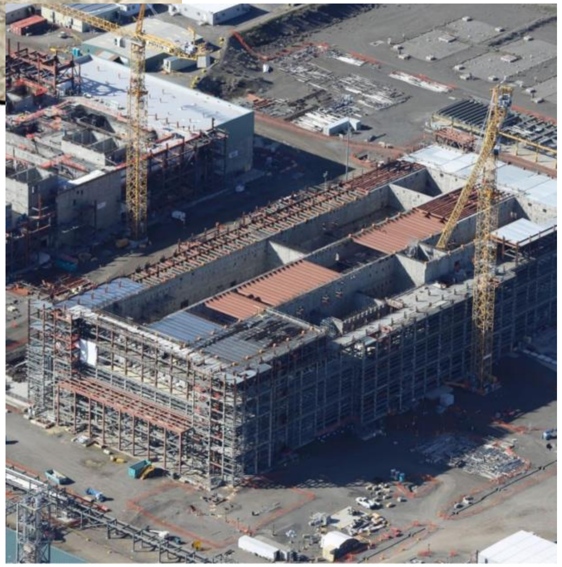
Hanford Tank Wastes

Recent Items of Interest



Jeff Burright
Radioactive Waste Remediation Specialist

OREGON DEPARTMENT OF ENERGY

Topics to cover

- Waste Treatment Plant Status and Analysis of Alternatives
- VLAW WIR
- TSCR Startup and DFLAW
- Test Bed Initiative
- HLW Definition
- Leaking Tank
- NAS study

Hanford's Tank Waste – 54,000,000 gallons of high-level waste

149 "single-shell" tanks

- ✓ Built 1944-1964
- ✓ Oldest tank has held waste for 73+ years

28 "double-shell" tanks

- ✓ Built 1968-1986
- ✓ Newest tank has held waste for 30+ years

Hanford's Tank Waste – 54,000,000 gallons of high-level waste

149 "single-shell" tanks
(28.5 million gallons)

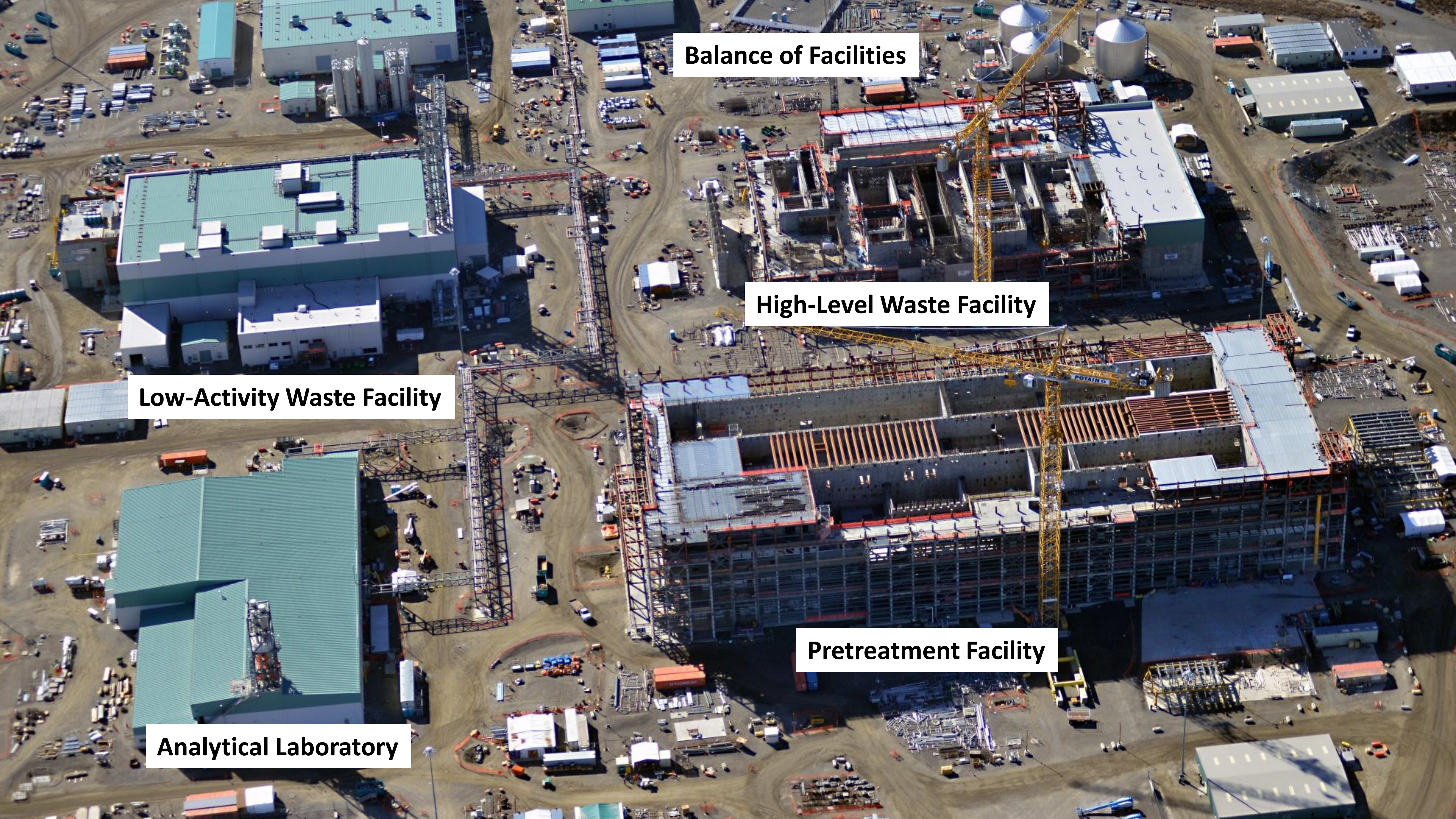
- ✓ 55,000 to 1,000,000 gallon capacity
- ✓ 67 known or suspect leaking tanks – ~~one~~ **two actively leaking to the soil**
- ✓ 17 tanks mostly emptied

28 "double-shell" tanks
(25.5 million gallons)

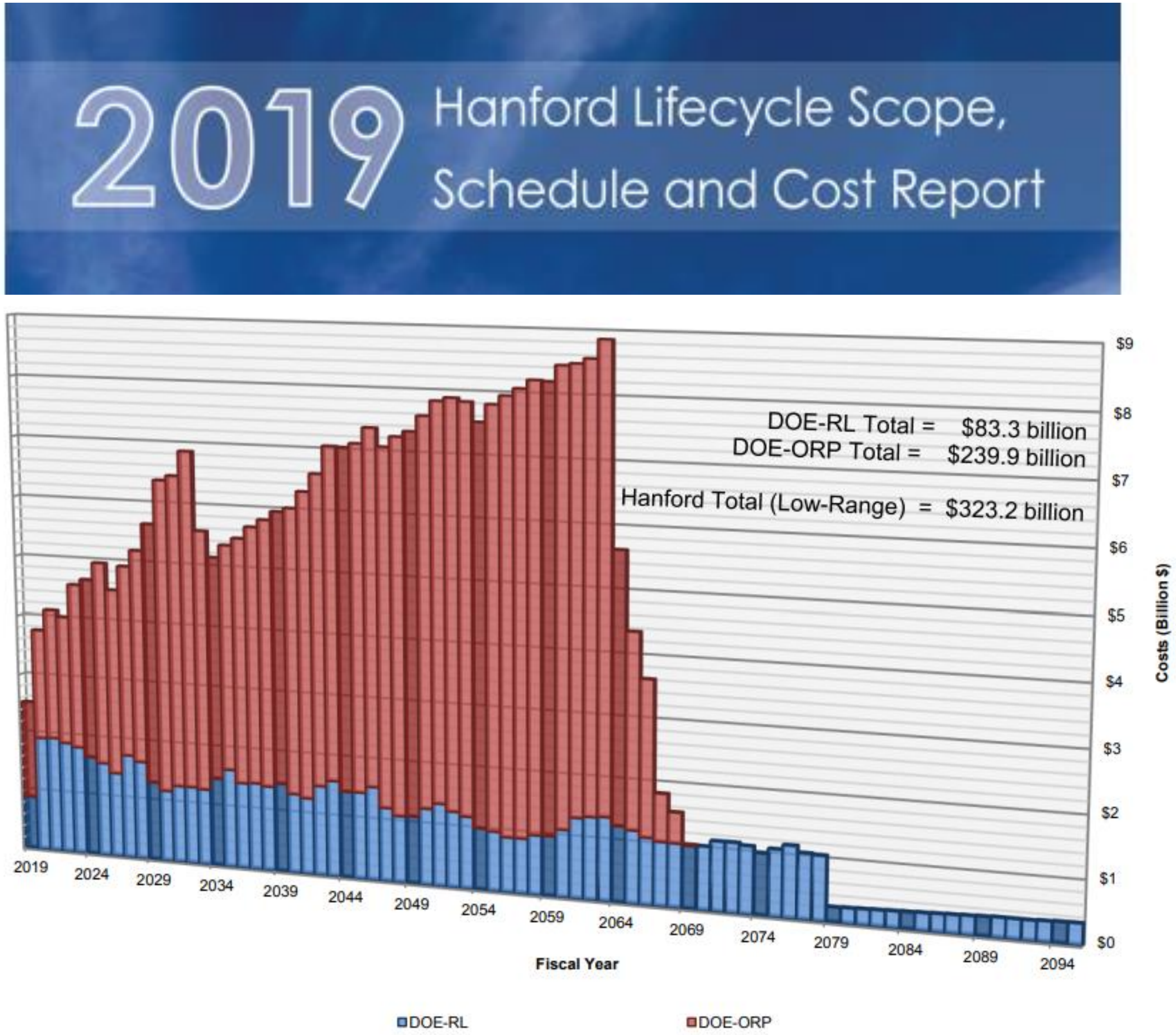
- ✓ 1,000,000 to 1,257,000 gallon capacity
- ✓ One out of service after actively leaking into containment

Waste Treatment Plant Status

Analysis of Alternatives and Holistic Negotiations


Balance of Facilities
High-Level Waste Facility
Low-Activity Waste Facility
Pretreatment Facility
Analytical Laboratory

