Department of Energy Lecture Series

"Hanford History"

Presented by: Carrie Meyer, Director of Public Affairs, DOE ORP

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Introduction

The U.S. Department of Energy (DOE) is responsible for one of the largest nuclear cleanup efforts in the world, managing the legacy of five decades of nuclear weapons production. DOE's ability to meet the legacy cleanup demands of the future depends on having an educated and dedicated STEM workforce

DOE Lecture Series Objective

To attract, engage, educate and inspire future generations to have exciting and meaningful careers within DOE's workforce at the Hanford site.

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What Is Hanford?

History

- Site was used to produce plutonium for the bomb that ended WWII in 1945
- 50,000 workers at peak
- Secrecy was paramount
- Production continued through Cold War
- Plutonium production ended at Hanford in 1989

Today

- 1989 – Present: Cleanup resulting from plutonium production
- The largest nuclear cleanup project in the country

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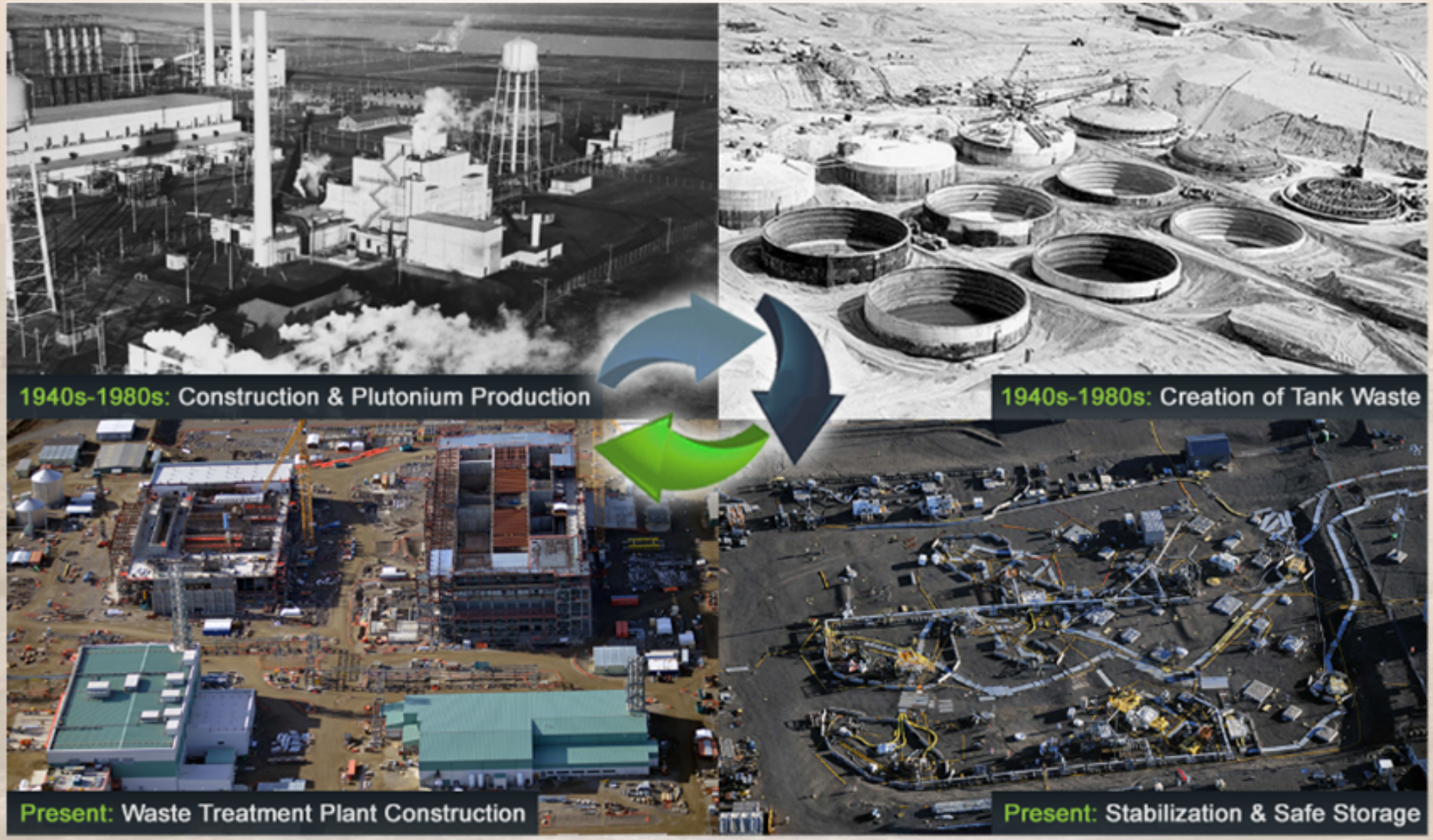
Historical overview of Hanford



