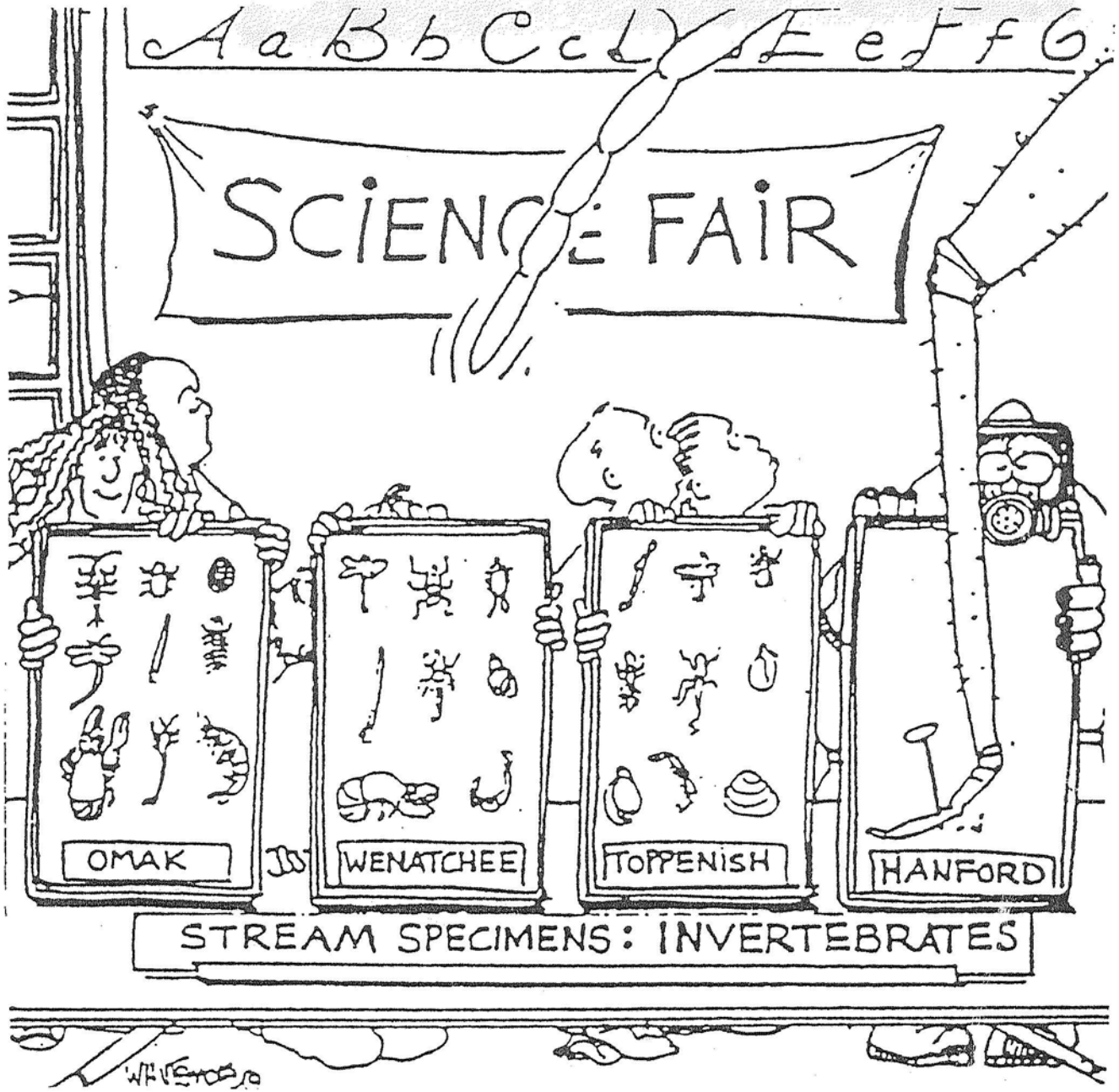
Hanford Nuclear Site

Disposal of waste into trenches before 1970

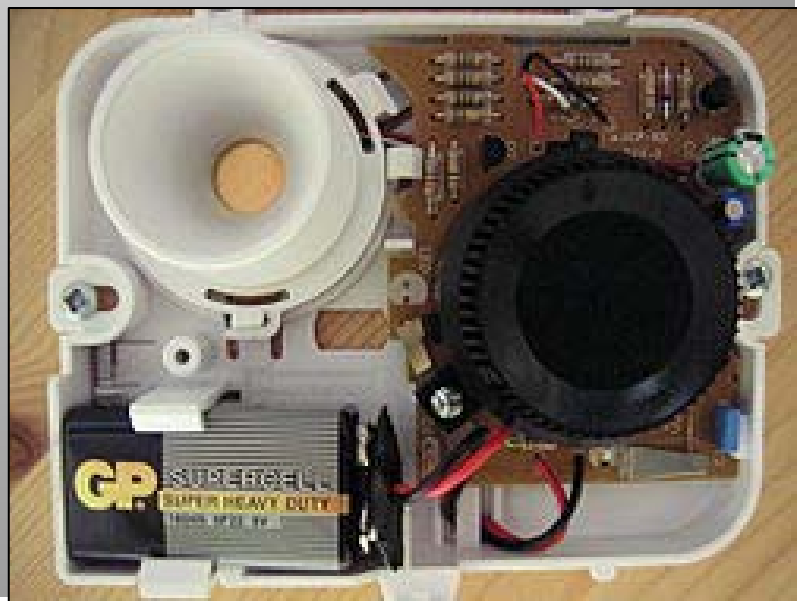
John Price, Tri-Party Agreement Section Manager
Department of Ecology
Nuclear Waste Program

DEPARTMENT OF ECOLOGY
State of Washington


SCIENCE FAIR
OMAK
WENATCHEE
TOPPENISH
HANFORD
STREAM SPECIMENS: INVERTEBRATES

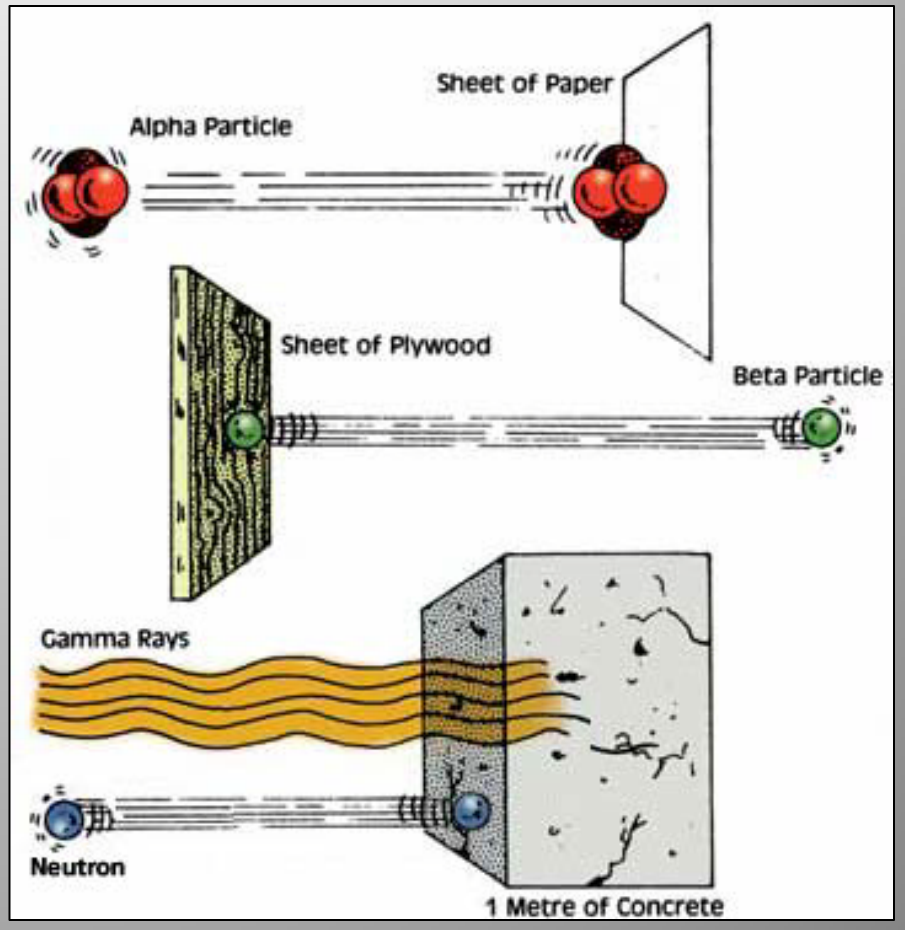
Introduction to radioactivity & waste

- **Radioactive materials** – naturally occurring or man-made substances that change elemental form through radioactive decay
- **Radioactivity or radiation** – energy given off by radioactive materials
- **Radioactive waste** – radioactive materials in a form or location that is no longer useful