Current cleanup path under threat



$323.2 billion to $677 billion*

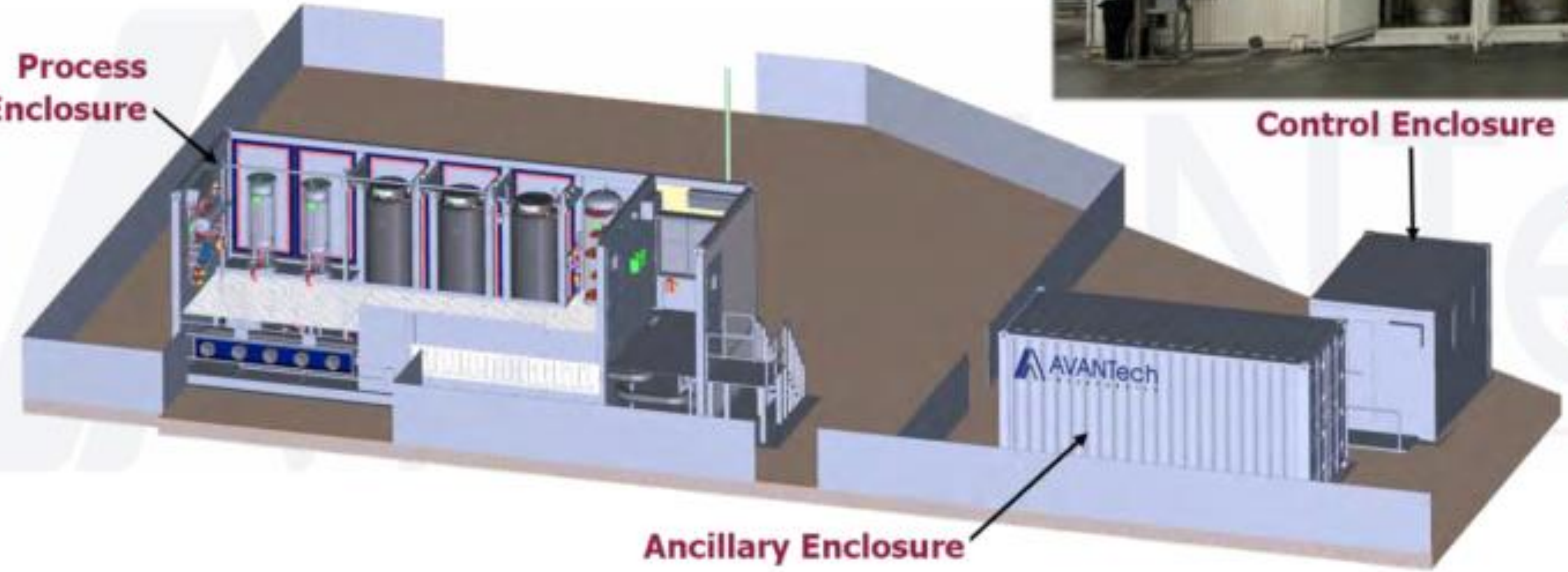
cleanup complete 2078 to 2102

Vitrified Low Activity Waste
Waste Incidental to Reprocessing
(VLAW WIR)

Tank Side Cesium Removal (TSCR)

Tank Side Cesium Removal (TSCR) System at Hanford

- Process Metrics
  - ✓ Filtration/ Ion Exchange
  - ✓ CST ion exchange media for Cs/ Sr Removal
  - ✓ Simple materials handling (IXC's, filters)



- ✓ Very high levels of radioactivity
- ✓ Single use ion exchangers stored onsite until disposal site identified

Test Bed Initiative

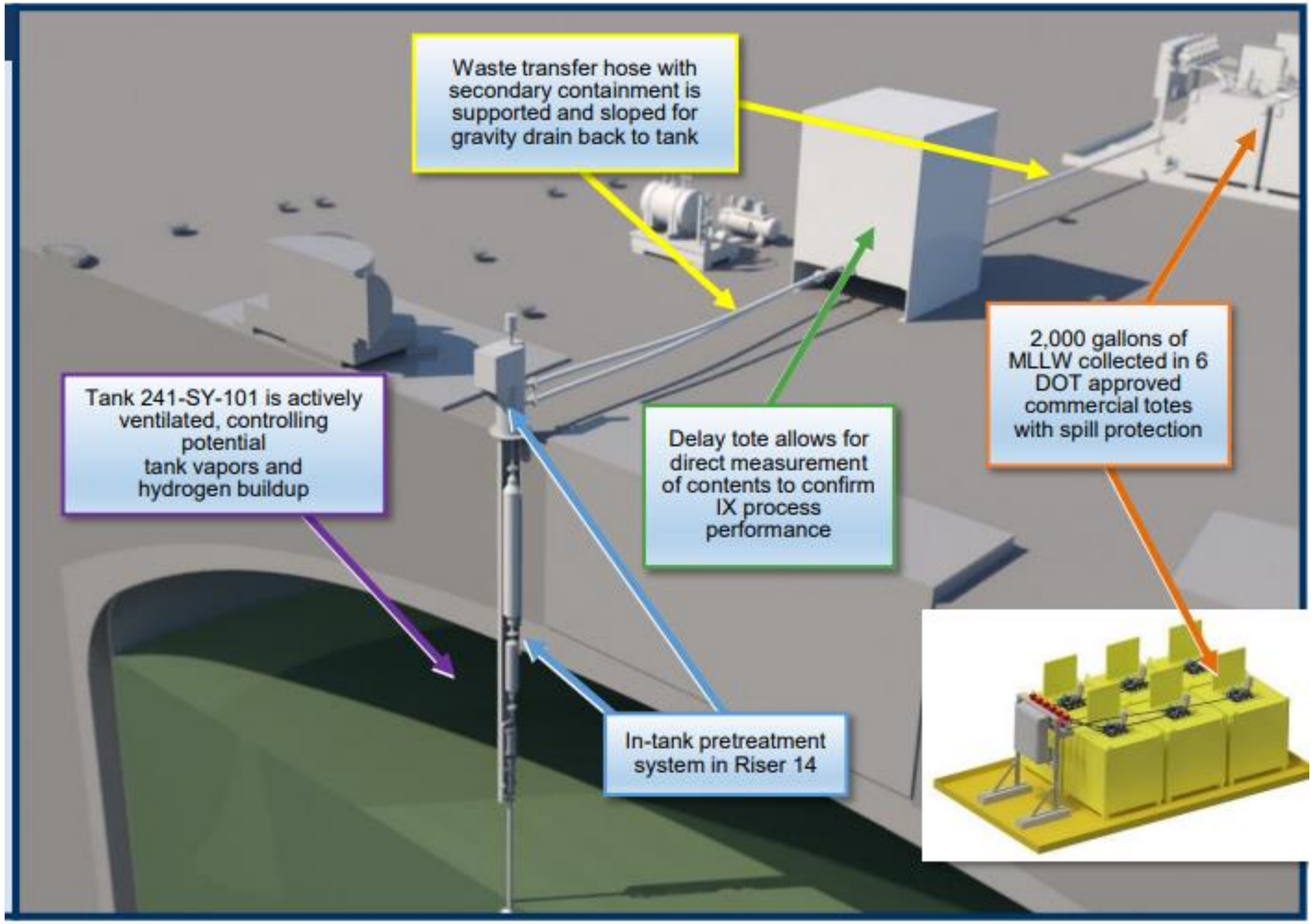
Test Bed Initiative

- First phase in 2017 sent 3 gallons of grouted tank waste to offsite disposal.
- Second phase kicked off **July 2021** with Environmental Assessment
  - Proposal is 2,000 gallons
- Third phase currently not planned
  - Proposal is up to 500,000 gallons

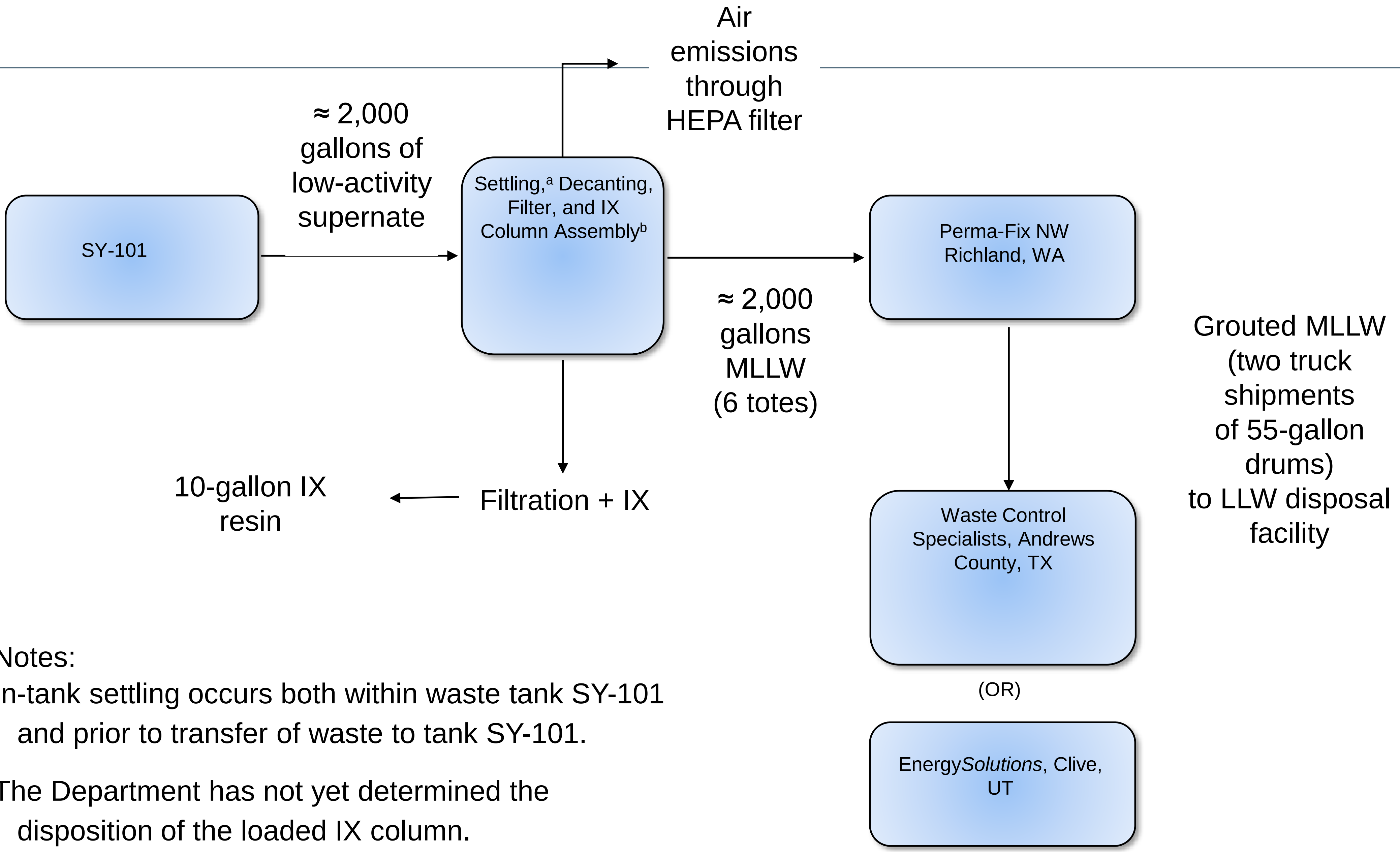
OREGON DEPARTMENT OF ENERGY

Test Bed Initiative Phase 2

- Purpose is to prove engineering, legal, and policy aspects of tank waste treatment, reclassification, and offsite disposal in grout.
- Proposes a single-use in-tank treatment system.