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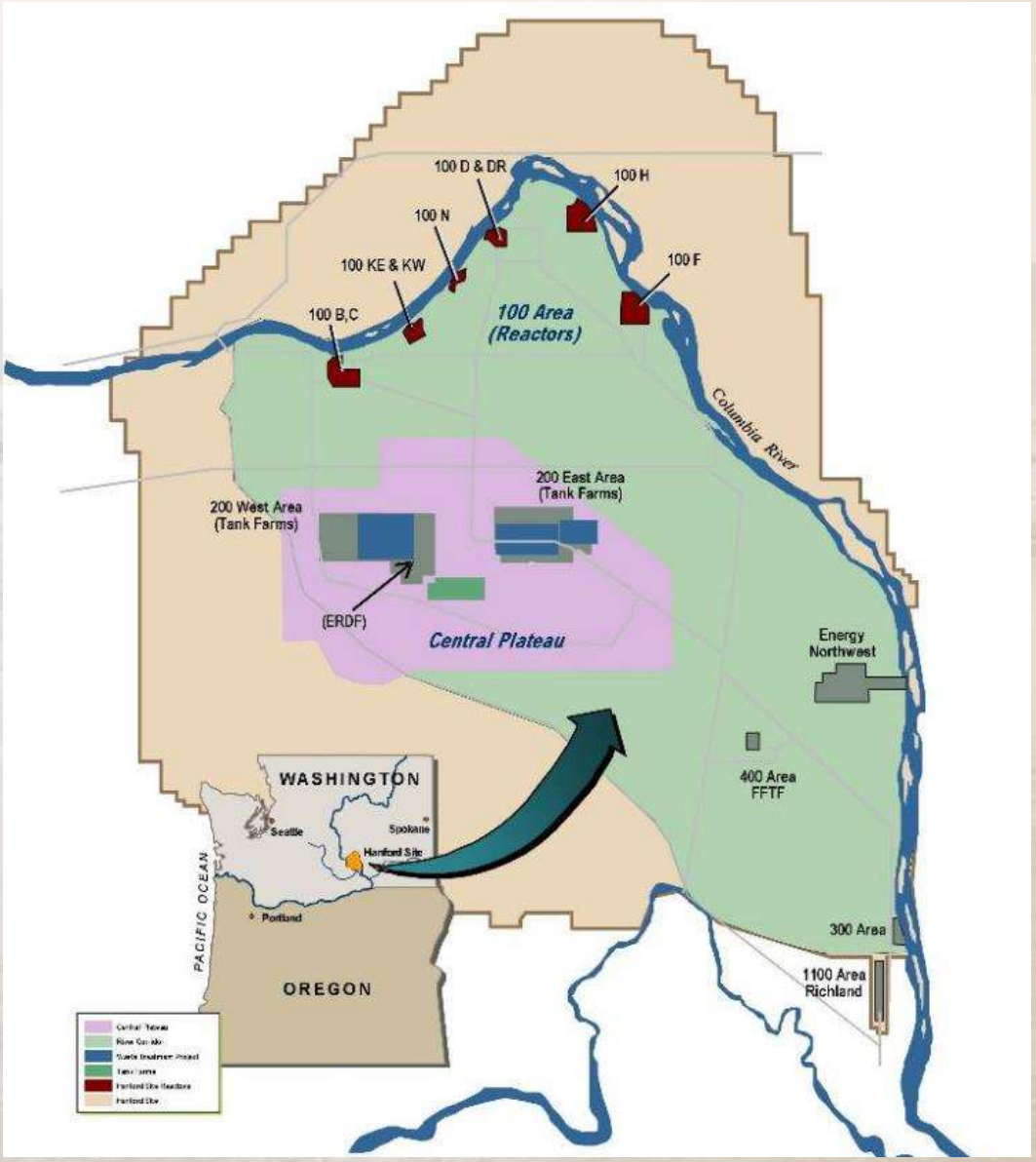
Why was the Hanford Site selected?