Types of radiation
Each has different properties & hazards

- **Alpha** – a heavy particle, positive charge
- **Beta** – a light particle, negative charge
- **Gamma** – energy rays
- **Neutron** – neutral particle, lighter than alpha and much heavier than beta (rarely encountered)



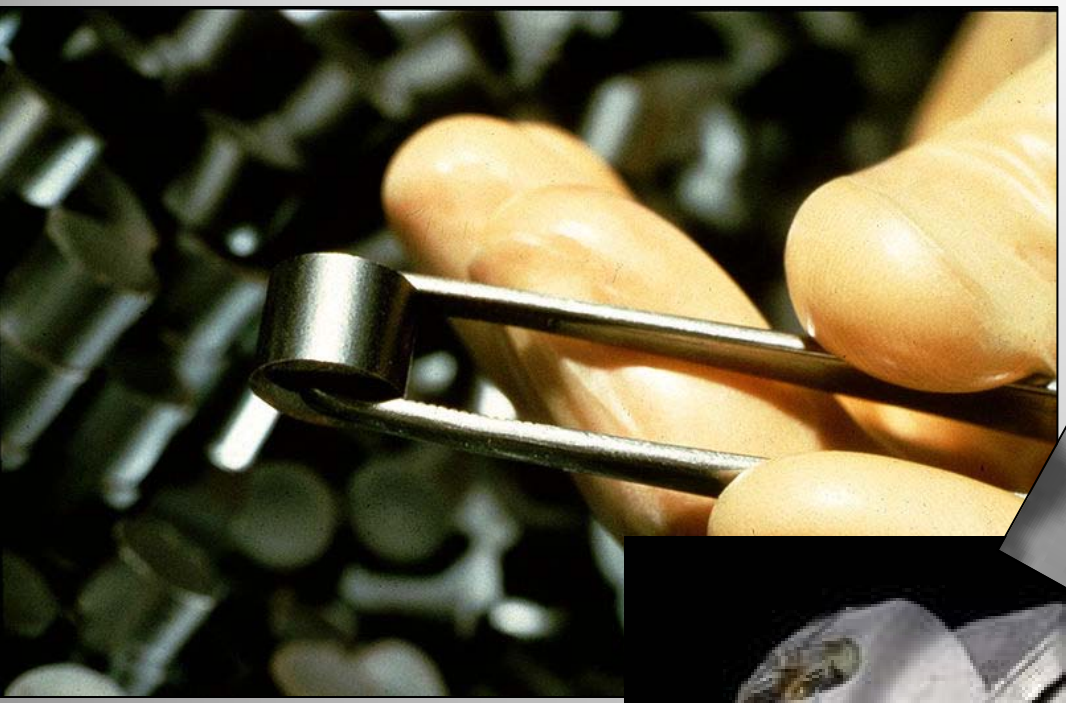
http://www.cameco.com/common/images/content/u101/r_particles.jpg

A weapons-grade ring of 99.96% pure electro-refined plutonium, enough for one bomb core. The ring weighs 5.3 kg (11.66 lbs), is ca. 11 cm in diameter and its shape helps with criticality safety.

7 elements of criticality safety

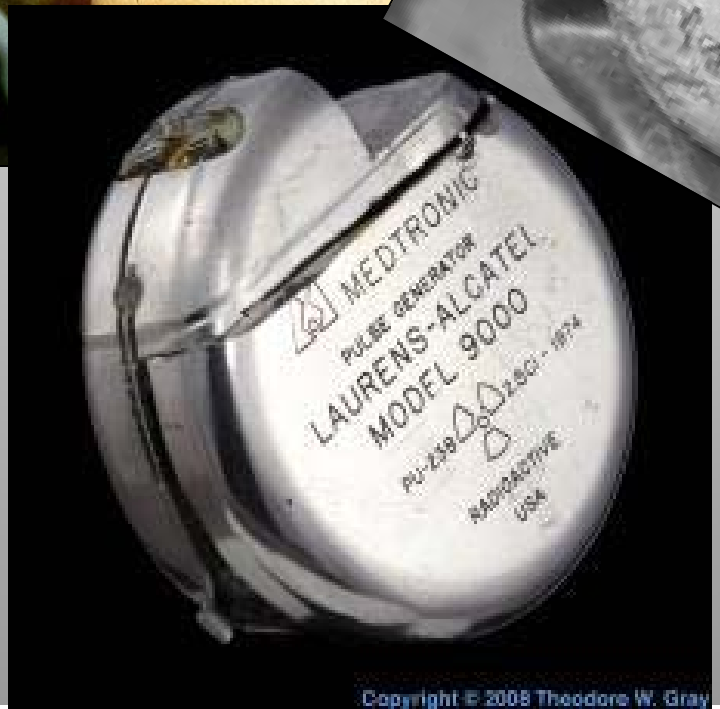
1. **Geometry or shape** – large surface area safer than the same amount of fissile material in a small, compact shape such as a cube or a sphere
2. **Interaction of units** – two close subcritical units can interact to become critical
3. **Reflection** – good reflectors: Be, C, lead, uranium, water, polyethylene, concrete, steel
4. **Moderation** – oil, polyethylene, water, wood, paraffin
5. **Absorption** – works against criticality
6. **Enrichment** – purity of the critical element
7. **Mass** – threshold below which no criticality can occur is “critical mass”