OREGON DEPARTMENT OF ENERGY



Notes:

In-tank settling occurs both within waste tank SY-101 and prior to transfer of waste to tank SY-101.

The Department has not yet determined the disposition of the loaded IX column.

OREGON DEPARTMENT OF ENERGY

How to reclassify* high-level waste

Is this high-level waste?

Retrieved sample from a WMA-C tank

Does it <u>result from</u> reprocessing spent nuclear fuel?

Yes

Then it is high-level waste.

Unless . . .

Can it meet criteria, developed by DOE and NRC, to demonstrate that it <u>would not pose an unacceptable risk</u> if managed as low-level or Transuranic waste?

No

Then it's still High-Level Waste.

Yes

Then it is **Waste Incidental to Reprocessing** and does not require deep geologic disposal.

OREGON DEPARTMENT OF ENERGY

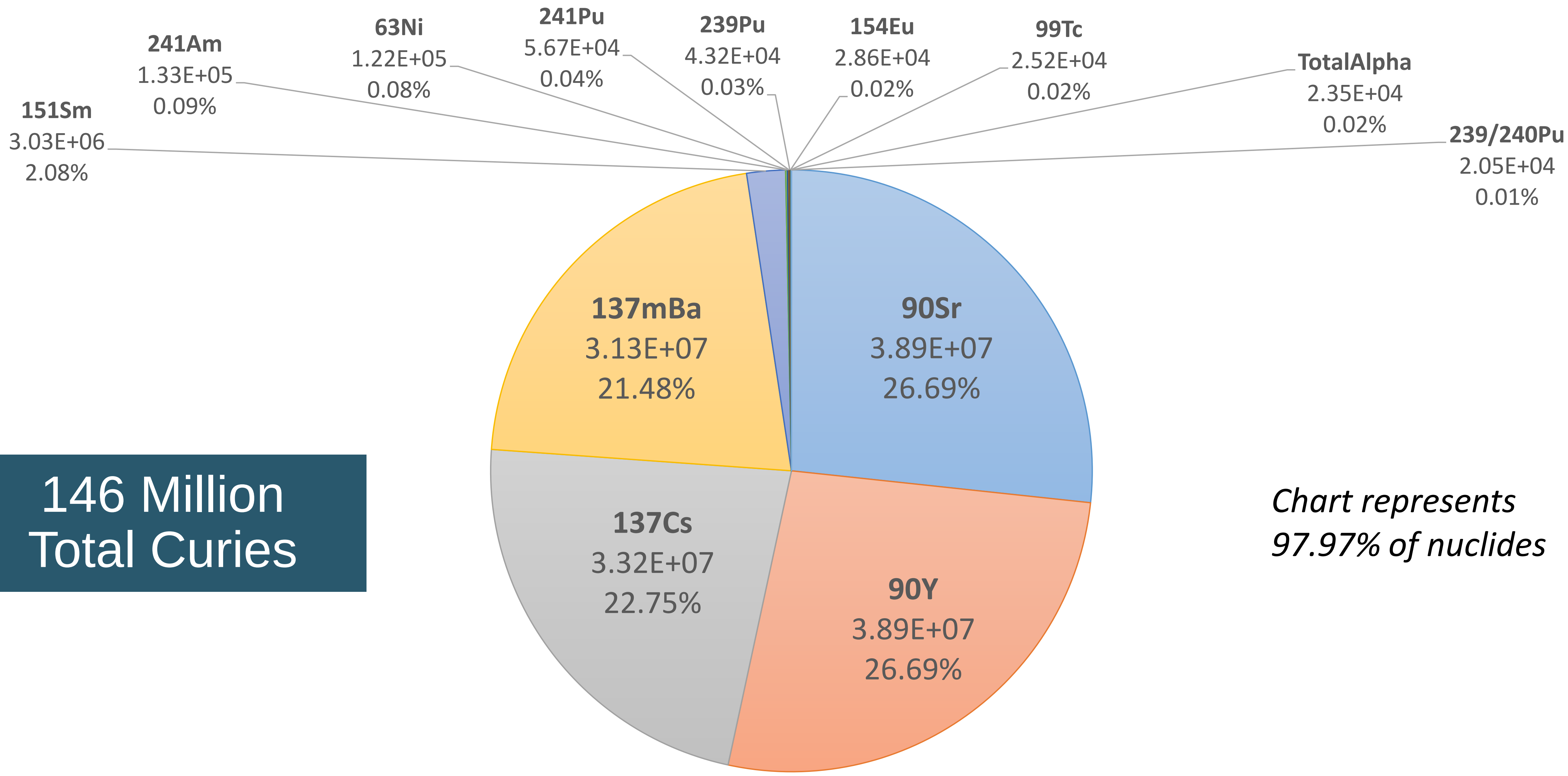
Waste Incidental to Reprocessing (WIR) Criteria

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, Performance Objectives; and
3. Are to be managed, pursuant to DOE's authority . . . provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55 . . .

OREGON DEPARTMENT OF ENERGY

Source: DOE M 435.1-1 – Chapter II, Section B (2)

Tank radionuclides (curies)

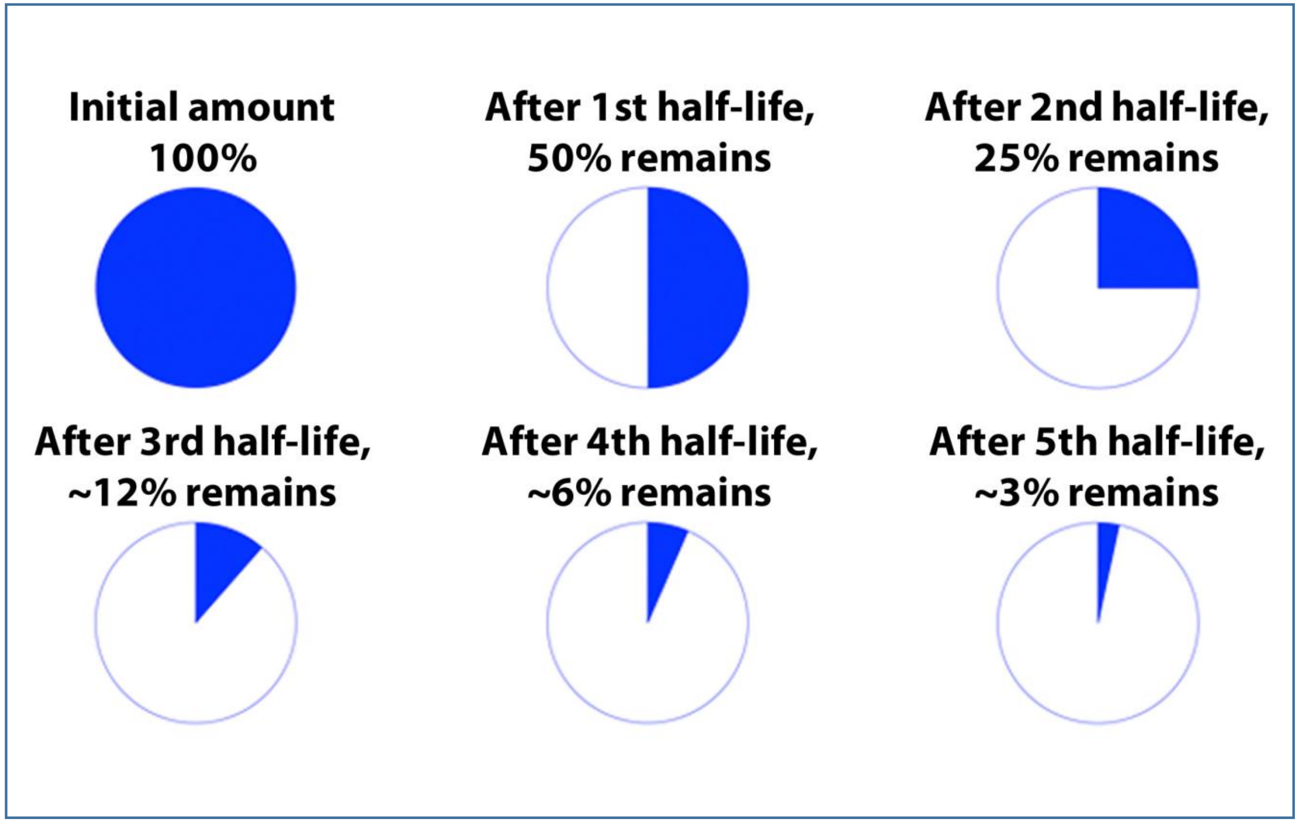


146 Million
Total Curies

Chart represents 97.97% of nuclides

Half Lives (in Years)

Strontium-90	29
Cesium-137	30
Samarium-151	90
Plutonium-239	24,100
Technetium-99	211,000
Iodine-129	15.7 million



High Level Waste Definition Interpretation

HANFORD

Feds say some **Hanford** radioactive waste is not so dangerous. **Oregon** disagrees

JANUARY 7, 2019, 7:28 PM

HANFORD

State and top fed official at odds over Hanford **high level** radioactive **waste**

JUNE 26, 2019, 5:32 PM

HANFORD

Congressman blocks **DOE** from reclassifying high level Hanford radioactive waste

JULY 12, 2019, 6:49 PM

HANFORD

Wash. state reverses course on some nasty Hanford nuclear **waste**. Alternative was worse

FEBRUARY 11, 2020, 12:07 PM

HANFORD

'Extraordinary concern.' WA state wants Biden to overturn Trump rule on Hanford nuclear **waste**

FEBRUARY 27, 2021, 5:00 AM

HANFORD

'**Just plain wrong**.' Tri-Cities leaders blast WA state over **Hanford** nuclear waste rule

MARCH 4, 2021, 10:29 AM

EDITORIALS

What's Trump got to do with nuclear waste? Nothing, so don't go there | Editorial