- Abundant water source (Columbia River)
- Proximity to Grand Coulee Dam (power source)
- Isolation from large cities, far enough inland from the Pacific Ocean
- Wide open spaces offered buffer zone for defense
- Area was lightly populated (Native Americans & residents in the small towns of White Bluffs and Hanford were given 30 days to leave the site)



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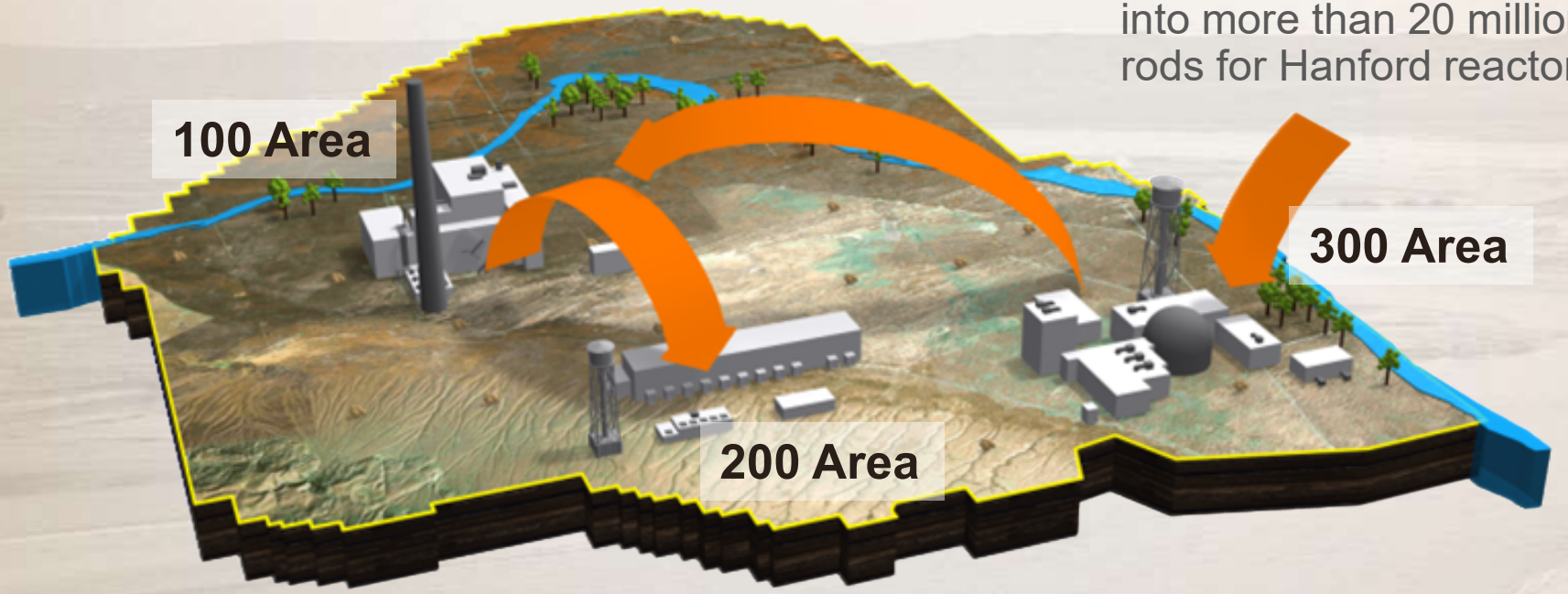
Plutonium Production

100 Area: Nine reactors operated to change a portion of the uranium to plutonium in nuclear reactions.

300 Area: Hundreds of thousands of tons of uranium was sent here to be fabricated into more than 20 million fuel rods for Hanford reactors.



200 Area: Hundreds of facilities operated to remove plutonium from reactor fuel rods and manage waste generated during the chemical separations processes.

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Cleanup Begins

In 1989, the effort shifted from plutonium production to cleanup

Hanford cleanup is guided by federal and state laws and is overseen by a number of regulatory agencies

Why is cleanup important?

- To reduce environmental risk
- To protect the Columbia River
- To eventually make the land available for other uses
- Because it is a federal obligation

Cleanup Process

What methods are used to clean up Hanford?

- **Facilities:** Decontaminate and demolish buildings
- **Waste/Burial Sites:** Dig up hazardous materials (soil, debris, garbage, waste) and transport to lined disposal facilities approved by EPA and Washington state
- **Groundwater:** Pump and treat groundwater to remove contaminants. Install chemical barriers to hold contamination in place until radioactivity decays.
- **Tank Waste:** Remove waste from tanks and immobilize in process called vitrification. (Limited vitrification expected to begin in 2023)

Cleanup Accomplishments

- Moved 2,300 tons of spent nuclear fuel away from Columbia River
- Moved more than 16 million tons of contaminated material away from river and disposed at engineered landfill in central Hanford
- Treated more than 15 billion gallons of contaminated groundwater
- Demolished more than 800 facilities and remediated 1,300 waste sites
- Six reactors “cocooned”
- Removed most pumpable liquid from 149 single-shell tanks

Spent fuel shipment to Central Plateau (top), K West Reactor Basin (bottom)

