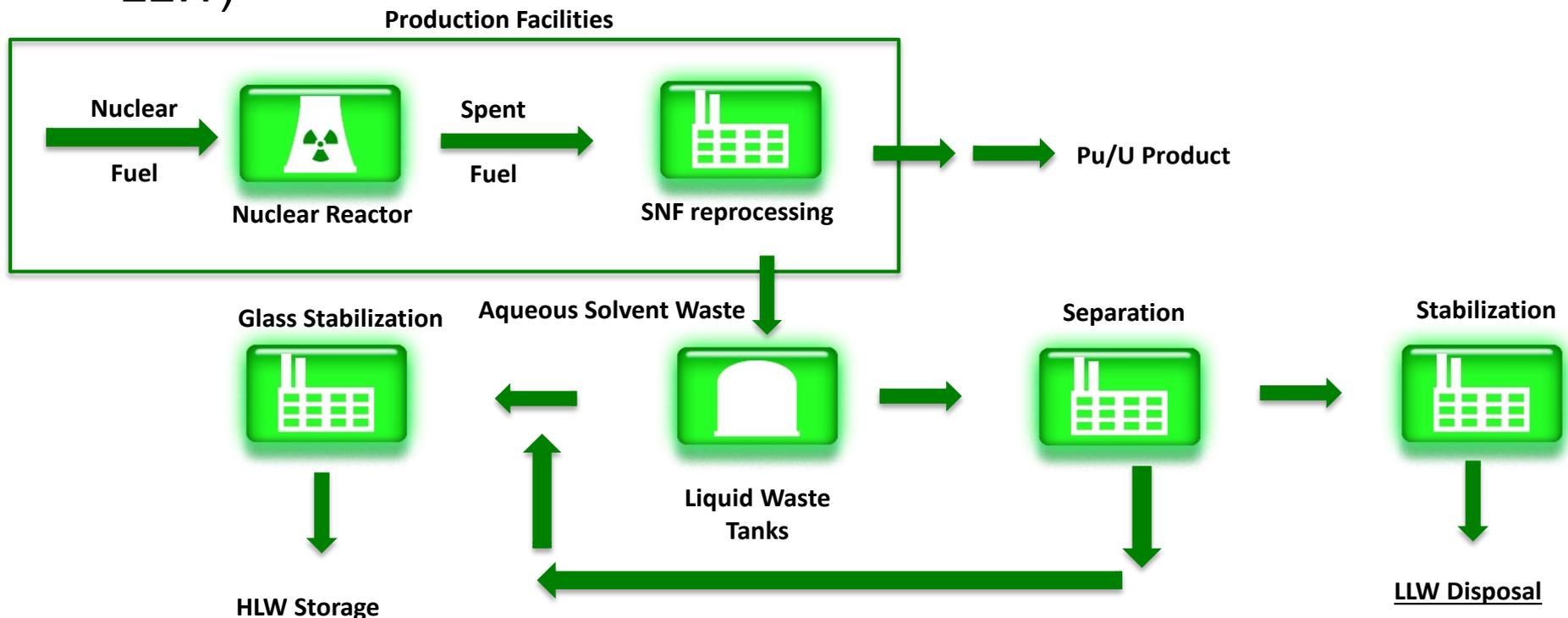
Radioactive Waste Management Basis (RWMB)

- **ALL RADIOACTIVE** facilities, operations, and activities **MUST** have a DOE approved RWMB
- Ensures hazards identified and analyzed, controls documented, implemented, maintained, and approved
- Approved by FEM and acts as Operating permit
- Flexible site implementation