MARCH 5, 2021, 10:54 AM

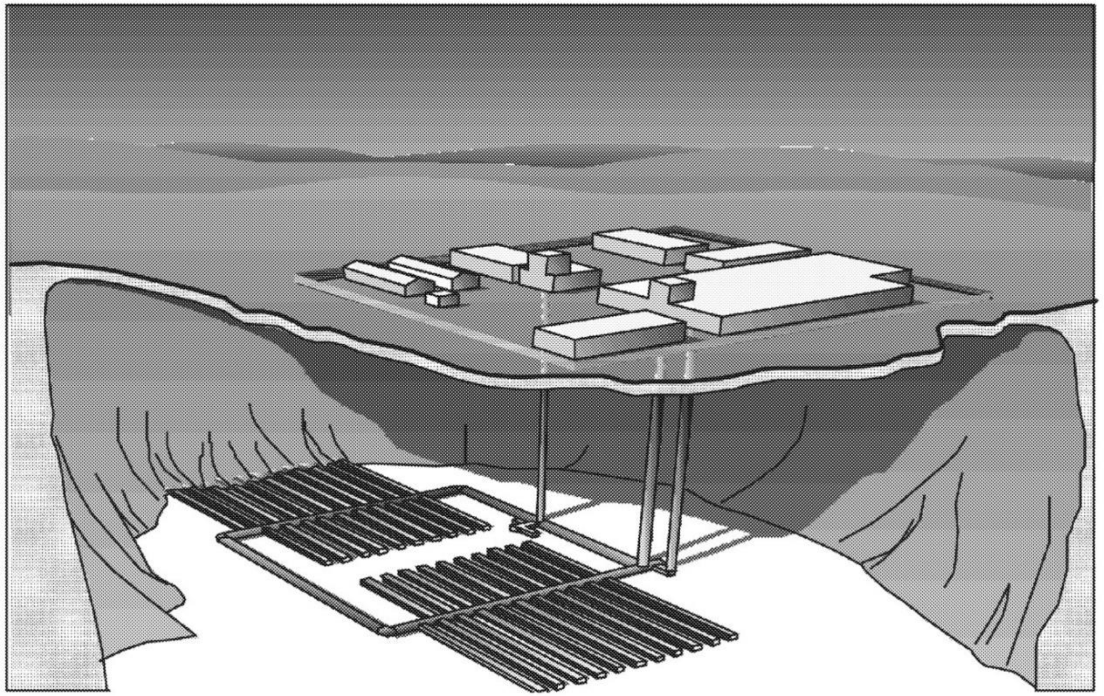
HANFORD

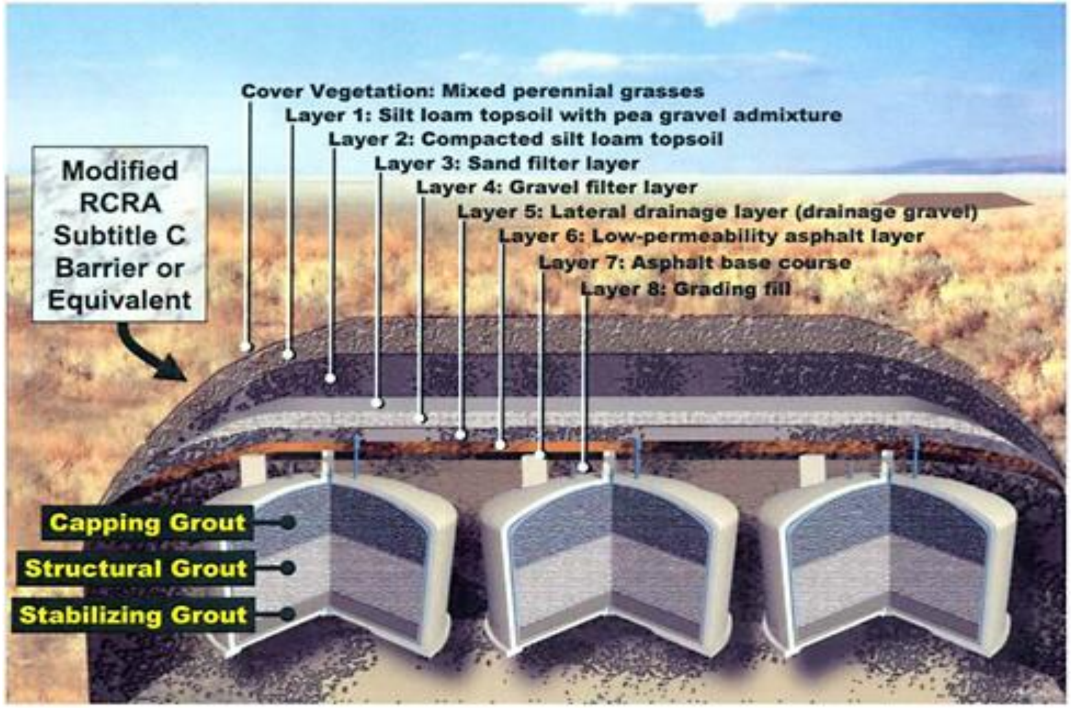
This way to treat Hanford radioactive **waste** could save $210 billion. But is it safe enough?

JANUARY 7, 2021, 12:54 PM

OREGON
DEPARTMENT OF
ENERGY

Why does waste classification matter?



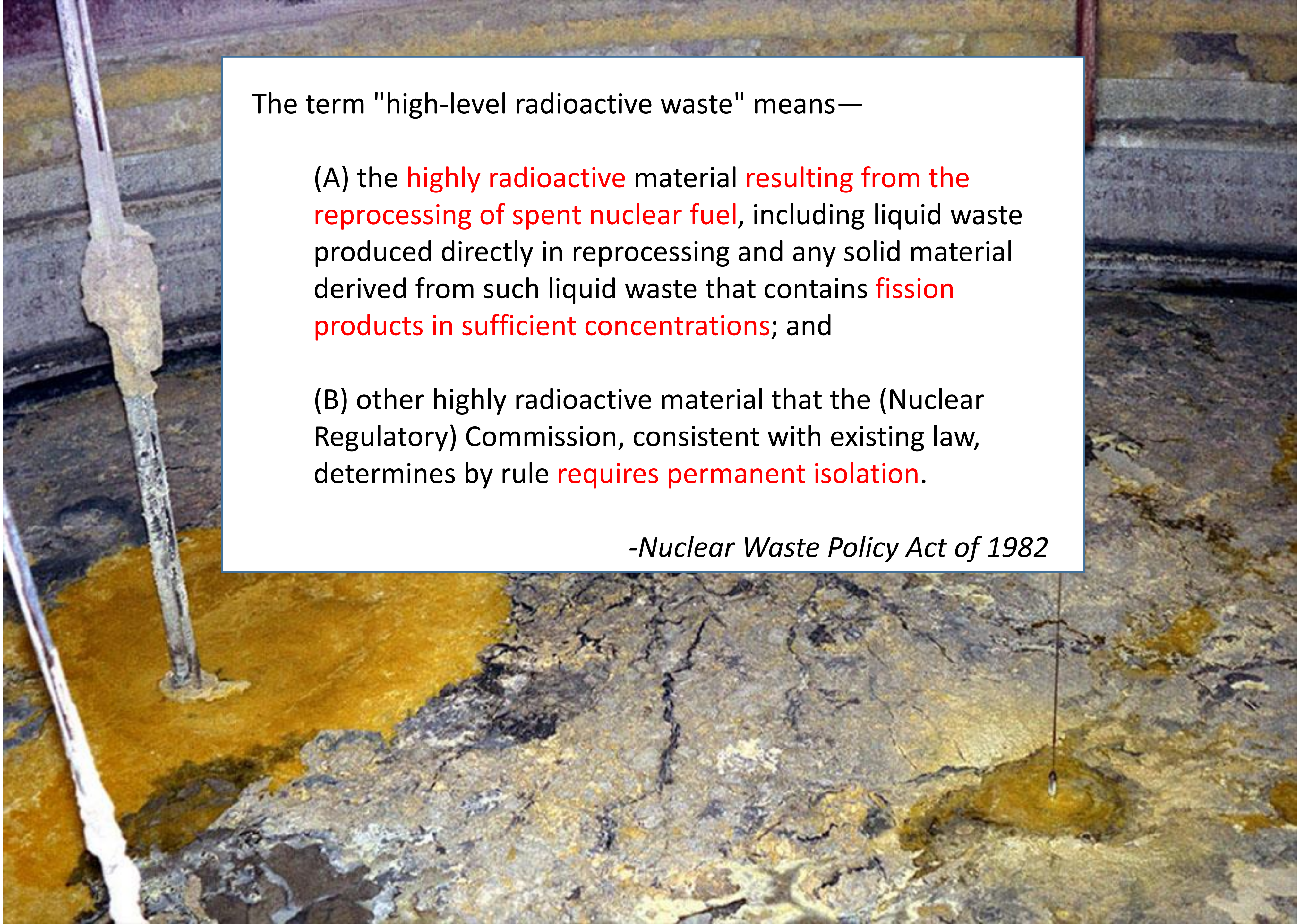


High-level: presumed remedy is **vitrification** and disposal in a **Deep Geologic Repository for HLW**, which does not yet exist in the United States.

Performance modeled to 1 million years.

Low-level: wastes may be disposed in **near-surface environments** depending on facility design and environmental factors.

Performance modeled to 10,000 years with 1,000 year compliance period.



The term "high-level radioactive waste" means—

(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and

(B) other highly radioactive material that the (Nuclear Regulatory) Commission, consistent with existing law, determines by rule requires permanent isolation.

-Nuclear Waste Policy Act of 1982

Waste Incidental to Reprocessing (WIR) Criteria

1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, Performance Objectives; and
3. Are to be managed, pursuant to DOE's authority . . . provided the waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55 . . .