Cleanup Challenges

- ~65 square miles of contaminated groundwater
- Retrieval and safe treatment of 56 million gallons of high-level waste in 177 underground tanks
- Remediation of contaminated soil
- Demolition of canyons, other facilities
- Hundreds of unlined solid waste trenches
- Sustained budget (currently about $2.3 billion annually)
- Maintain or replace aging infrastructure

Above: Retrieval equipment in place at C Tank Farm

Left: Demolition of the 224-U facility

Groundwater Remediation

- All major treatment facilities in place along Columbia River and at center of the Site
- Treated more than 15 billion gallons since cleanup began and removed more than 200 tons of contamination
- Areas and levels of contamination are being reduced along the river
- Cleanup to continue for decades

Groundwater Strategy: Stop key contaminants from entering the Columbia River and eventually clean up groundwater to drinking water standards

Plutonium Finishing Plant

- Final stop in plutonium production, began in 1949
- Among highest hazard facilities in DOE waste management
- Scheduled to tear down facility by the end of September 2017

Above: Removing glove boxes from Americium Recovery Facility (a.k.a., McCluskey Room)

Right: Aerial of the Plutonium Finishing Plant

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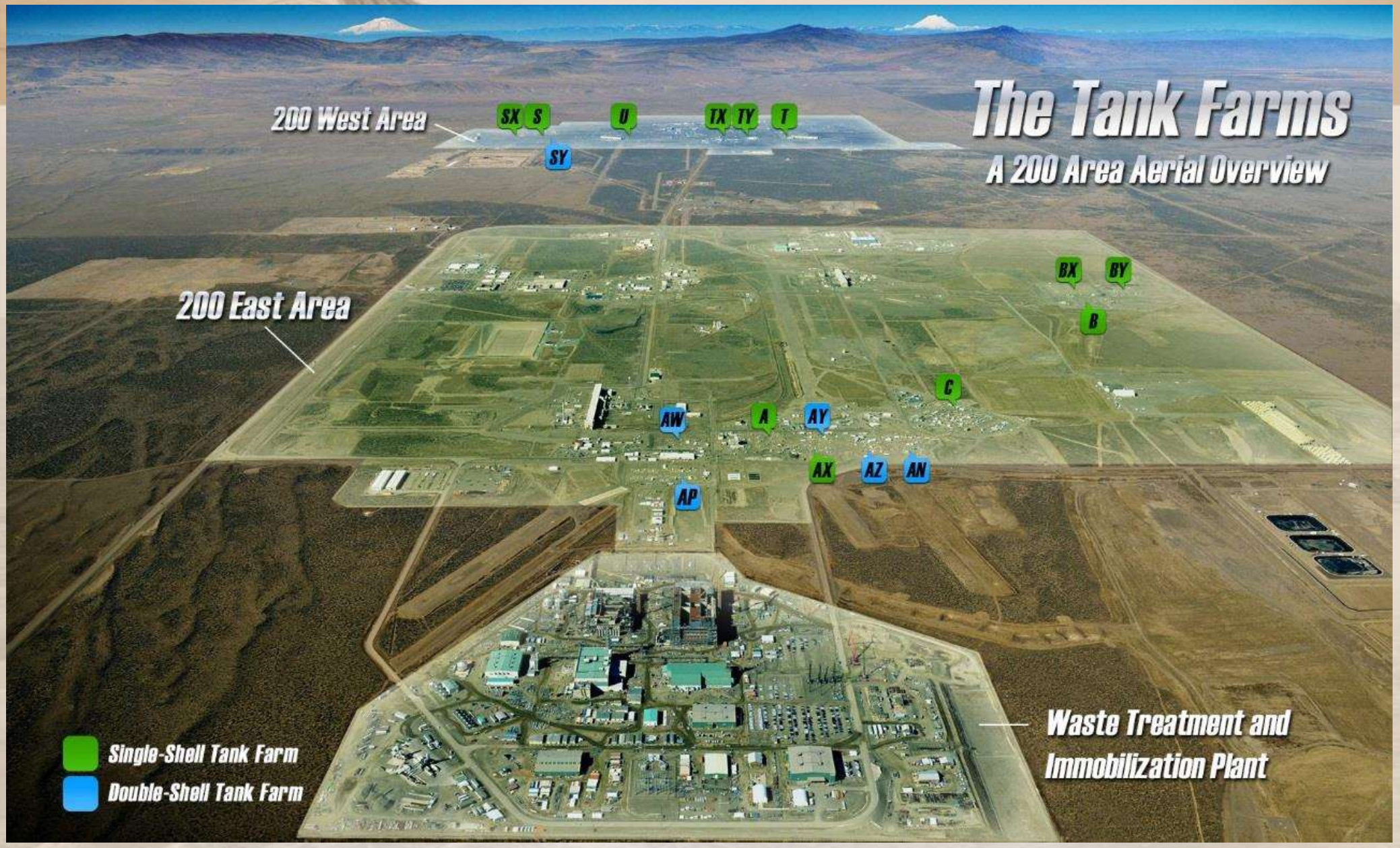
Waste Encapsulation Storage Facility