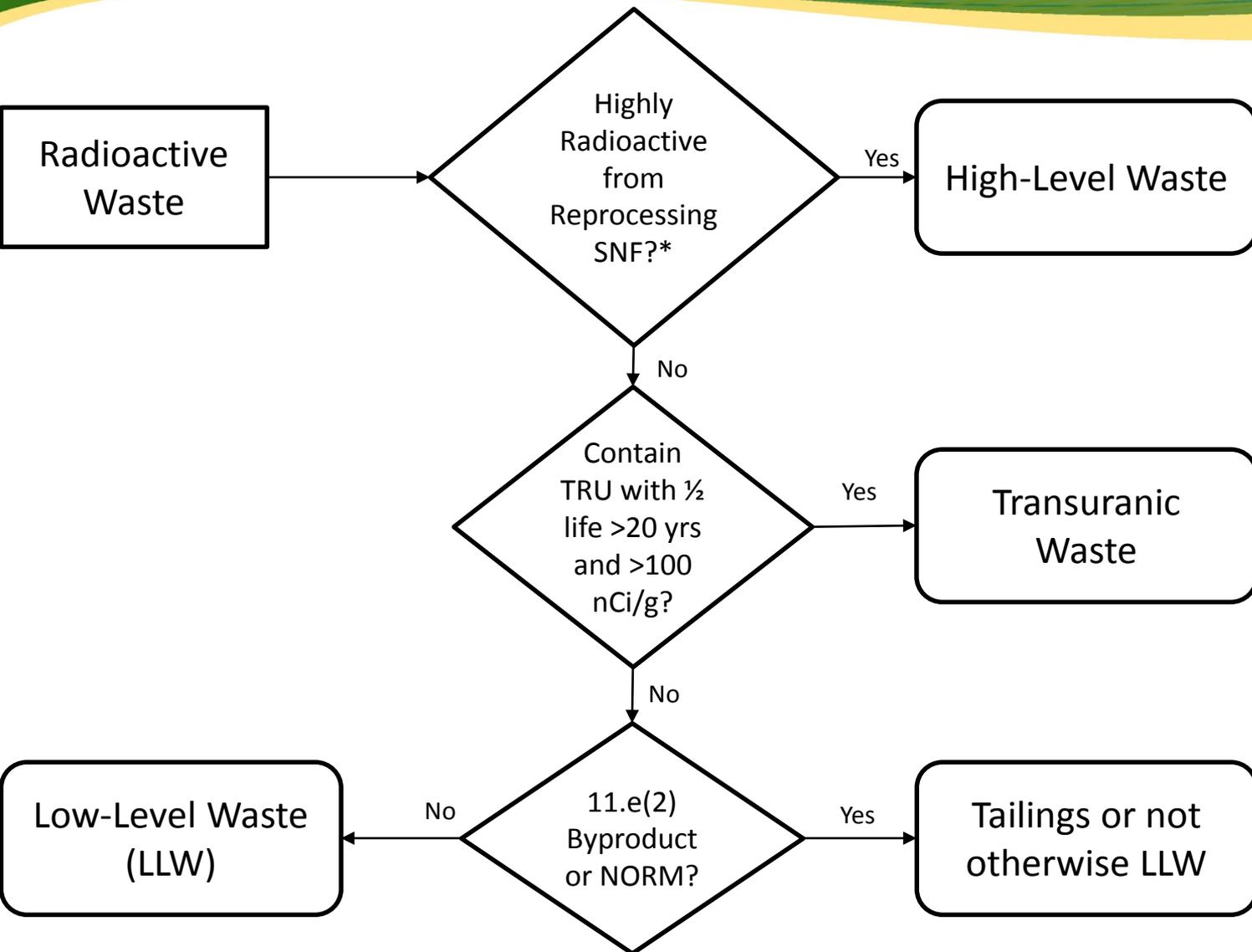


Waste Classification

- Waste is classified at generation for proper management – and on the final waste characteristics prior to disposal
- If waste is separated or treated for stability (e.g., grouting) the classification may change (e.g., TRU waste to LLW or HLW to LLW)