Unirradiated uranium & plutonium



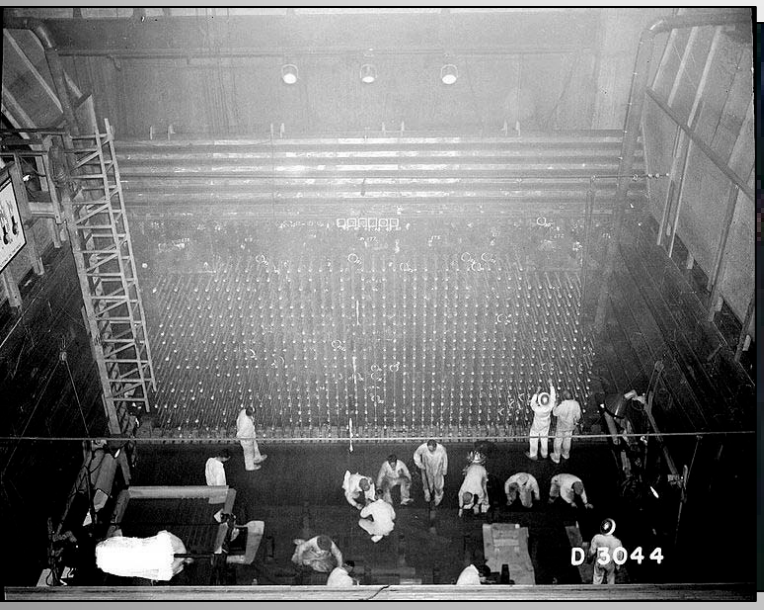
Uranium fuel pellet

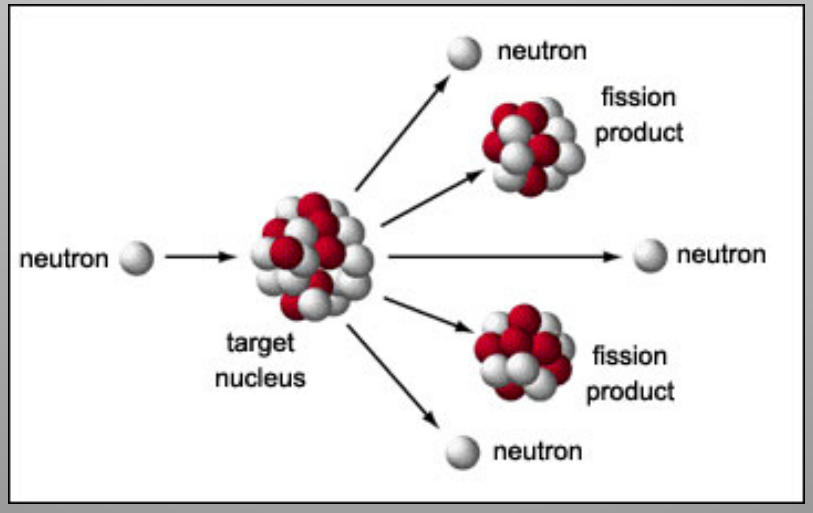
Plutonium “button” for weapons



Plutonium-powered heart pacemaker

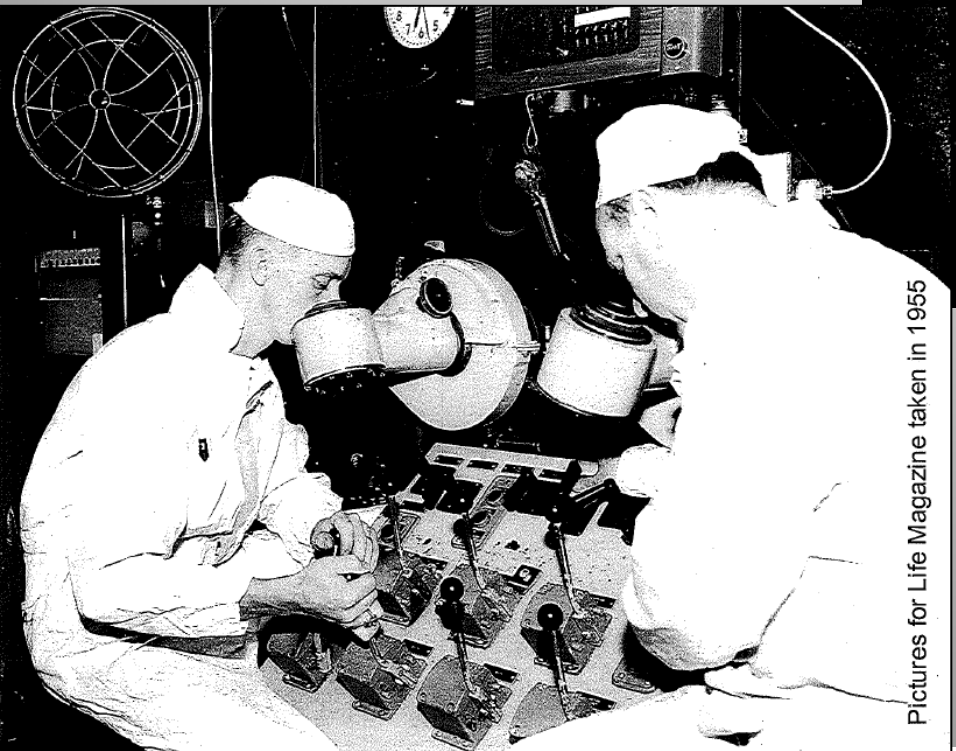
Nuclear reactors irradiate materials
Fission products result



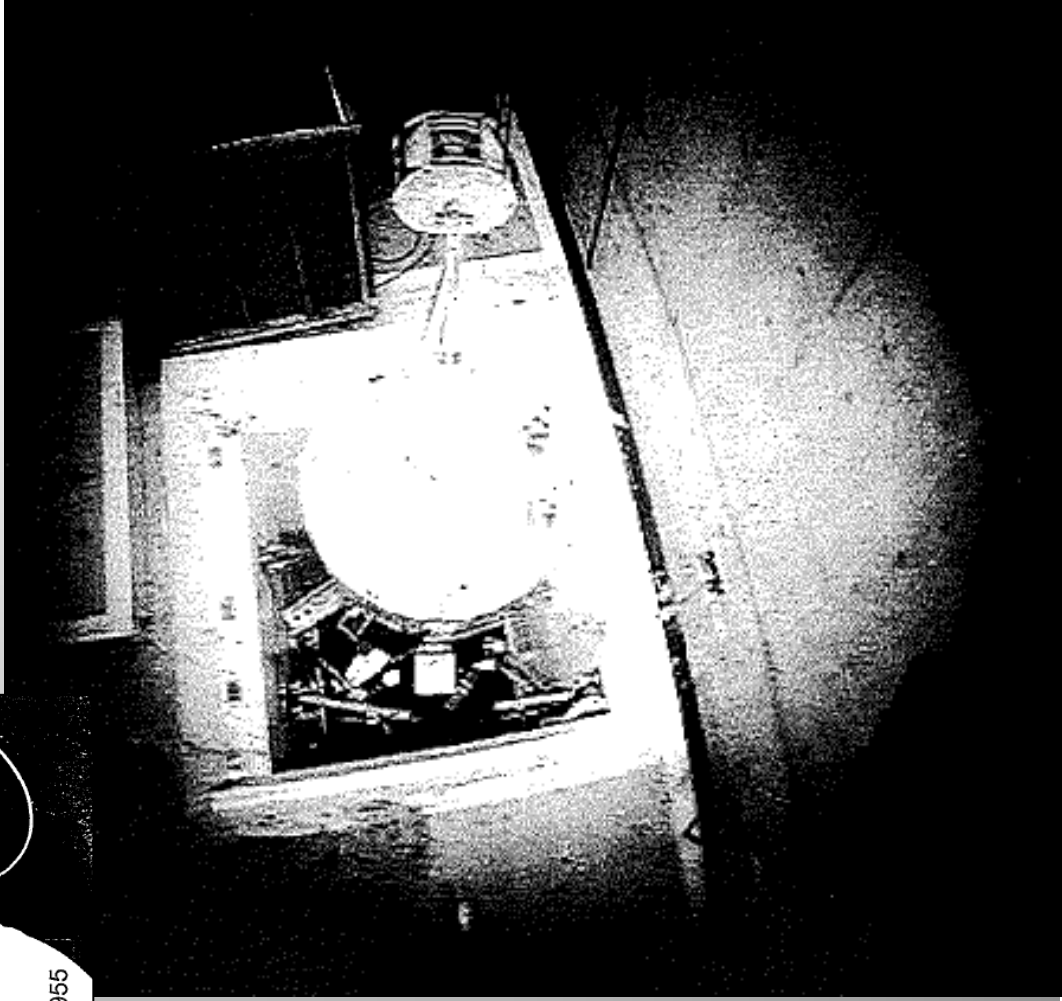


Chemical processing of irradiated fuel

Operators in a Canyon building



Pictures for Life Magazine taken in 1955



Radioactive waste classification schemes

- **International**
  - Low-, intermediate-, and high-level waste
- **US Department of Energy (USDOE)**
  - Low-level, transuranic, and high-level waste
- **US Nuclear Regulatory Commission (NRC)**
  - High-level, low-level, and uranium mill tailings
    - Low-level A, B, and C waste
- **Low-activity** and **high-activity waste** are not regulatory classifications