- Currently stores 1,936 capsules in pools of water
- One-third of nuclear material by radioactivity at the Hanford Site
- Plan is to move capsules into dry storage casks


The Tank Farms
A 200 Area Aerial Overview
200 West Area
200 East Area
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Waste Treatment and Immobilization Plant
Single-Shell Tank Farm
Double-Shell Tank Farm

Hanford's Greatest Challenge

- **1943-1964: 149 single-shell tanks constructed**
  - Up to 67 presumed to have leaked
- **1968-1986: 28 double-shell tanks constructed**
  - 1 leaking, retrieval nearing completion

Retrieval and safe treatment of 56 million gallons of radioactive and chemical waste

What's in the tanks?

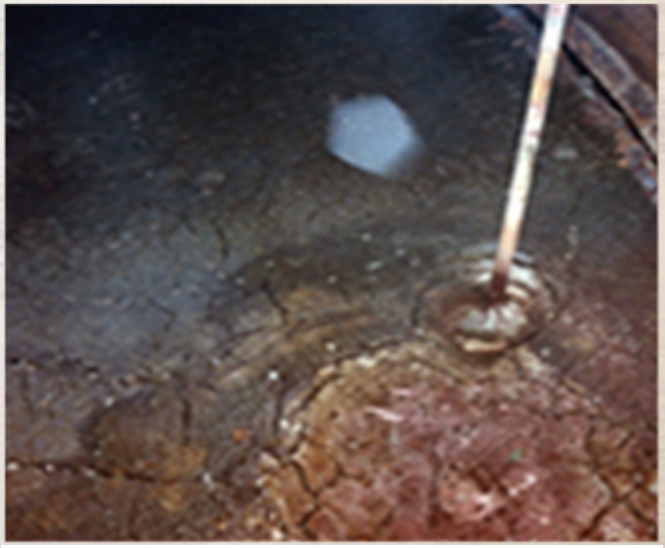
Saltcake
23M gallons

Any non-interstitial liquid in the tanks

Supernate
21M gallons

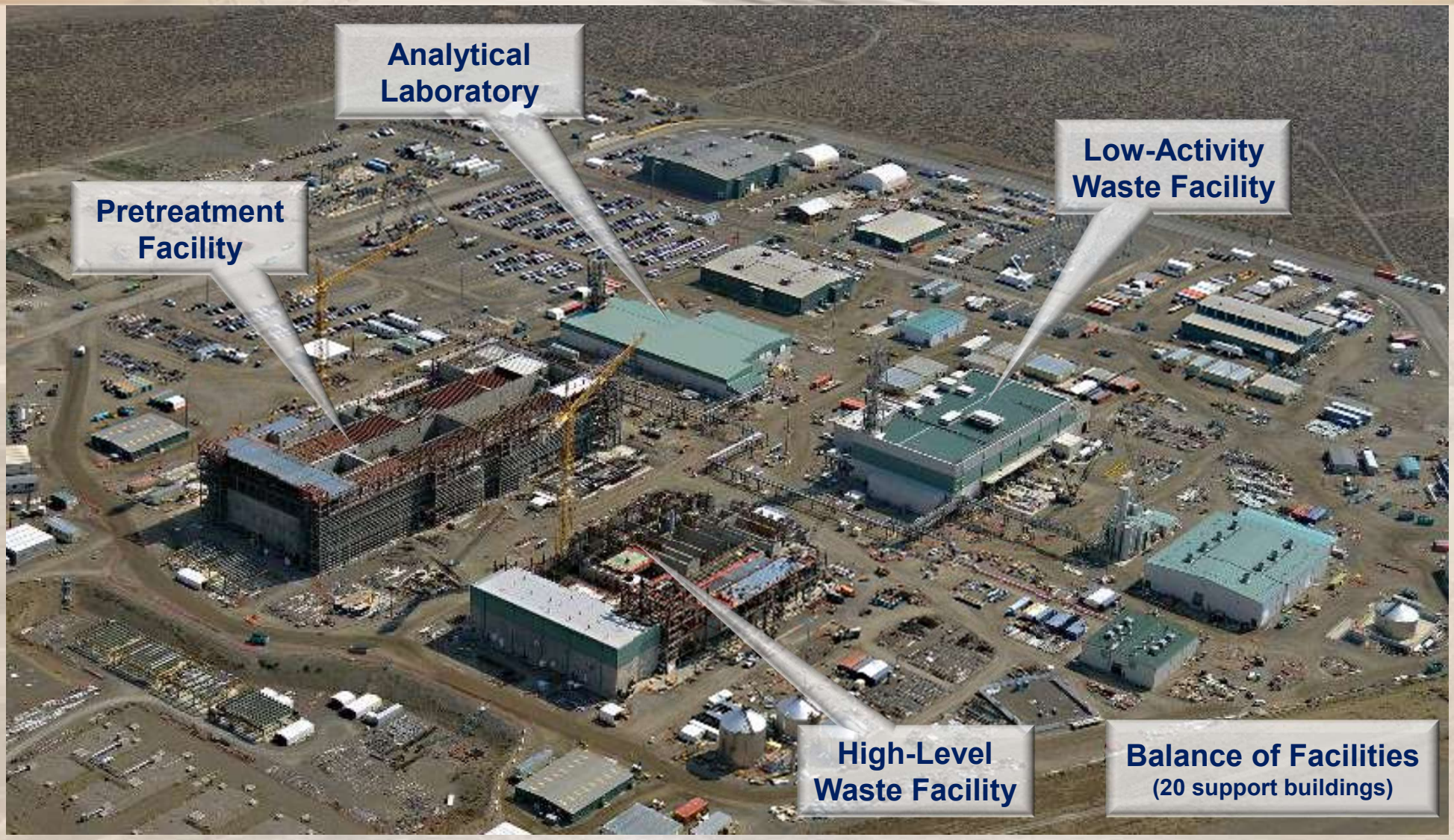
Mostly water-soluable salts: small amount of interstitial liquid