OREGON
DEPARTMENT OF
ENERGY

Source: DOE M 435.1-1 – Chapter II, Section B (2)

Adopted Interpretation June 2019

- (I) does not exceed concentration limits for Class C low-level radioactive waste as set out in section 61.55 of title 10, Code of Federal Regulations, and meets the performance objectives of a disposal facility;

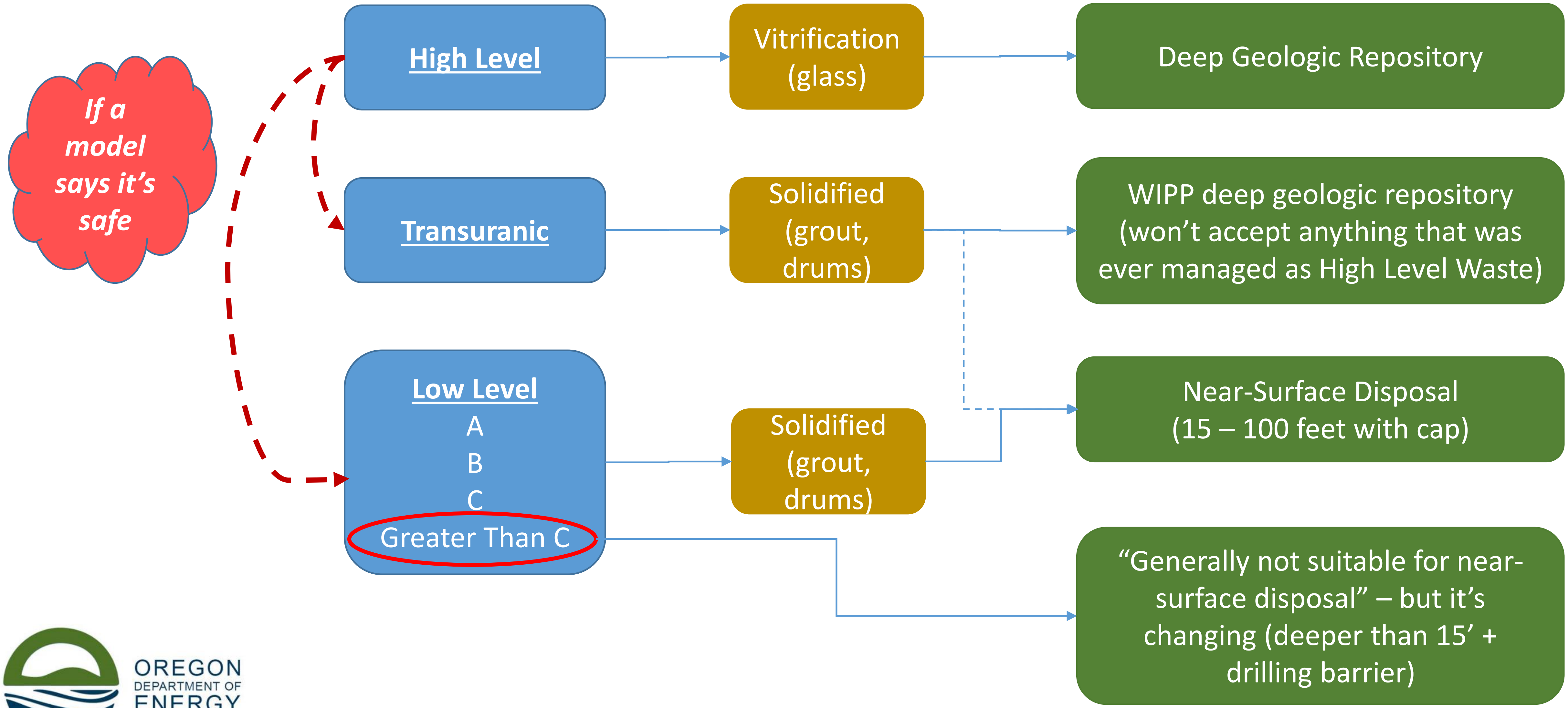
  OR

- (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 ~~regulatory~~ requirements.

Concentration + Model Results for Disposal Facility

Subjective Judgment + Model Results for Disposal Facility

Where does waste go?



OREGON DEPARTMENT OF ENERGY

Oregon's main issues with the HLW definition

If the model rules, who rules the model?

"The burden of proof would be weak indeed if it was simply a matter of DOE convincing itself that it is right."

"A separate federal entity is needed as the regulatory decision maker for exemption purposes."

"Unilateral action seems likely to exacerbate the sense of mistrust that has developed between DOE and at least some of the parties that are its partners in seeking site cleanup."

--National Academies of Sciences, 2005

Oregon's issues with the HLW definition

When is "removal of key radionuclides to the maximum extent practical" a worthwhile precaution?

"It is inefficient to remove more key radionuclides than are required for a disposal facility to accept the waste" (*fit the soup to the bowl*).

Vs.

"If you have imperfect knowledge and want to leave wastes in place (unretrieved tanks? leaks to soil?), a precautionary approach is warranted."

OREGON
DEPARTMENT OF
ENERGY

New Single Shell Tank Leak
B-109

OREGON
DEPARTMENT OF
ENERGY

New Leaking Single-Shell Tank

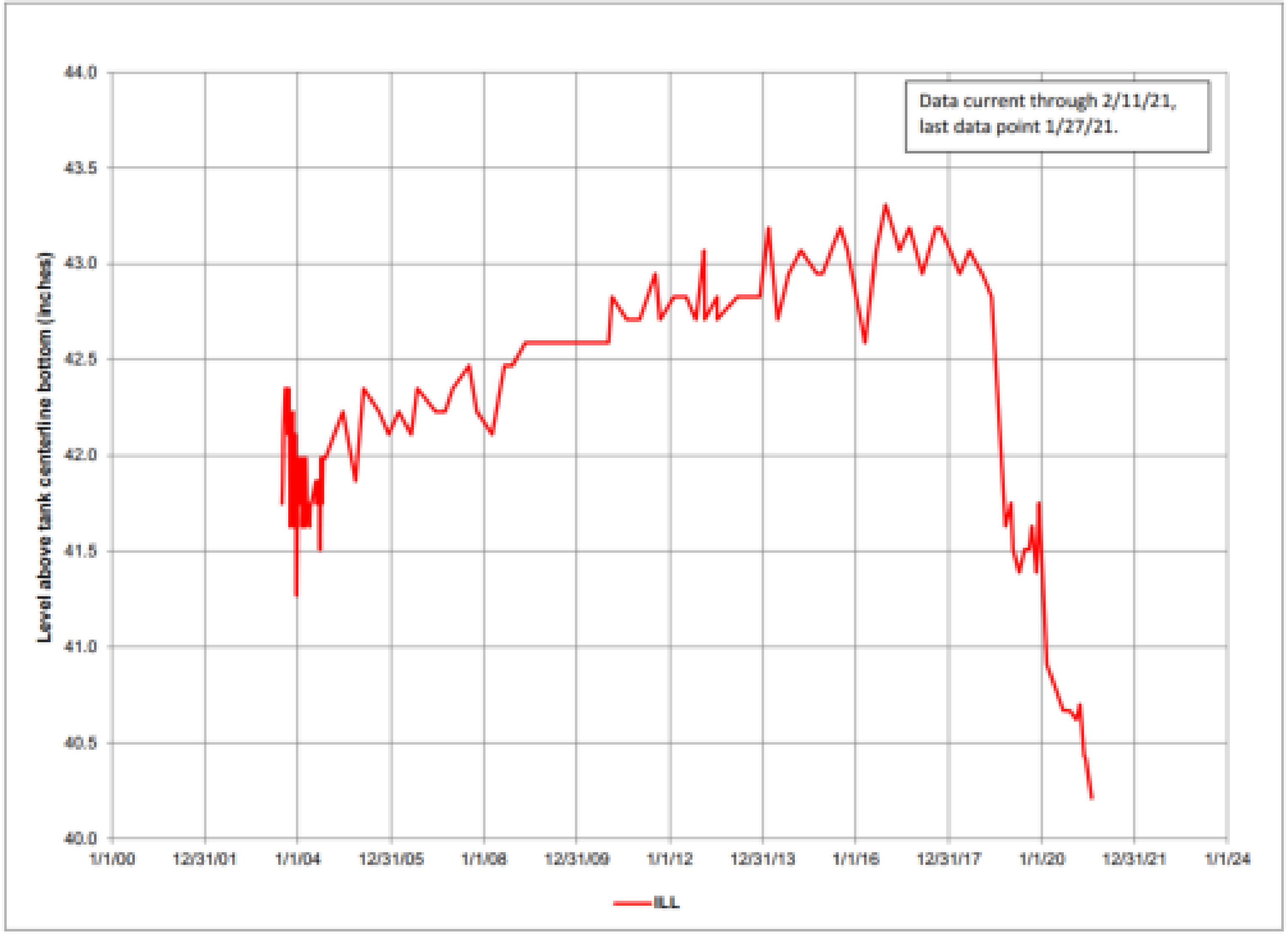


Figure 5-2. Tank B-109 ILL Data Since 2003 LOW Installation

OREGON DEPARTMENT OF ENERGY

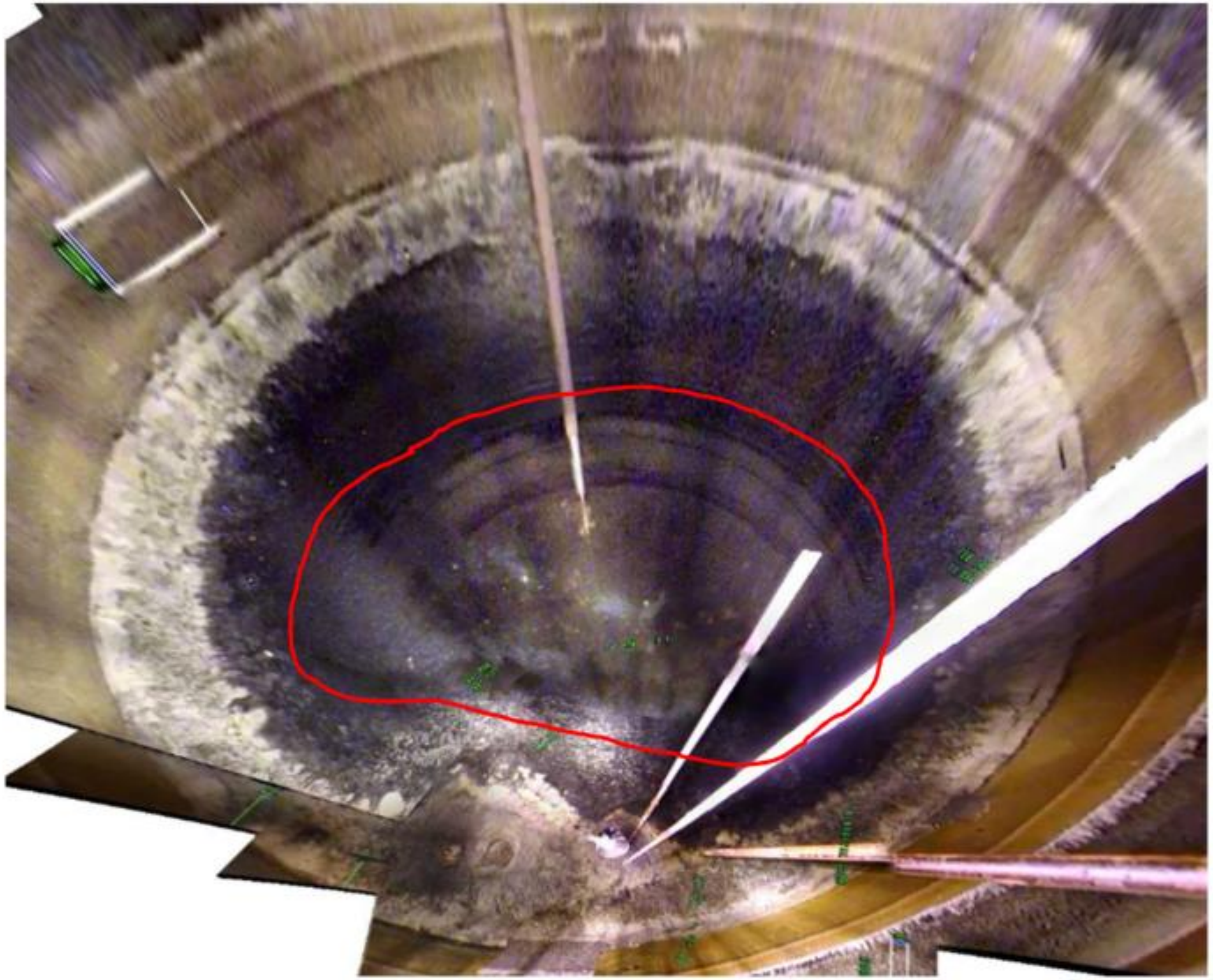


Figure 5-5. Tank B-109 February 11, 2014 Waste Surface Composite View from Riser 2