USDOE low-level waste disposal

Environmental Restoration Disposal Facility (ERDF) at the Hanford Site

- Current disposal for the Hanford Site
- As of February 2010, 9 million tons of waste disposed

Pit 5 at the Area 5 Radioactive Waste Management Site on the Nevada Test Site

- Accepts waste from other USDOE sites

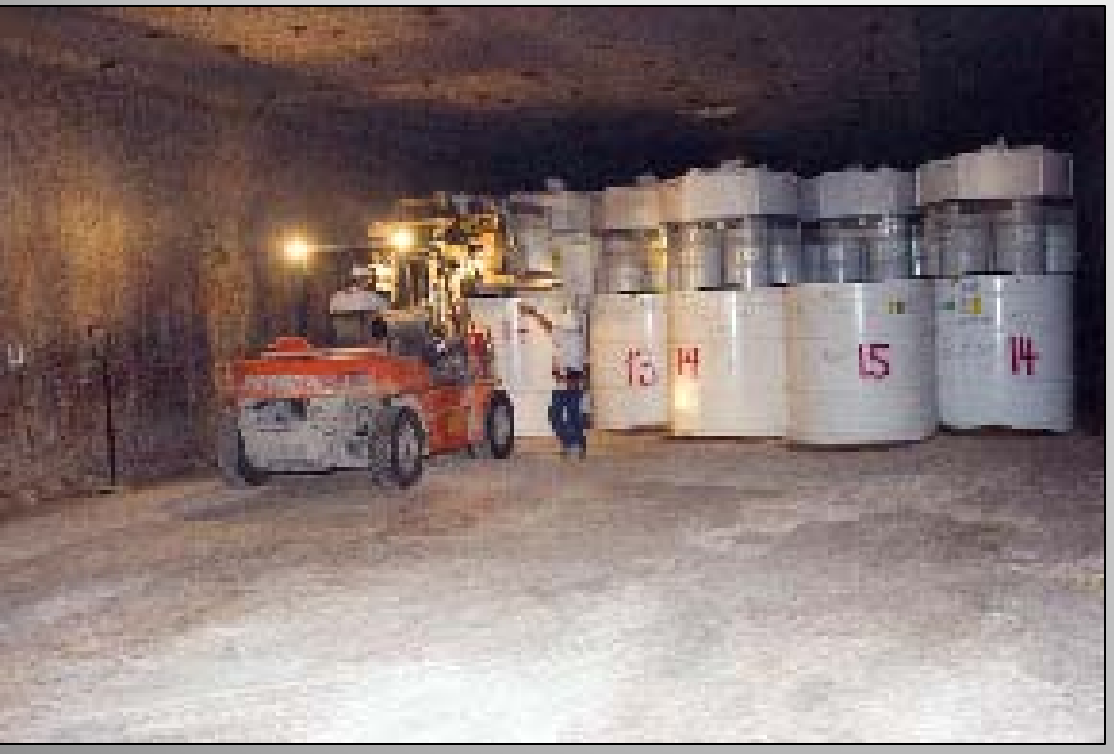
Energy Solutions
Commercial low-level waste disposal site

- Located in Great Salt Lake desert west of Salt Lake City, Utah
- Accepts USDOE waste (typically large volume, low radioactivity)

Waste arrives either by highway or rail transportation and is taken to disposal embankments or cells for isolation from the environment.

Containerized waste is unloaded using cranes.

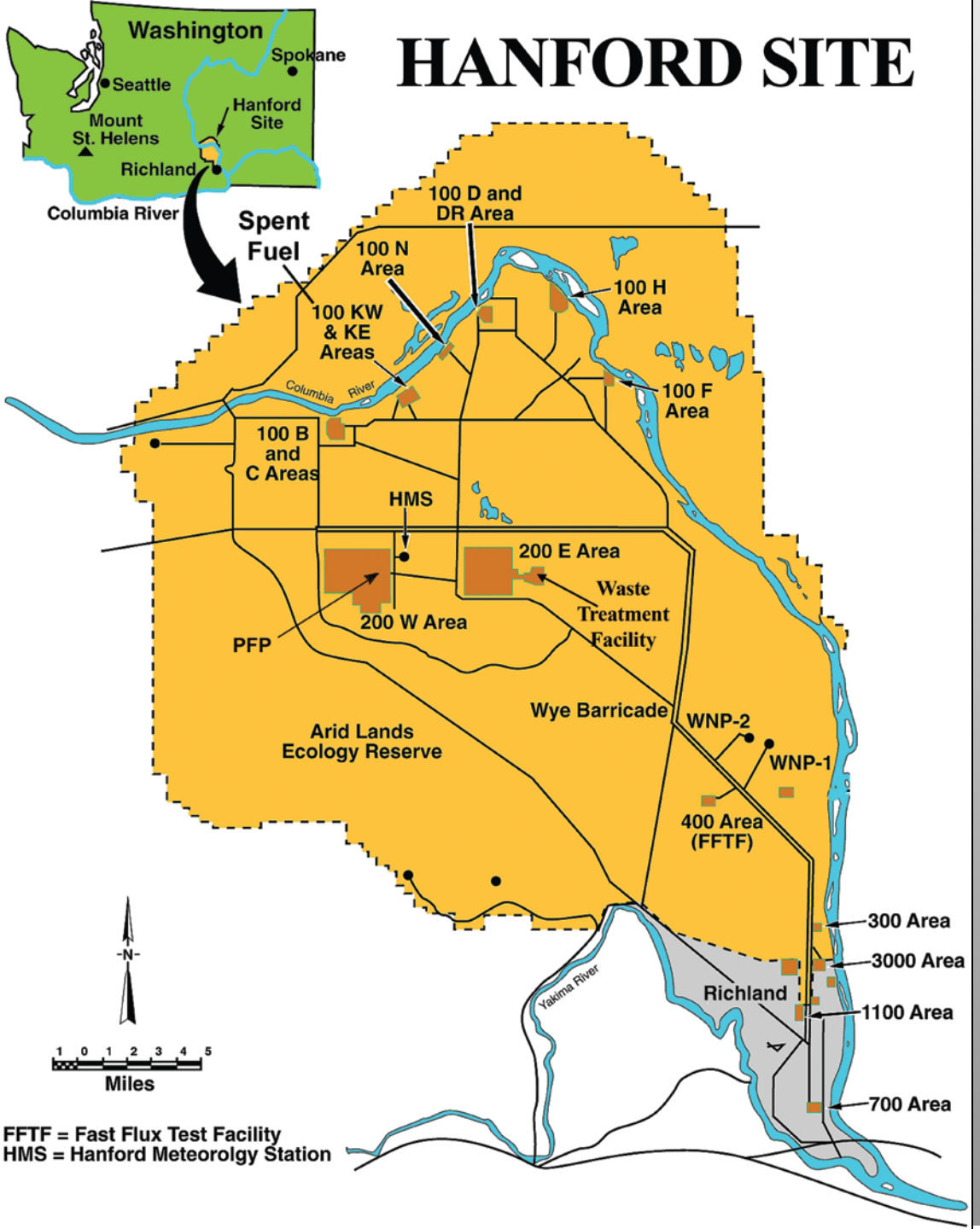
Waste Isolation Pilot Plant (WIPP)
Disposal of transuranic waste