Classification Process



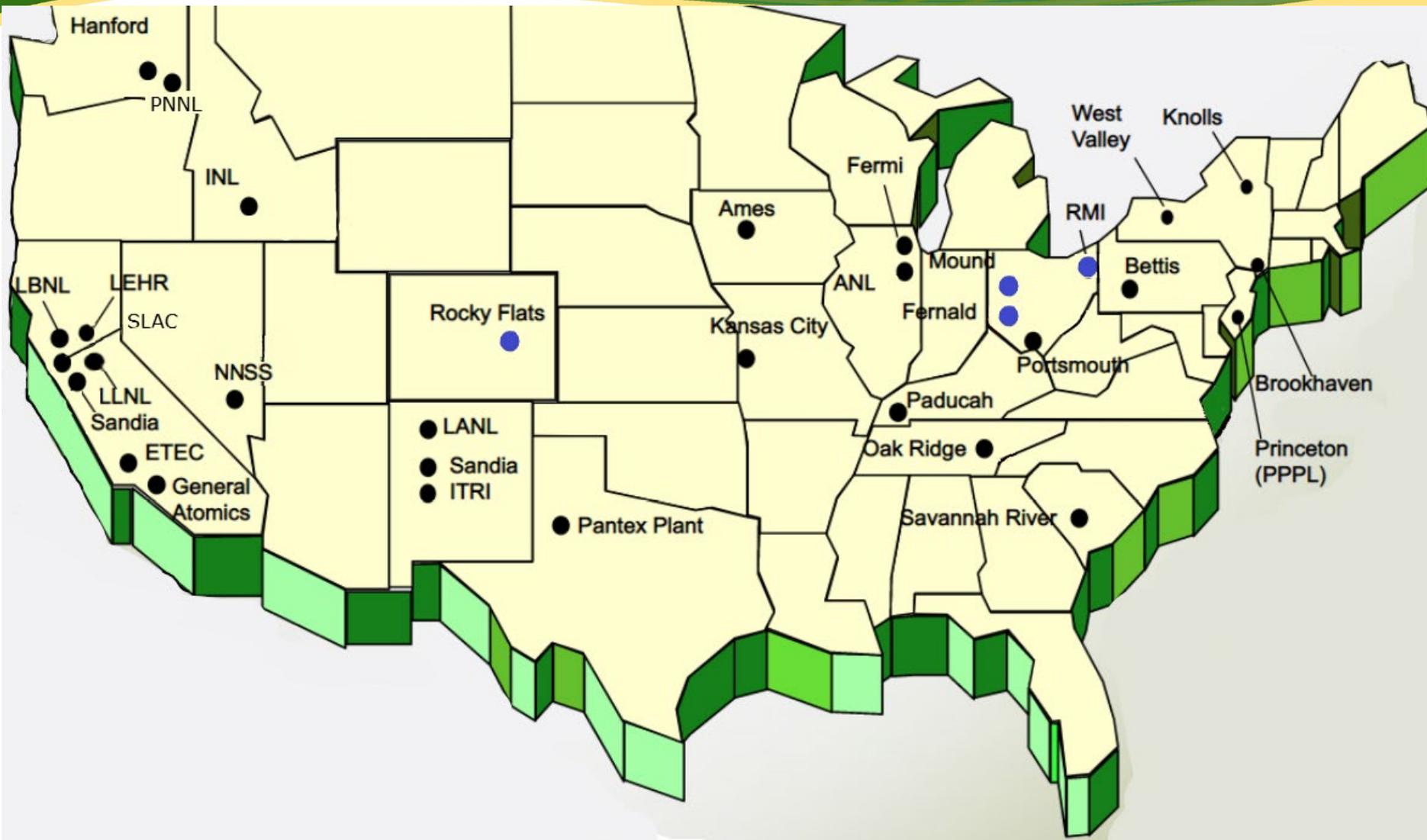
* Abbreviated definition see Slide 7

Life-cycle planning

- Determine generation, treatment, storage, transfer/transportation, and disposal management needs prior to project start
- DOE waste hierarchy for treatment, storage, and disposal
 - On-site
 - Off-site at other DOE facility
 - Off-site commercial facility (requires FEM approved exemption)
- Waste streams with no disposal path
 - Approval from FEM in RWMB needed prior to generation
 - Why must you generate it?
 - How will you safely store it?
 - What are you doing to get it disposed?