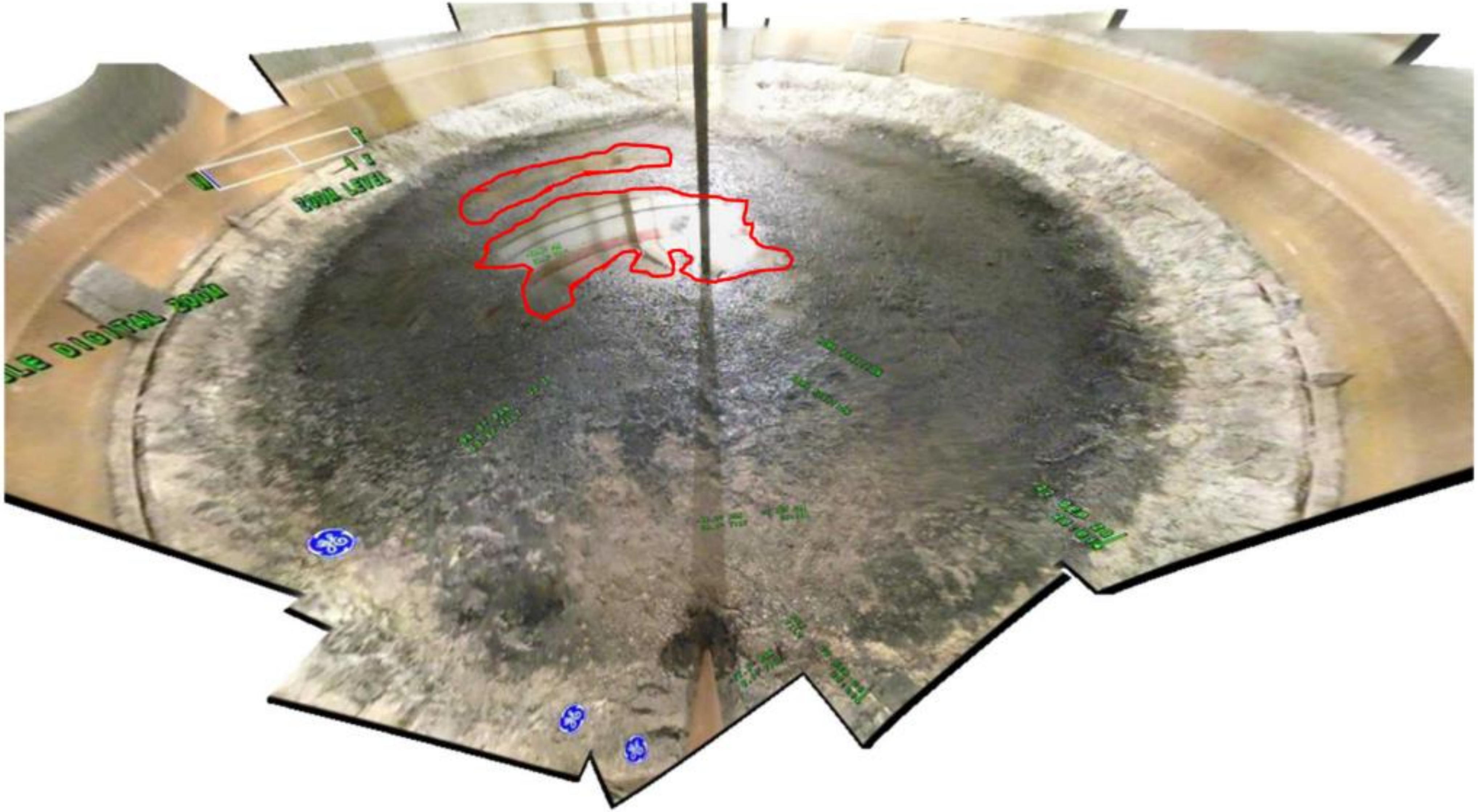


Figure 5-7. Tank B-109 September 22, 2020 Waste Surface Composite View from Riser 7

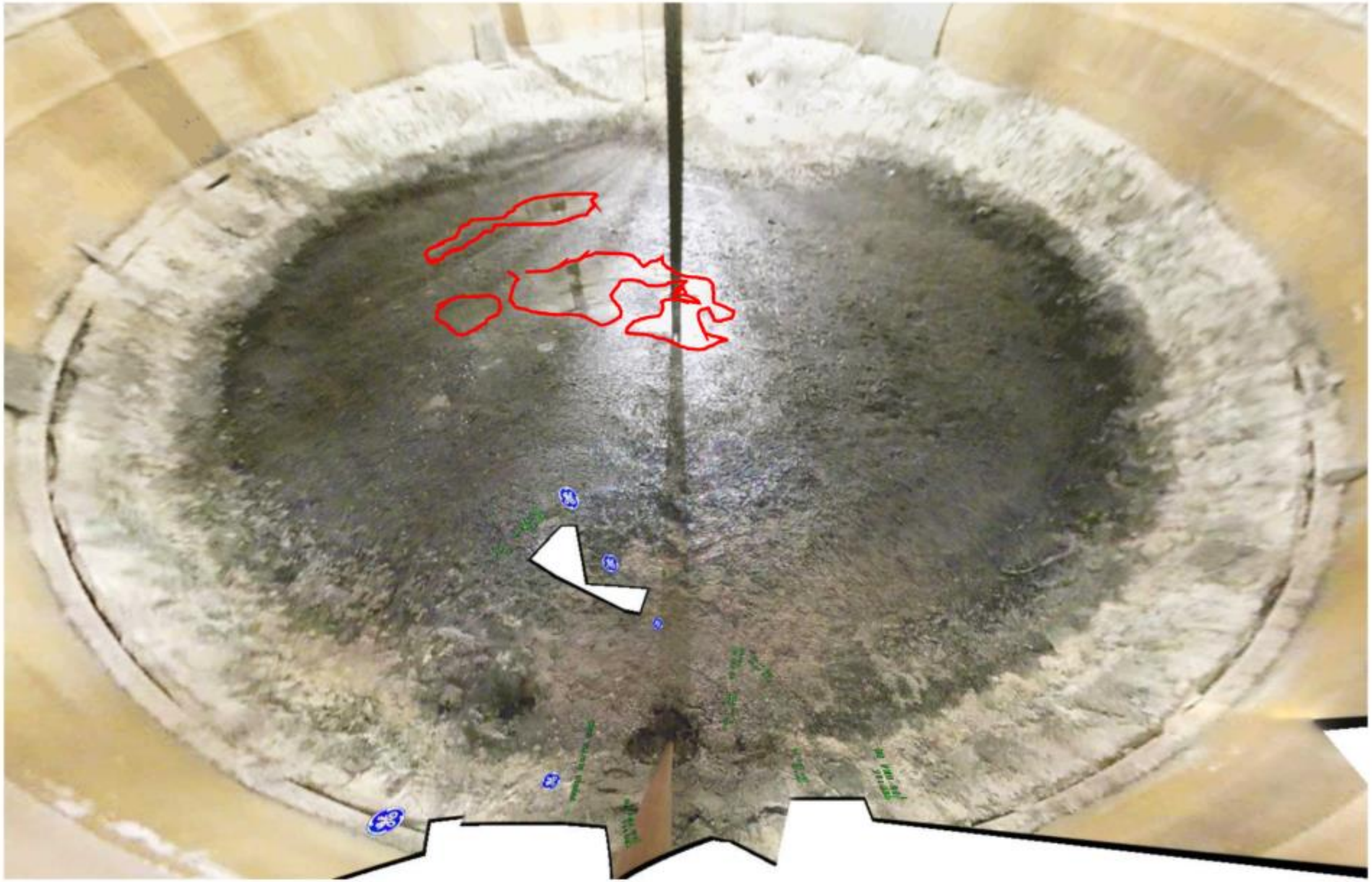


Figure 5-8. Tank B-109 February 5, 2021 Waste Surface Composite View from Riser 7

Figure 5-6. Baseline Case – Single-Shell Tank Retrieval Sequence and Timing.