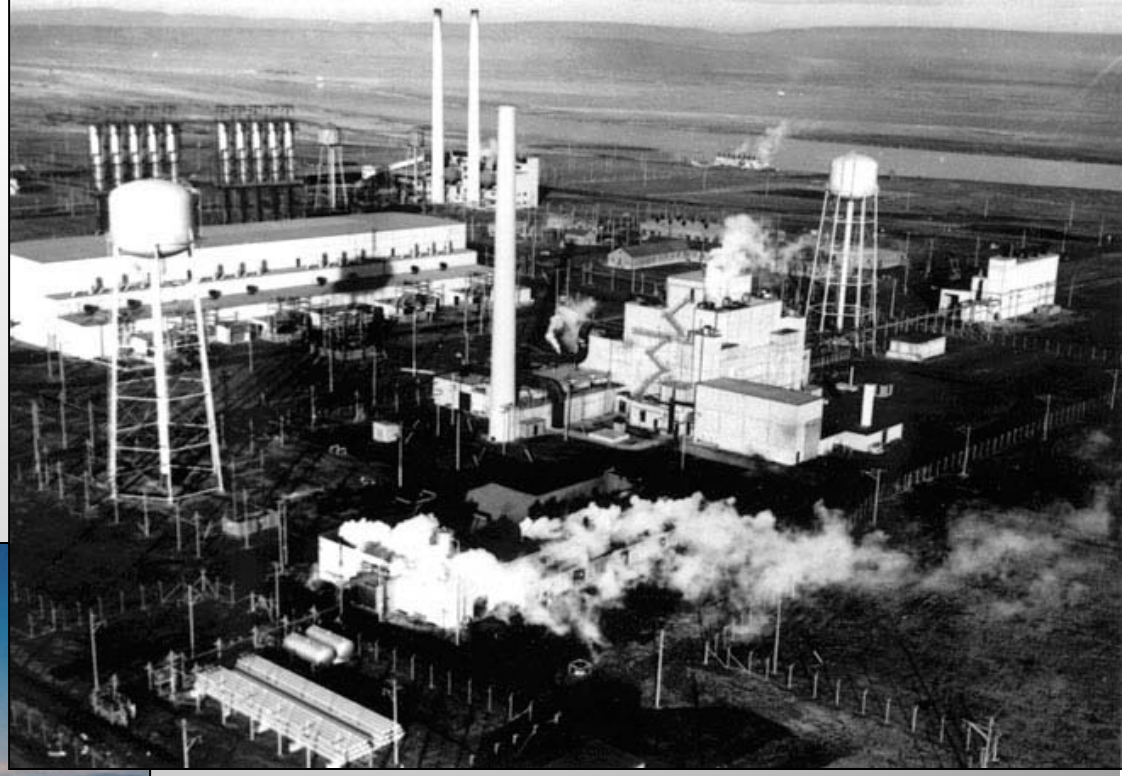
WIPP is licensed to permanently dispose of transuranic radioactive waste that is left from the research and production of nuclear weapons for 10,000 years[1].

Waste is placed in rooms 2,150 feet (655 m) underground that have been excavated within a 3,000 foot (1,000 m) thick salt formation where salt tectonics have been stable for more than 250 million years.

HANFORD SITE



100 Area



Hanford Reach National Monument

200 Area

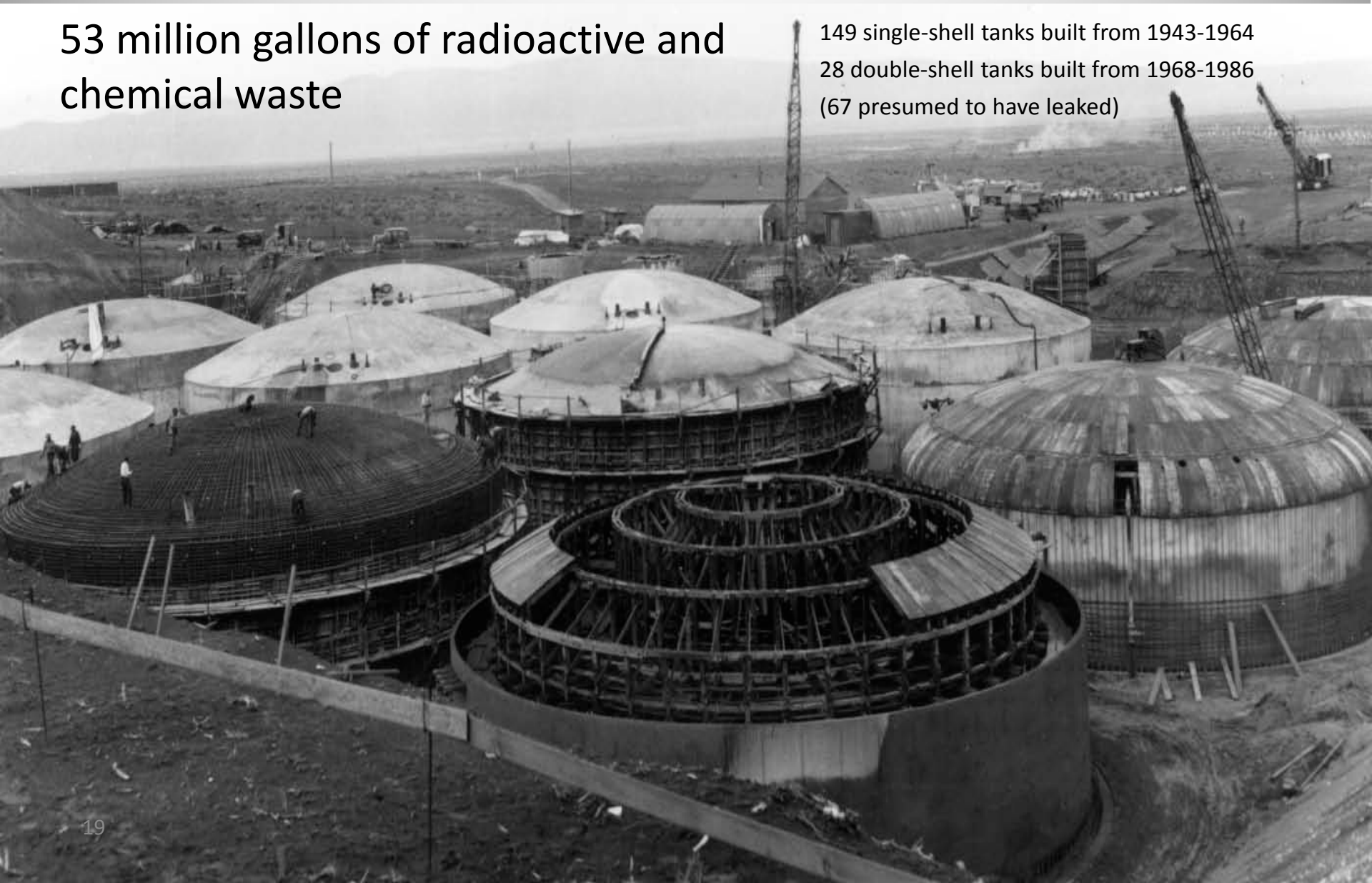
Low-level radioactive liquid waste disposed to the ground

Waste water in Hanford's central plateau created lakes in the desert

Hanford's Greatest Cleanup Challenge
The Tank Farms

53 million gallons of radioactive and chemical waste

149 single-shell tanks built from 1943-1964
28 double-shell tanks built from 1968-1986
(67 presumed to have leaked)



149 single-shell, high-level radioactive waste tanks

Radioactive saltcake in a high-level waste tank

Tank Waste Treatment Plant

- Concrete: 262,000 yards
  - 26,200 trucks
- Structural Steel: 36,500 tons
  - 3 Eiffel Towers
- Piping: 1,017,000 linear feet
- Electrical Cable: 4,762,000 linear feet
- Area: 65 acres
- Capital Cost: $12 billion
- Hot Start: 2019

Lab

Low-Activity Waste (LAW)

Pretreatment (PT)

High-Level Waste (HLW)