Waste Generator Sites

Past and Present



Blue - Closed facility

Receiving facilities must have:

- waste acceptance requirements to safely manage waste
 - Receipt, evaluation and acceptance requirements
 - Testing, receipt inspections, paperwork reviews, etc.
 - Allowable activities and/or concentration of specific radionuclides
 - Acceptable waste form and/or container requirements
 - Exceptions, restrictions or prohibitions
 - May include EPA, DOT and host State requirements
- Non-conforming waste disposition process
 - Segregation from acceptable waste, notifications, disposition methods

- Receiving facility must authorize waste transfer
- Transportation costs are a significant consideration
- Minimize volume and number of shipments



LLW Storage Limit

One-year storage limit

Longer periods allowed if storage for decay and/or authorized by RWMB

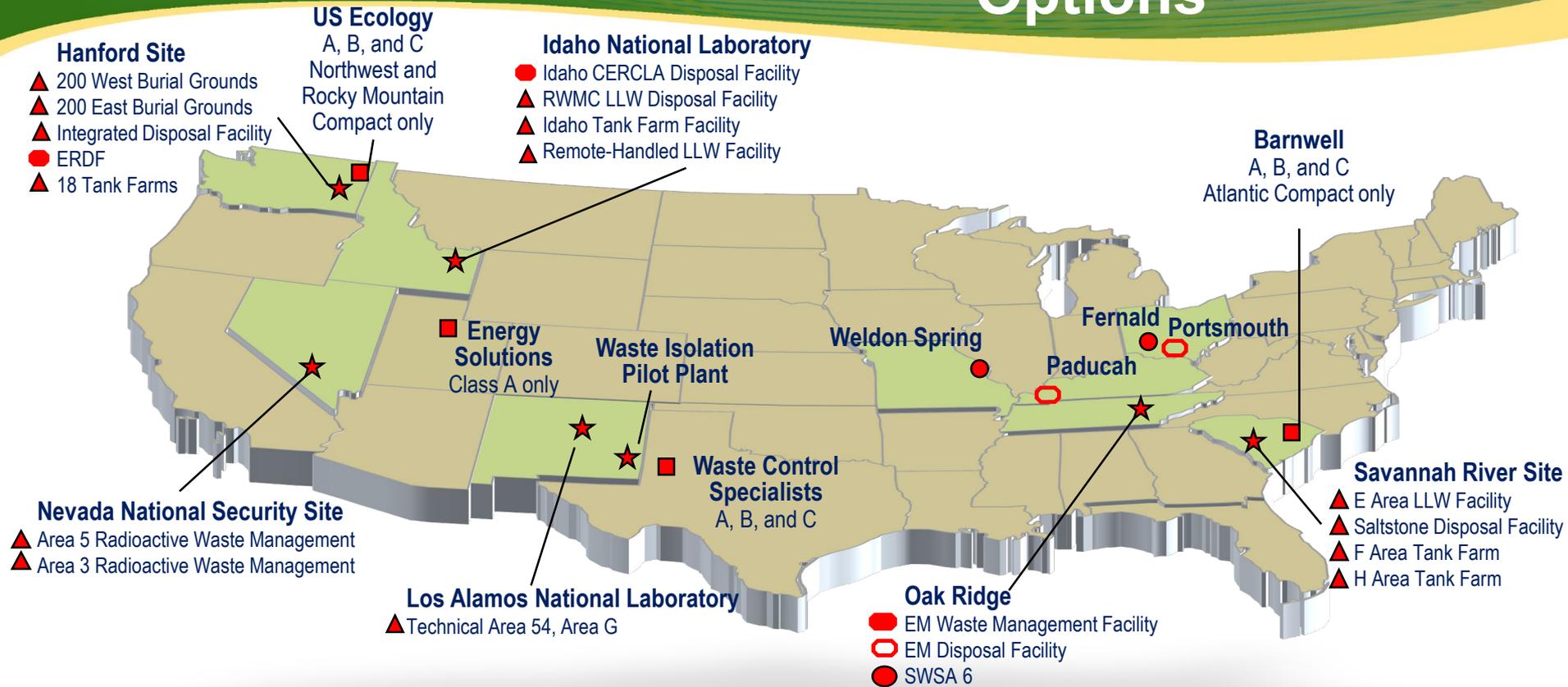
Staging

< 90 days waste accumulation for transportation, treatment, and/or disposal



- LLW disposal facilities are sited, designed, operated, maintained, and closed so that a **reasonable expectation** exists that mandated performance objectives will be met.
- Various technical basis documents are used to provide the reasonable expectation of performance. For Example:
 - Performance Assessment
 - Composite Analysis
 - Monitoring Plan
 - Maintenance Plan
 - Closure Plan
- DOE-STD-5002-2017, *Disposal Authorization Statement and Tank Closure Documentation* provides guidance on technical basis documents content, format, and review criteria.
- Disposal Authorization Statement – Authorization to dispose issued from EM HQ