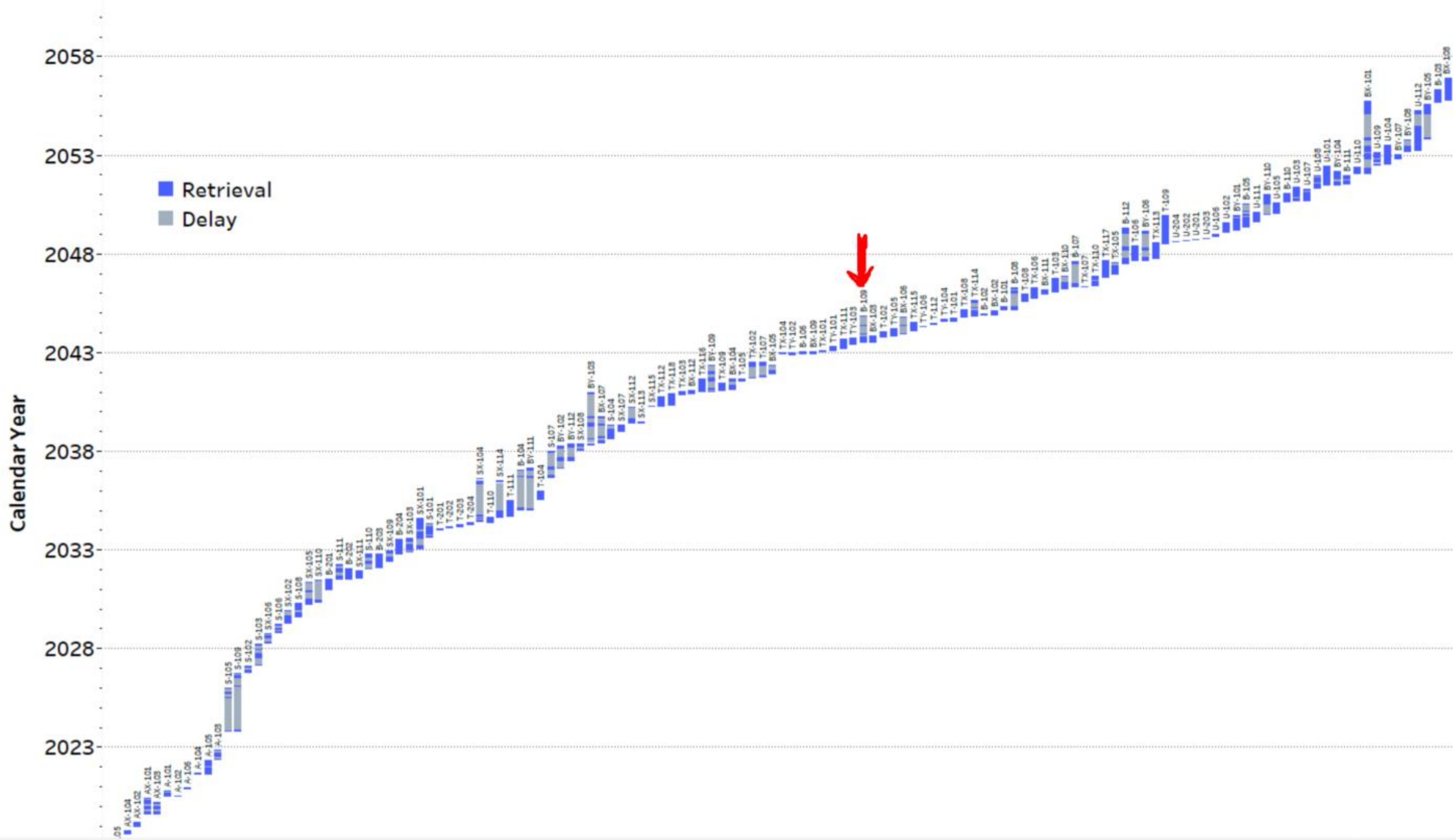


Figure 3-8. Simplified Representation of the Hanford Waste Feed Delivery System.

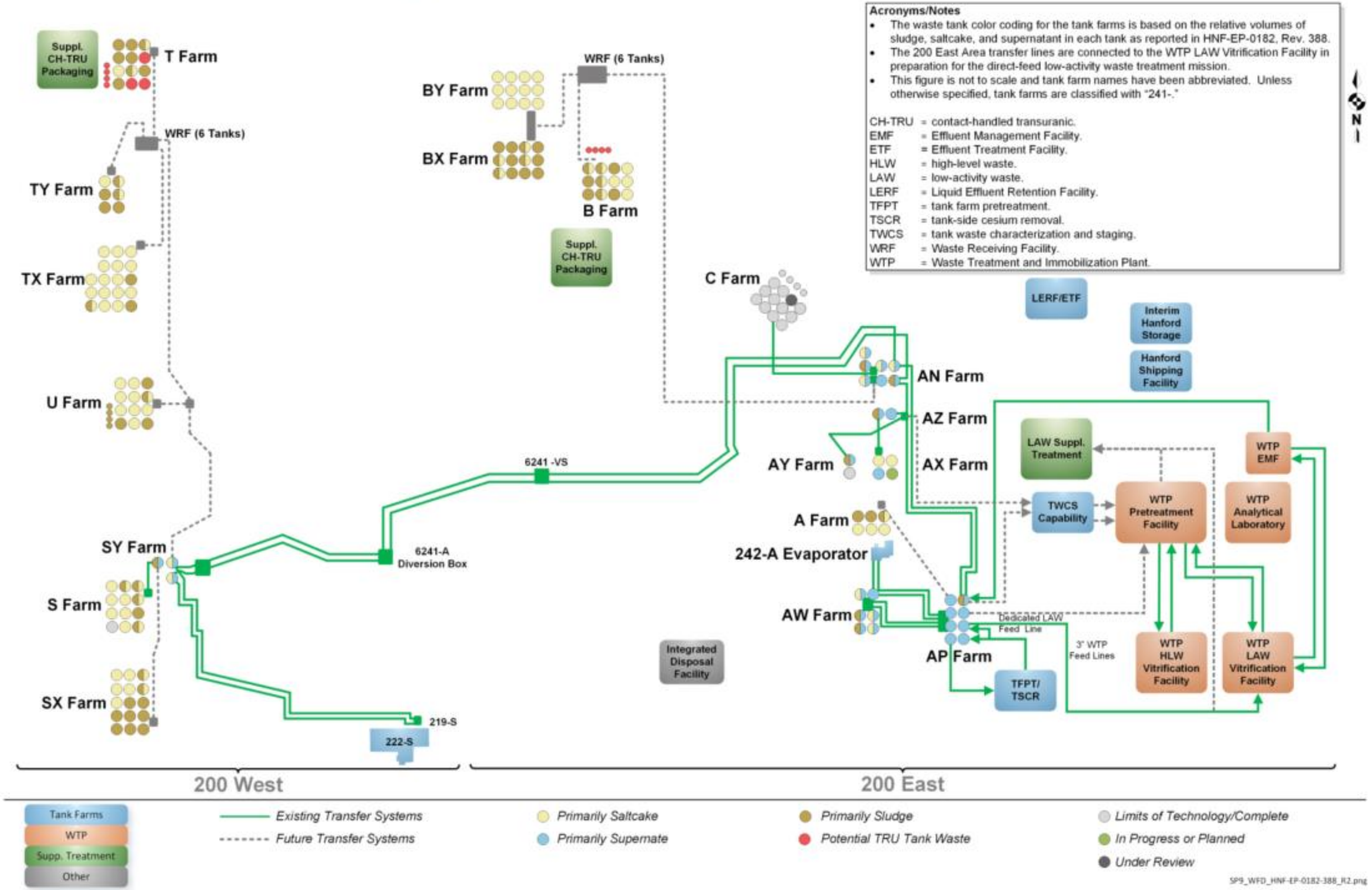
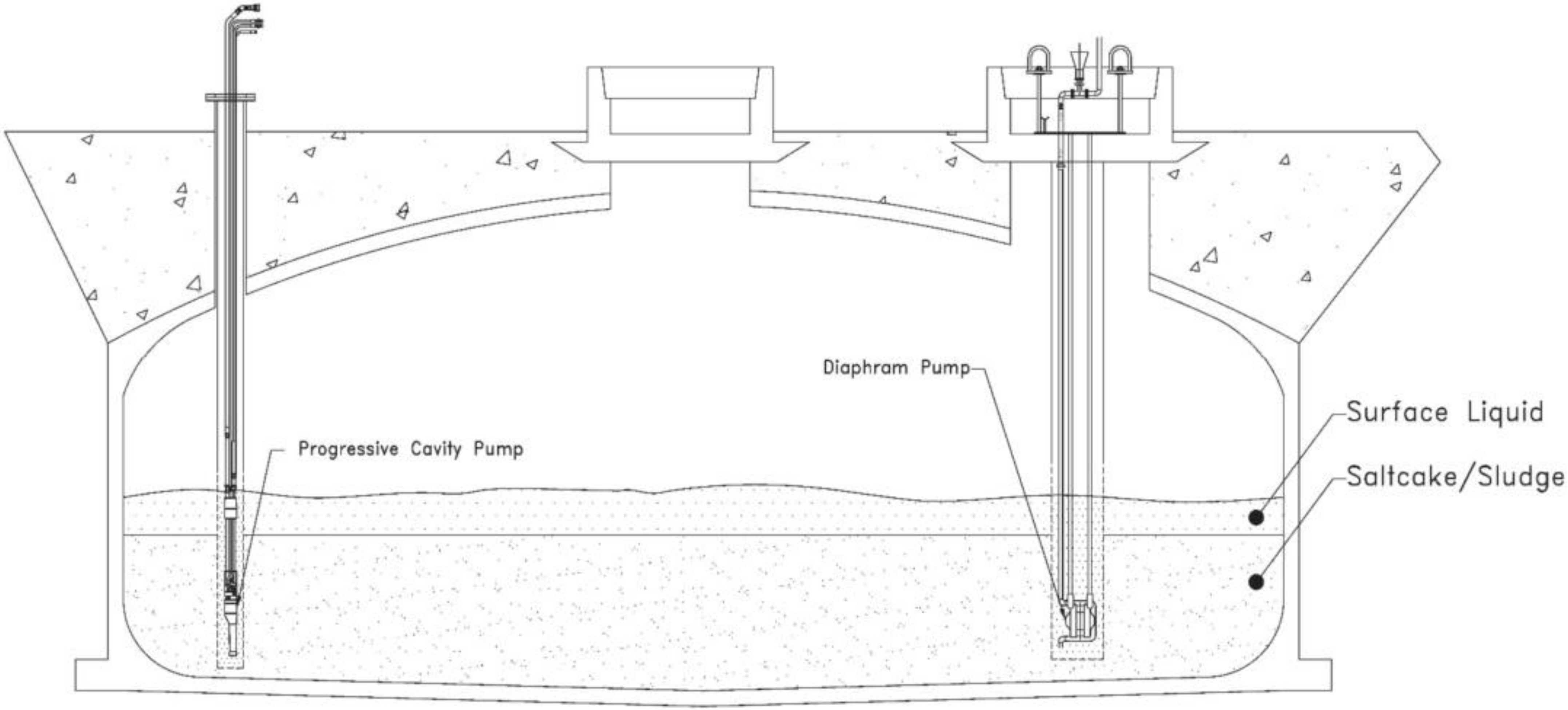


Figure A4-5. Technology 5 – Enhanced Saltwell Pumping.



Main Points of the Draft HAB Advice:

1. Remove leakable liquids from leaking tanks as quickly as feasible.
2. Create a Leak Response Plan for the SSTs (with stakeholder input)
3. Feasibility Assessment for B-109 leak response. Consider all potential options and seek public input.
4. Invest in R&D to increase agility to respond to future SST leaks.
5. Check the soil around tanks sooner in leak assessment processes.
6. Include Ecology and other non-DOE/contractors in the leak assessment process.
7. Explore options to build retrieval infrastructure quicker/earlier.