Sludge
12M gallons

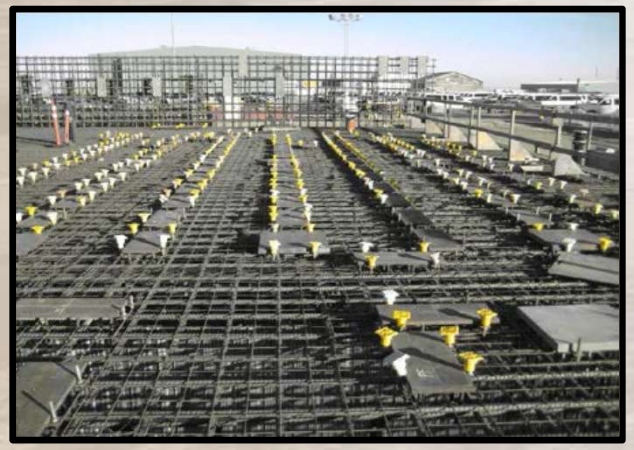


Water-insoluble metal oxides, significant amount of interstitial liquid – texture similar to peanut butter

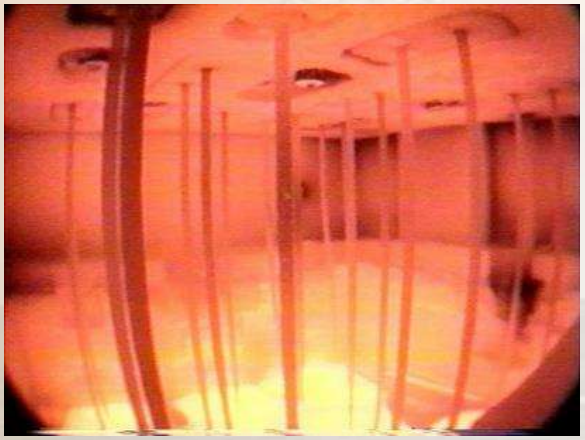
Waste Treatment Plant



Physical Progress at WTP



Vitrification and storage



Molten glass and waste in a melter

Simulated vitrified waste

High-level waste (tall) canister and low-activity waste container

Simulated vitrified waste in a canister

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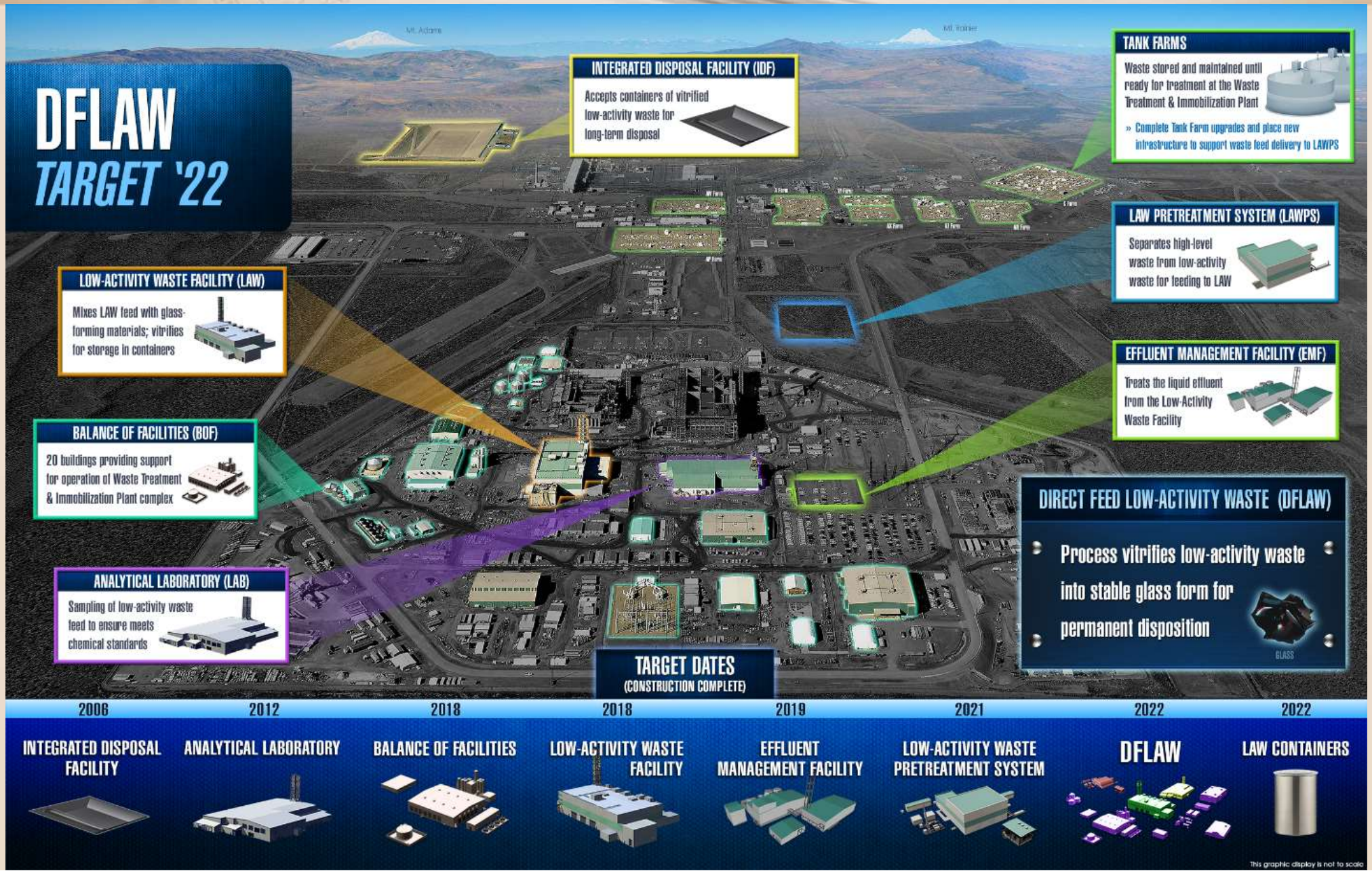