DOE and Commercial Disposal Options



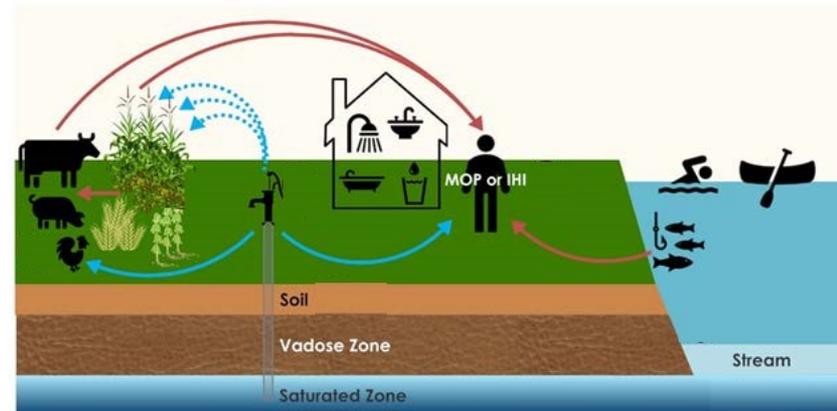
Facilities

- Existing CERCLA Disposal Facility*
- Proposed CERCLA Disposal Facility
- ▲ LLW Operations Disposal Facility/Tank Farm Closure
- Closed Disposal Facility
- Commercial LLW Disposal Facility

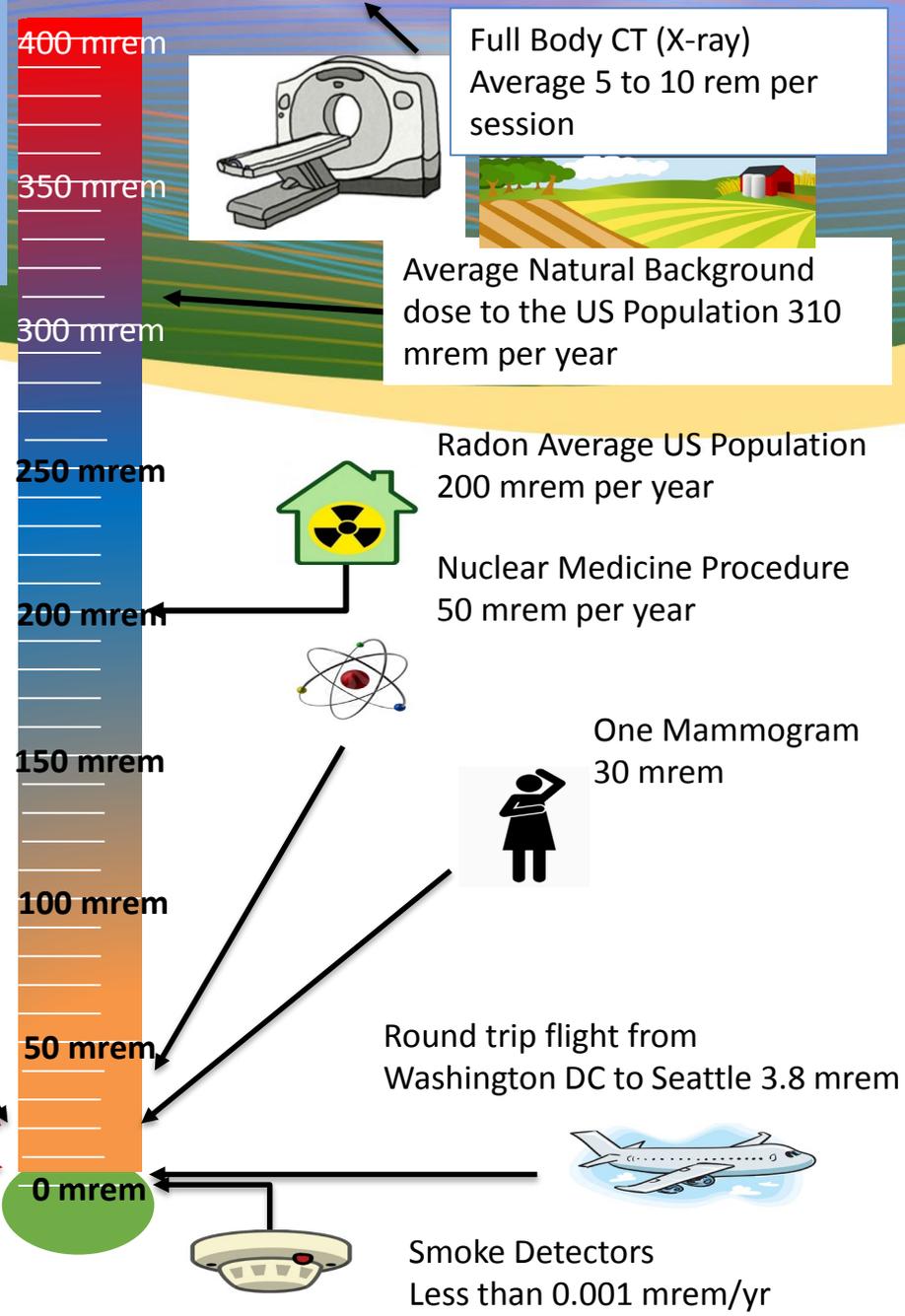
*Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