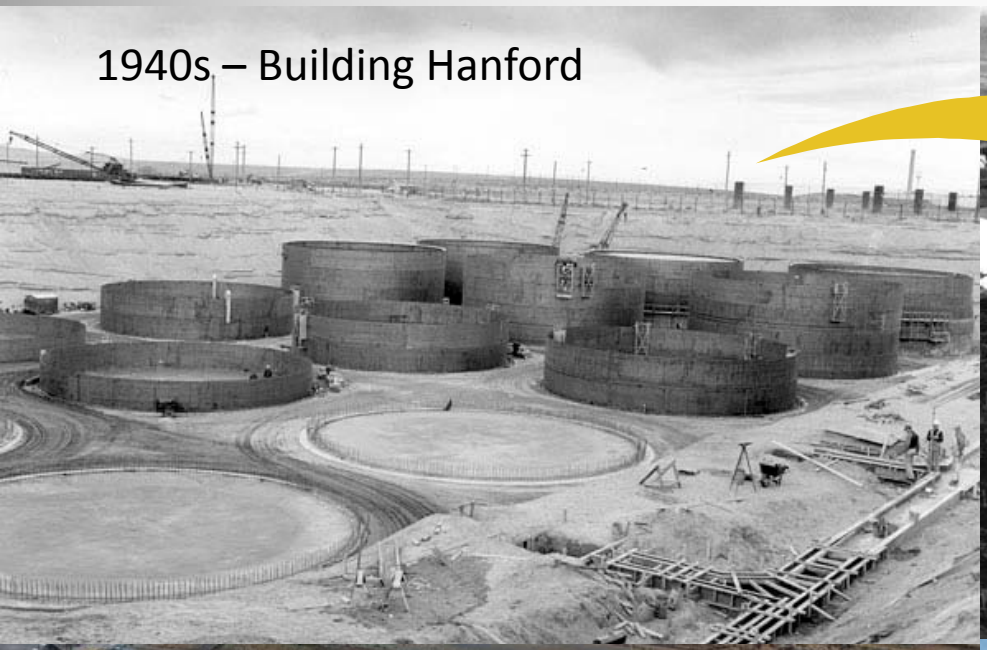
300 Area – testing, former fuel fabrication
Pacific NW Nat'l Lab
Ecology office
High School

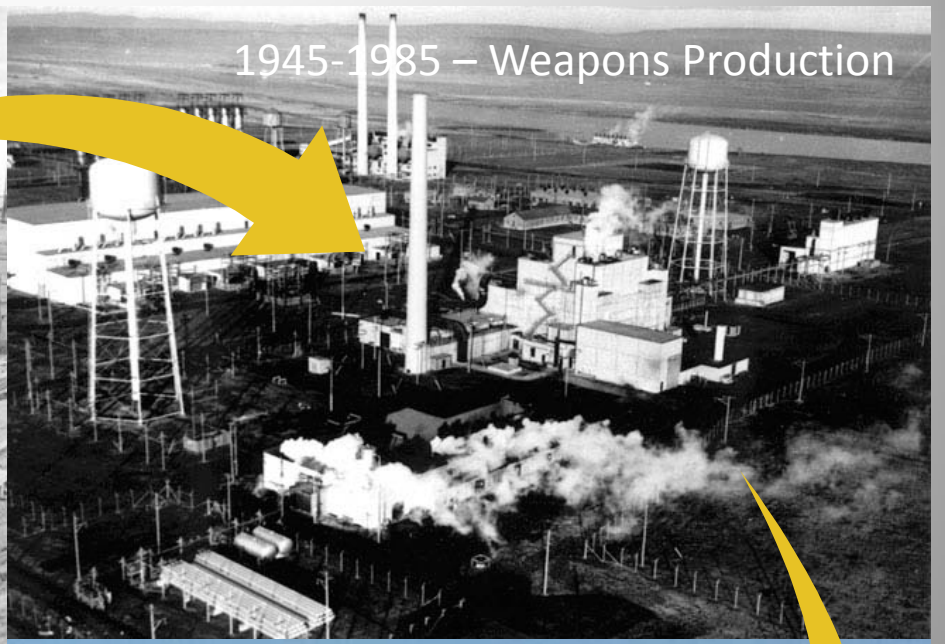
Hanford pre-1942

Wanapum village looking downstream toward Hanford

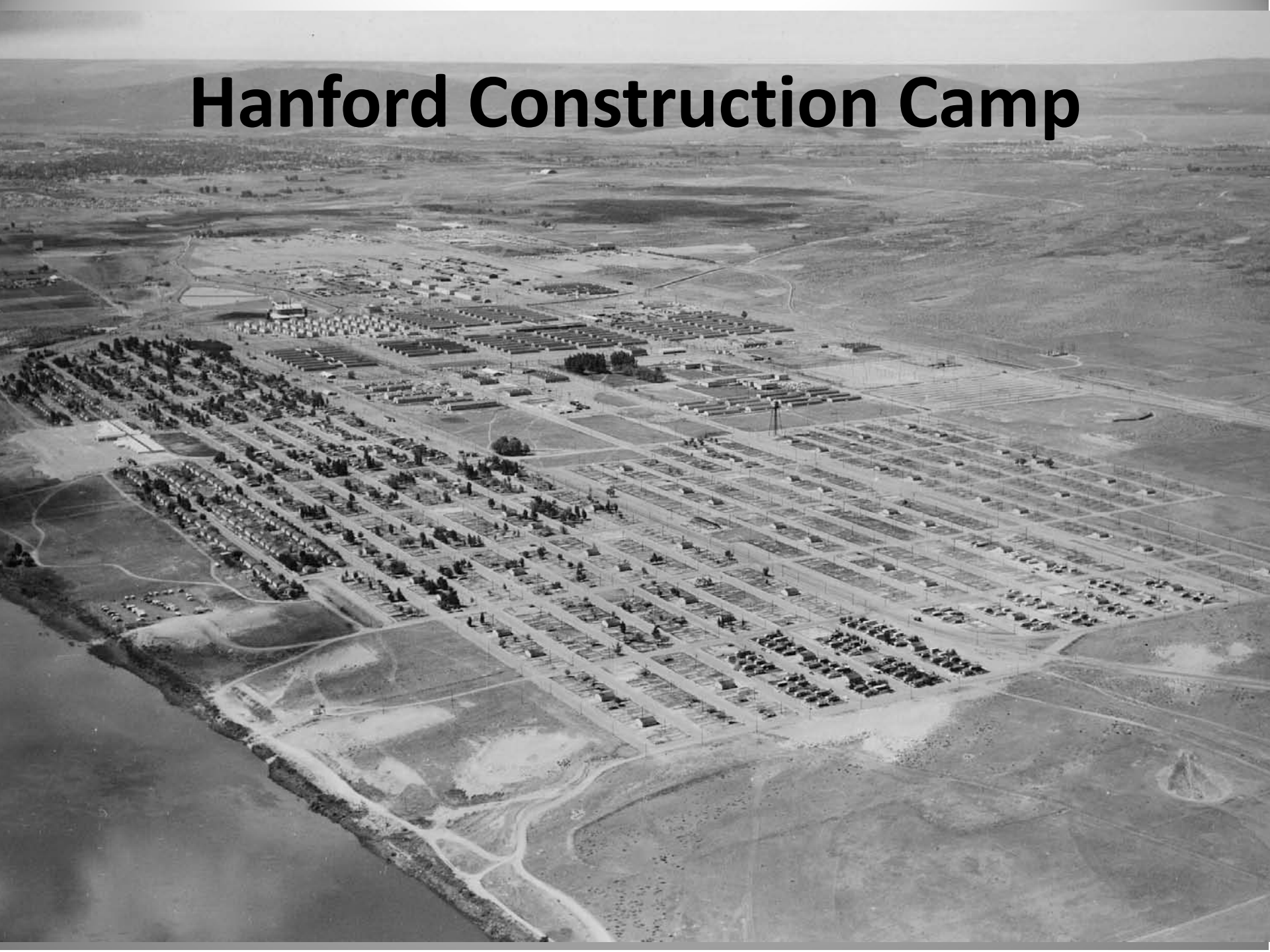
Small agricultural communities of Hanford and White Bluffs