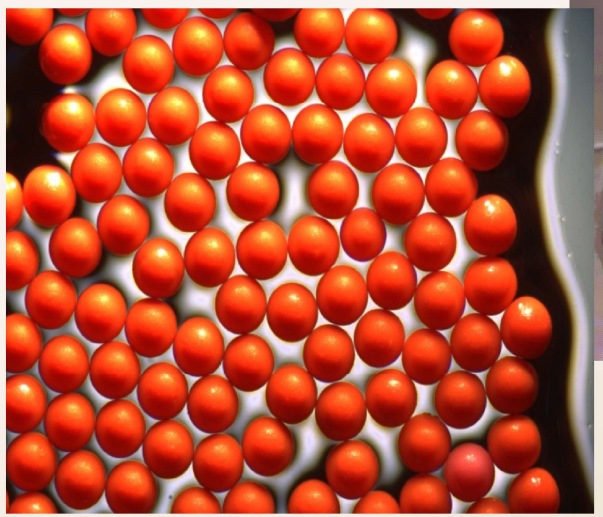
Direct Feed Low-Activity Waste



Low-Activity Waste Pretreatment System

- Cross-Flow Filtration was selected for technical maturity, cost, and maintenance considerations
- Spherical Resorcinol Formaldehyde (sRF) resin was chosen over other non-elutable IX media for cost and media disposal considerations
- **Both selections also provide operations and maintenance experience relevant to future Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility operations**