<https://www.epa.gov/superfund/superfund-cercla-overview>

- Three performance objectives:
 - All pathways of exposure – not exceed 25 mrem in a year (groundwater, surface water, air, but excludes radon)
 - Air pathway of exposure – not exceed 10 mrem in a year (based on NESHAP)
 - Radon - less than an average flux of 20 pCi/m²/sec at the disposal facility surface or 0.5 pCi/liter at facility boundary
- CERCLA facilities must meet substantive requirements of Order; must demonstrate compliance with dose requirements



Relative Doses from Radiation Sources



DOE/NRC Standard for the General Public
100 mrem per year

Normal Cosmic Radiation at Piketon, OH
28 mrem per year



DOE/NRC Standard for Decommissioning sites
25 mrem per year



EPA/ dose limit for Air Releases- 10 mrem per year



Sources: <https://www.epa.gov/radiation/radiation-sources-and-doses>
<https://www.nrc.gov/about-nrc/radiation/around-us/calculator.html>
 Mettler Jr, Fred A., et al. "Effective doses in radiology and diagnostic nuclear medicine: a catalog." Radiology 248.1 (2008): 254-263.

TRU Waste Management and Disposal

- Since concentration-based standard – TRU waste determination made at the time of waste certification and waste transfer
 - Treatment may change the waste category
- Defense determination required for WIPP disposal
- Central Characterization Project (CCP) provides characterization and certification at the generator sites
- RCRA Land Disposal Restriction (LDR) treatment standards **DO NOT** apply if waste is disposed at WIPP
- Transport to WIPP must be in NRC approved Type-B package
- WIPP only accepting Contact-Handled TRU (no Remote-Handled)
 - Current forecast to resume accepting Remote-Handled waste in ~ 2025

Pre-1970 Transuranic (TRU) Waste

1970 AEC Immediate Action Directive required sites to retrievably store suspect TRU waste. TRU waste disposed prior to 1970 is not subject to DOE O 435.1.



TRU wastes generated as part of an environmental remediation effort, regardless of when they were buried, are subject to regulation by DOE O 435.1.



- DOE has self-regulating authority for radioactive materials and waste
- DOE Order 435.1 and Manual 435.1-1 implement the authority
 - Oversight at the Headquarters and Field level
- Waste types are defined by source, concentration, and what they are not (HLW, TRU waste, and LLW)
- Radioactive Waste Management Basis – Authorization to operate approved by FEM
- Disposal Authorization Statement – Authorization to dispose issued from EM HQ
- Radioactive Waste planning, generation, characterization, classification, storage, treatment and disposal requirements

Questions?