Historical Overview of the Hanford Site

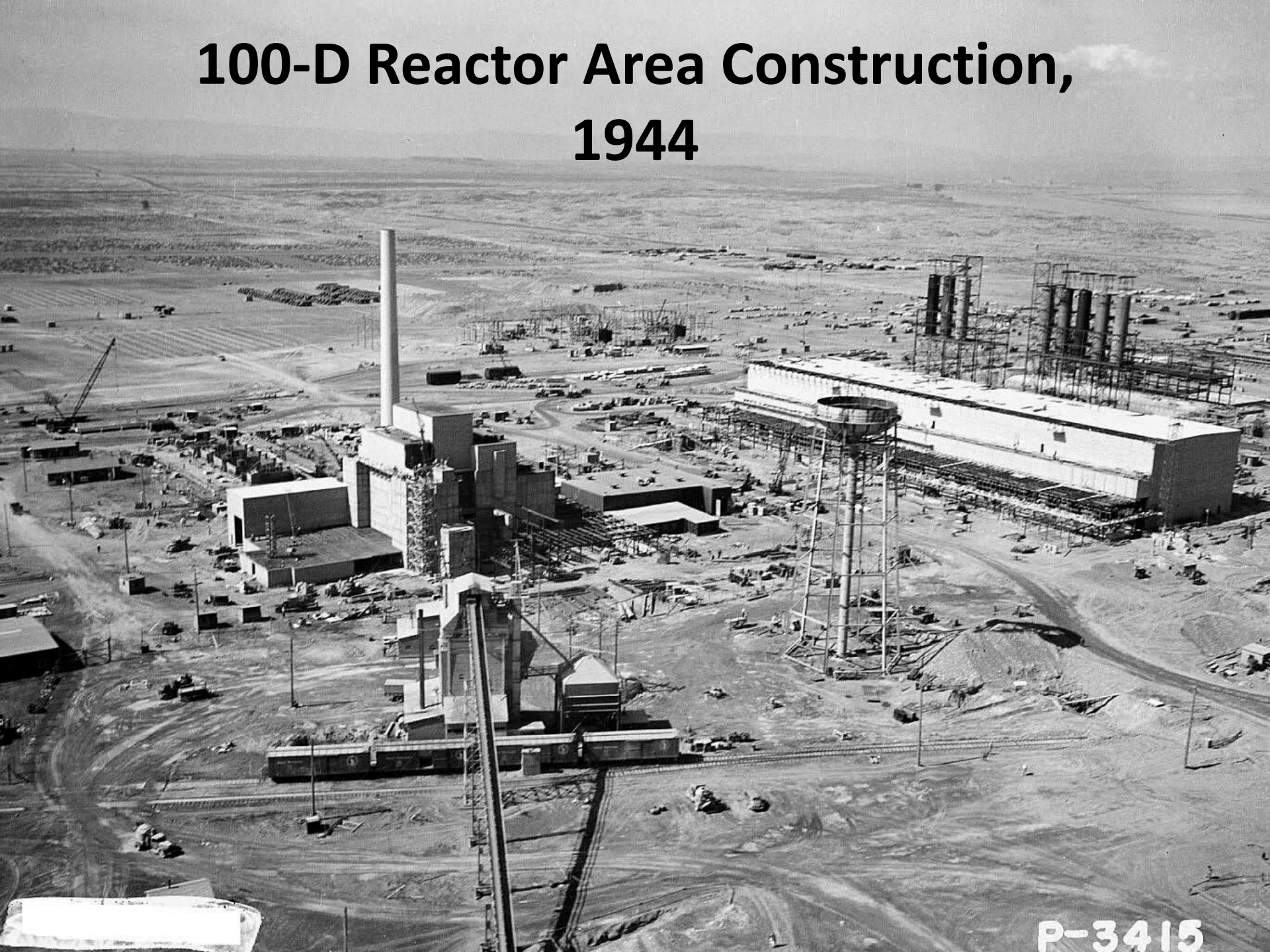




Hanford Construction Camp

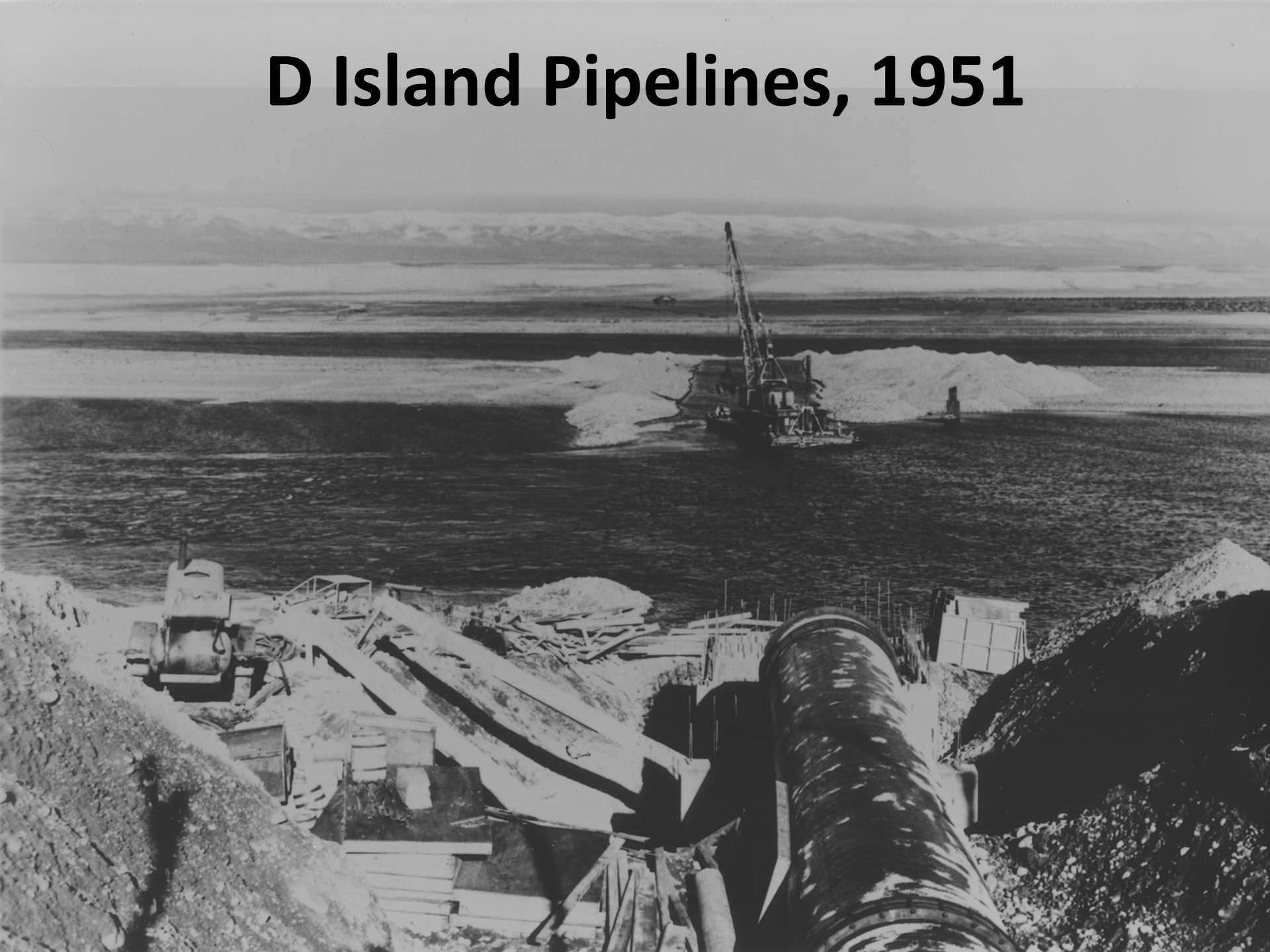


100-D Reactor Area Construction, 1944



D Island Pipelines, 1951

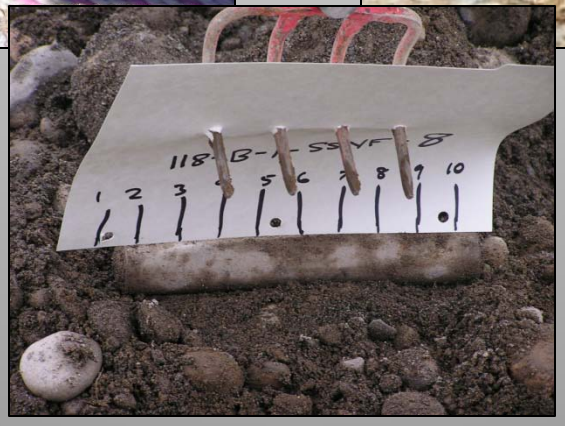
D Island Pipelines, 1951



Example wastes
Burial grounds near Columbia River

Mercury tubes

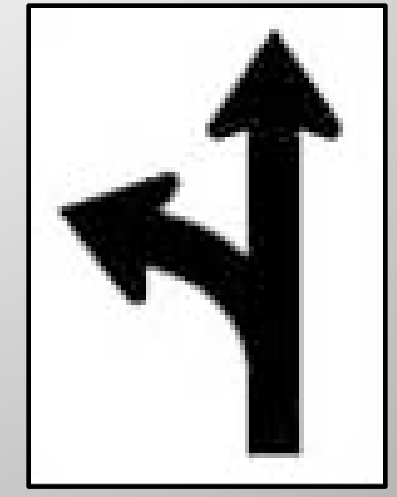
Test animal carcass at 100-F Area



10” piece of Spent Nuclear Fuel

300 Area burial ground
Pyrophoric uranium in drums

What's next?



- All ~50 radioactive waste burial grounds in the Columbia River corridor have been cleaned up, or are subject to a legal decision to clean them up.