Cross-Flow Filtration Element



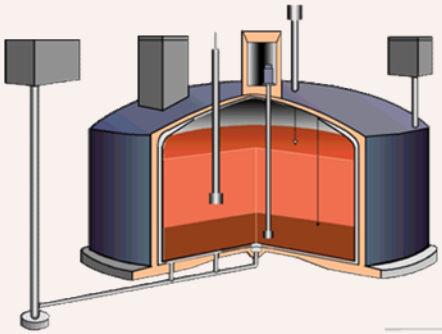
sRF Resin

DFLAW Program Expected Results

20 Proposed waste feed delivery campaigns

6.3 Million gallons of tank space generated*

1,000,000
Gallons per campaign



9,600 Metric tons of sodium processed

15% of Tank Farm sodium inventory

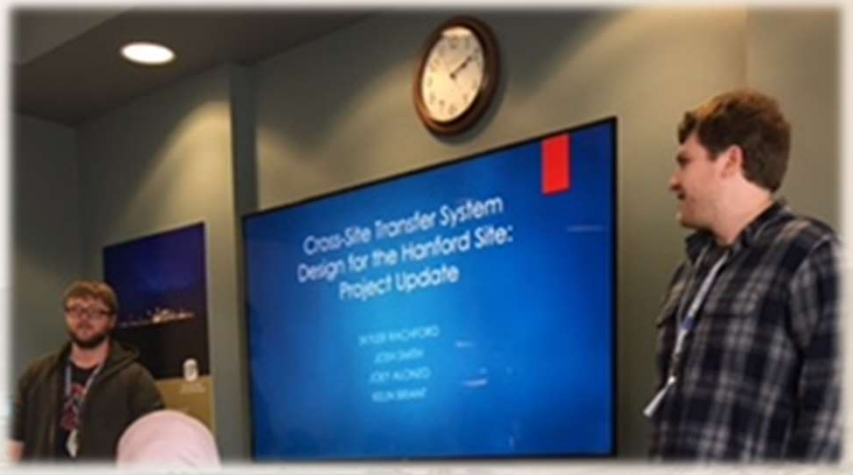
12,000 Immobilized LAW containers produced

Restore Hanford Land for Access & Use

- Manage and operate the Manhattan Project National Historical Park in partnership with the National Park Service
- Increase controlled Tribal and public access and use
- Recent transfer of 1,641 acres of land to local Community Reuse Organization
- Work closely with our partners to enable reuse of Hanford land consistent with the Comprehensive Land-Use Plan

Building Our Future Through STEM Outreach

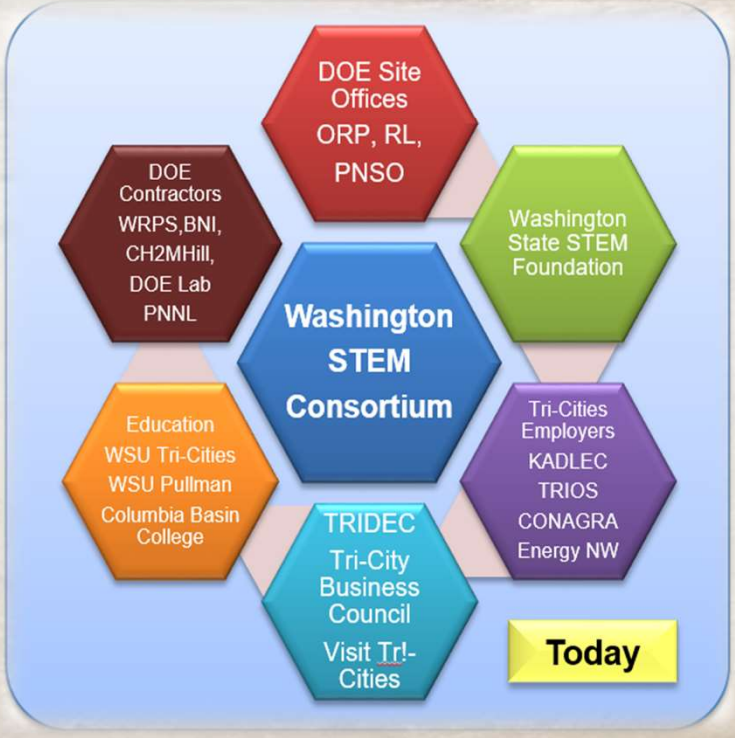
- **Outreach activities include:**
  - Mission briefings and site tours for university faculty and students
  - DOE Lecture Series with universities
  - Expanded internship opportunities
  - Engineering Case Study as capstone project for students
    - March 2017: DOE hosted 20 WSU Seniors for Design Capstone Project presentations and Site Tour



Upcoming Lecture Topics:

-The Hanford Tank Waste Challenge

-Building the Waste Treatment and Immobilization Plant



For more information on DOE's STEM Program, please contact
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