OREGON DEPARTMENT OF ENERGY

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99354 • (509) 372-7950
711 for Washington Relay Service • Persons with a speech disability can call (877) 833-6341

August 26, 2021 21-NWP-141

Re: Schedule for Corrective Actions for Single Shell Tanks 241-B-109 and 241-T-111

Dear Brian A. Harkins:

The Department of Ecology (Ecology) appreciates the willingness of the United States Department of Energy (USDOE) to work collaboratively with us in developing an Agreed Order (AO). The purpose of the AO is to set out corrective actions and a schedule for responding to the leaking Single Shell Tanks (SSTs) 241-B-109 and 241-T-111.

USDOE and Ecology meet weekly, and agree to continue discussions for no more than two months, to come to an agreement on the corrective actions and schedule for the order. In these meetings we would like to come to agreement on:

- Leak response actions for both tanks.
- Dates to implement those responses.
- Dates and activities for the development of a site-wide leak response plan for all SSTs.

Any disagreements about scope or schedule will be elevated to our respective management teams for timely resolution.

We look forward to agreeing on a path forward to effectively respond to the leaking tanks.

OREGON DEPARTMENT OF ENERGY

National Academy of Sciences
New Study on Hanford Tank Waste Treatment

(Glass vs. Grout, Round 2)

Tank mission "product"

High-level waste canisters

- 6,600 pounds of glass each
- ~ 7,200 to 27,800 canisters
- Temporarily stored at Hanford until National Repository opened

Low-activity waste canisters

- 13,000 pounds of glass each
- ~ 58,000 to 96,000 canisters
- Disposed on Hanford Site
- Current LAW Vitrification facility only sized to handle ~50% of this waste volume.

Source: System Plan 8

Major Options Considered in Phase 1

- Vitrification
- Fluidized Bed Steam Reforming
- Grout
  - Onsite disposal
    (Hanford Integrated Disposal Facility)
  - Offsite disposal
    (Waste Control Specialists Low Level Waste Facility in Texas)
- Pretreatment to remove organics, technetium-99, and/or iodine-129

OREGON DEPARTMENT OF ENERGY

Hanford Integrated Disposal Facility

Saltstone Disposal Units at Savannah River

Waste Control Specialists, Texas

- Facility underlain by 600 ft of nearly impermeable redbed clays
- WCS facilities not over or adjacent to a drinking water aquifer
- ! WCS does not have limits for Technetium or Iodine
- DOE signed agreement to take ownership of Federal Waste Cell after closure
- Offsite disposal of Hanford Supplemental LAW estimated to take 26 railcars per month for 28 years

Figure 5-2 A Waste Control Specialists Disposal Cell and Wastes Being Placed in Modular Concrete Canisters (note workers for scale)

OREGON DEPARTMENT OF ENERGY

FFRDC General Findings of the Prior Study

!

- The FFRDC believes that grout can meet performance objectives for **onsite or offsite** disposal, without removing Tc-99 or I-129.
- Additional R&D is needed before implementing grout for Hanford.
- Compared against vitrification, grout is less complicated* (room temperature process).
- Compared against vitrification, grout produces less secondary waste (i.e., glass offgas effluents, which would be grouted anyway).
- Grout requires more disposal space than glass, but capacity is available.
- Grout is estimated to be significantly cheaper than glass.
- A near-term decision is needed for Supplemental LAW to guide investment, but there is inadequate funding no matter the option chosen.

Congress Initiates Phase 2 Study

Sec. 3125. Continued Analysis of Approaches for Supplemental Treatment of Low-Activity Waste at Hanford Nuclear Reservation

a) ***IN GENERAL.—*** *Not later than 60 days after the date of the enactment of this Act, the Secretary of Energy shall—*

1) *enter into an arrangement with a federally funded re- search and development center to conduct a follow-on analysis to the analysis required by section 3134 of the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328; 130 Stat. 2769) with respect to approaches for treating the portion of low-activity waste at the Hanford Nuclear Reservation, Richland, Washington, intended for supplemental treatment; and*
2) *enter into an arrangement with the National Academies of Sciences, Engineering, and Medicine to review the follow-on analysis conducted under paragraph (1).*

b) ***COMPARISON OF ALTERNATIVES TO AID DECISIONMAKING.—*** *The analysis required by subsection (a)(1) shall be designed, to the greatest extent possible, to provide decisionmakers with the ability to make a direct comparison between approaches for the supplemental treatment of low-activity waste at the Hanford Nuclear Reservation based on criteria that are relevant to decisionmaking and most clearly differentiate between approaches.*

Purpose & Scope of the Phase 2 NAS Study

Sec. 3125. Continued Analysis of Approaches for Supplemental Treatment of Low-Activity Waste at Hanford Nuclear Reservation

c) ***ELEMENTS.*** *—The analysis required by subsection (a)(1) shall clearly lay out a framework of decisions to be made among the treatment technologies, waste forms, and disposal locations by including an assessment of the following:*

1) *The most effective potential technology for supplemental treatment of low-activity waste that will produce an effective waste form, including an assessment of the following:*
   - A. *The **maturity and complexity of the technology**.*
   - B. *The **extent of previous use of the technology.***
   - C. *The **life cycle costs and duration of use of the technology**.*
   - D. *The **effectiveness of the technology with respect to immobilization.***
   - E. *The **performance of the technology expected under permanent disposal**.*
   - F. *The **topical areas of additional study required for the grout option identified in the analysis required by section 3134** of the National Defense Authorization Act for Fiscal Year 2017.*
2) *The differences among approaches for the supplemental treatment of low-activity waste considered as of the date of the analysis required by subsection (a)(1).*
3) *The **compliance** of such approaches with the technical standards described in section 3134(b)(2)(D) of the National Defense Authorization Act for Fiscal Year 2017.*
4) *The **differences among potential disposal sites for the waste form produced through such treatment**, including mitigation of radionuclides, including technetium-99, selenium-79, and iodine-129, on a system level.*

Sec. 3125. Continued Analysis of Approaches for Supplemental Treatment of Low-Activity Waste at Hanford Nuclear Reservation

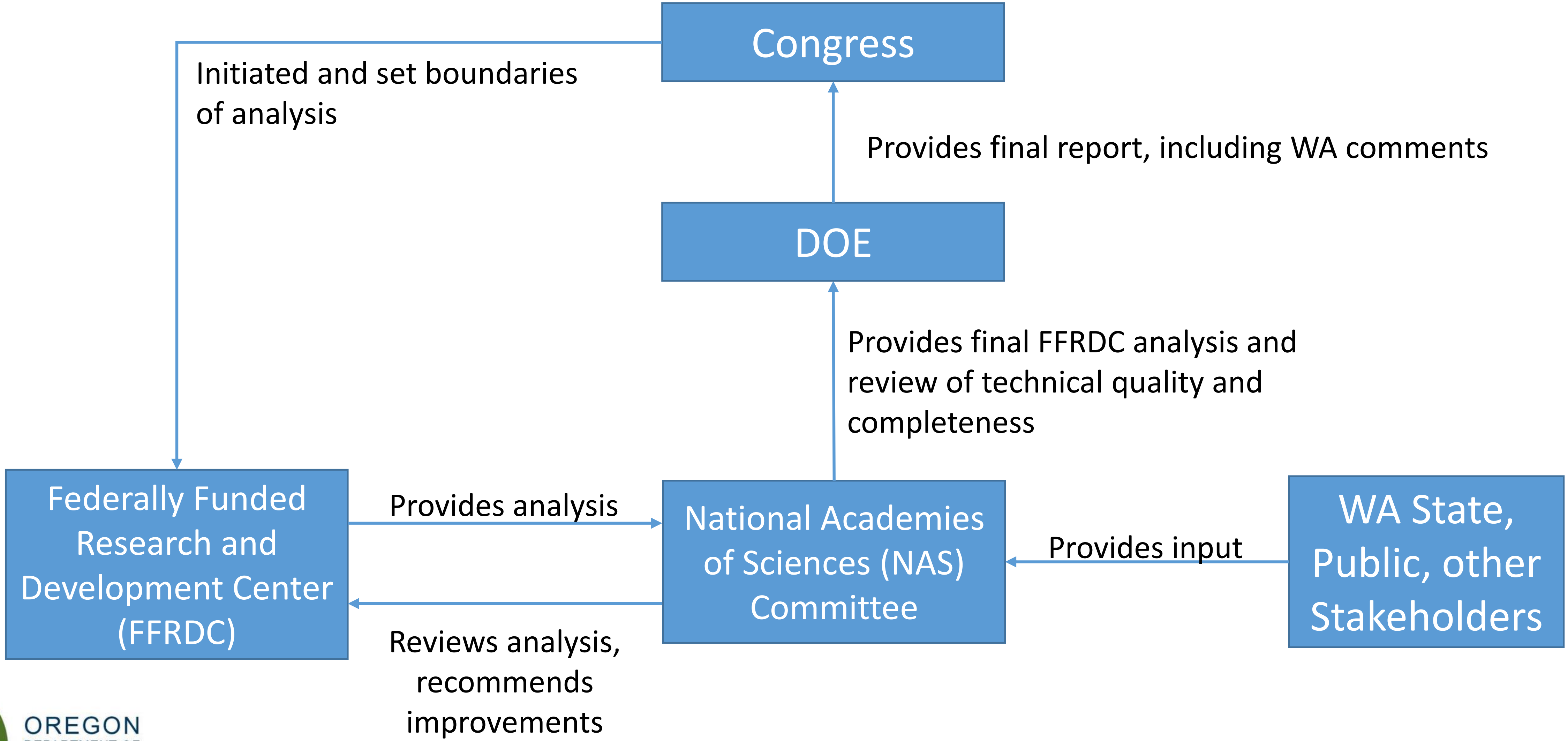
5) Potential **modifications to the design of facilities to enhance performance with respect to disposal** of the waste form to account for the following:
   - A. **Regulatory compliance.**
   - B. **Public acceptance.**
   - C. **Cost.**
   - D. **Safety.**
   - E. **The expected radiation dose to maximally exposed individuals over time.**
   - F. **Differences among disposal environments**

6) Approximately **how much and what type of pretreatment is needed to meet regulatory requirements** regarding long-lived radionuclides and hazardous chemicals to reduce disposal costs for radionuclides described in paragraph (4).

7) **Whether the radionuclides can be left in the waste form or economically removed** and bounded at a system level by the performance assessment of a potential disposal site and, if the radionuclides cannot be left in the waste form, how to account for the secondary waste stream.

8) Other relevant factors relating to the technology de- scribed in paragraph (1), including the following:
   - A. The **costs and risks in delays with respect to tank performance over time.**
   - B. Consideration of **experience with treatment methods at other sites and commercial facilities**.
   - C. **Outcomes of the test bed initiative** of the Office of Environmental Management at the Hanford Nuclear Reservation.

Simplified Study Process



OREGON DEPARTMENT OF ENERGY

Questions/Discussion