- No decision has been made for the 22 radioactive waste burial grounds in the center of Hanford.

Administrative Record & Public Information Repository

DOE/RL-2004-60
Revision 0

200-SW-1 Nonradioactive Landfills Group Operable Unit and 200-SW-2 Radioactive Landfills Group Operable Unit Remedial Investigation/Feasibility Study Work Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

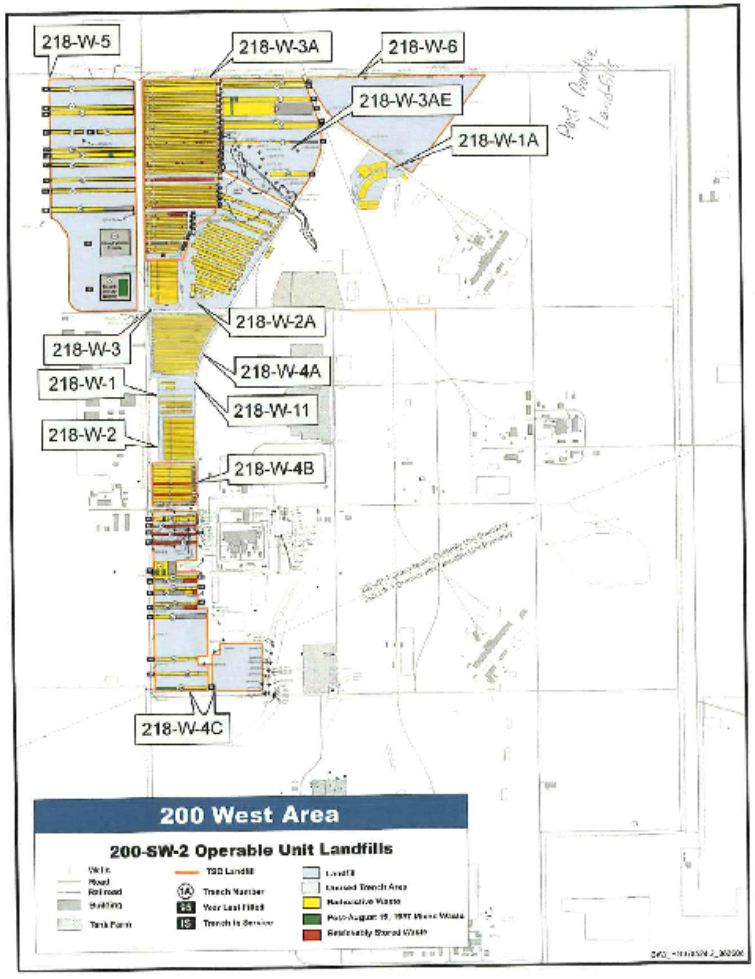
Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

FLUOR
P.O. Box 1000
Richland, Washington

Approved for Public Release;
Further Dissemination Unlimited

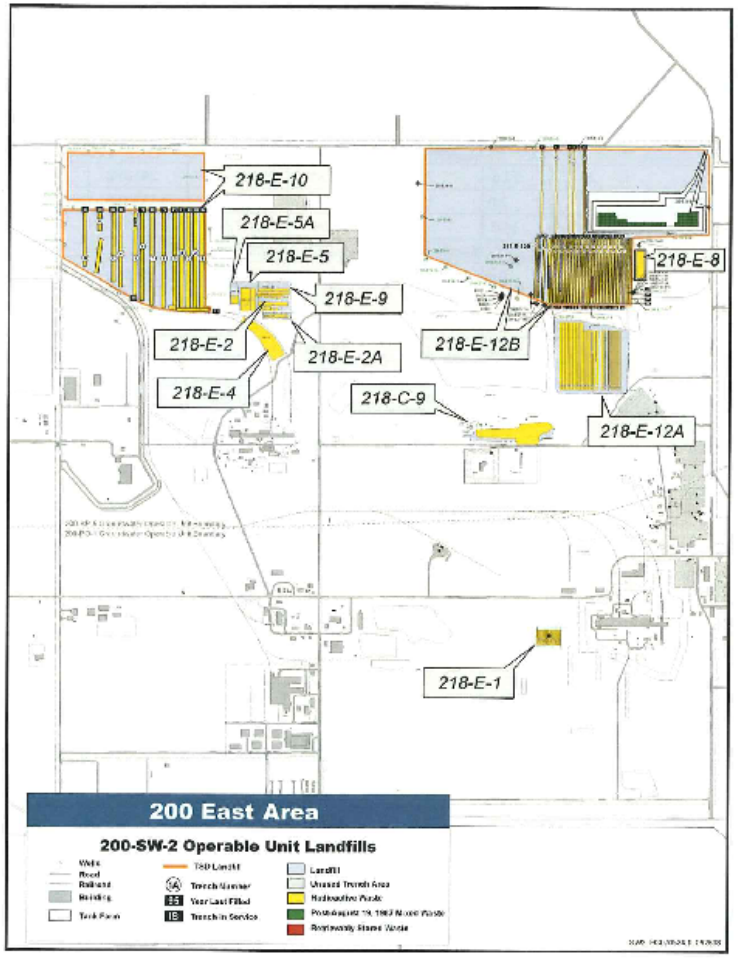
200 West

Figure 1-3. Location of 200-SW-2 Operable Unit Landfills in the 200 West Area.



200 East

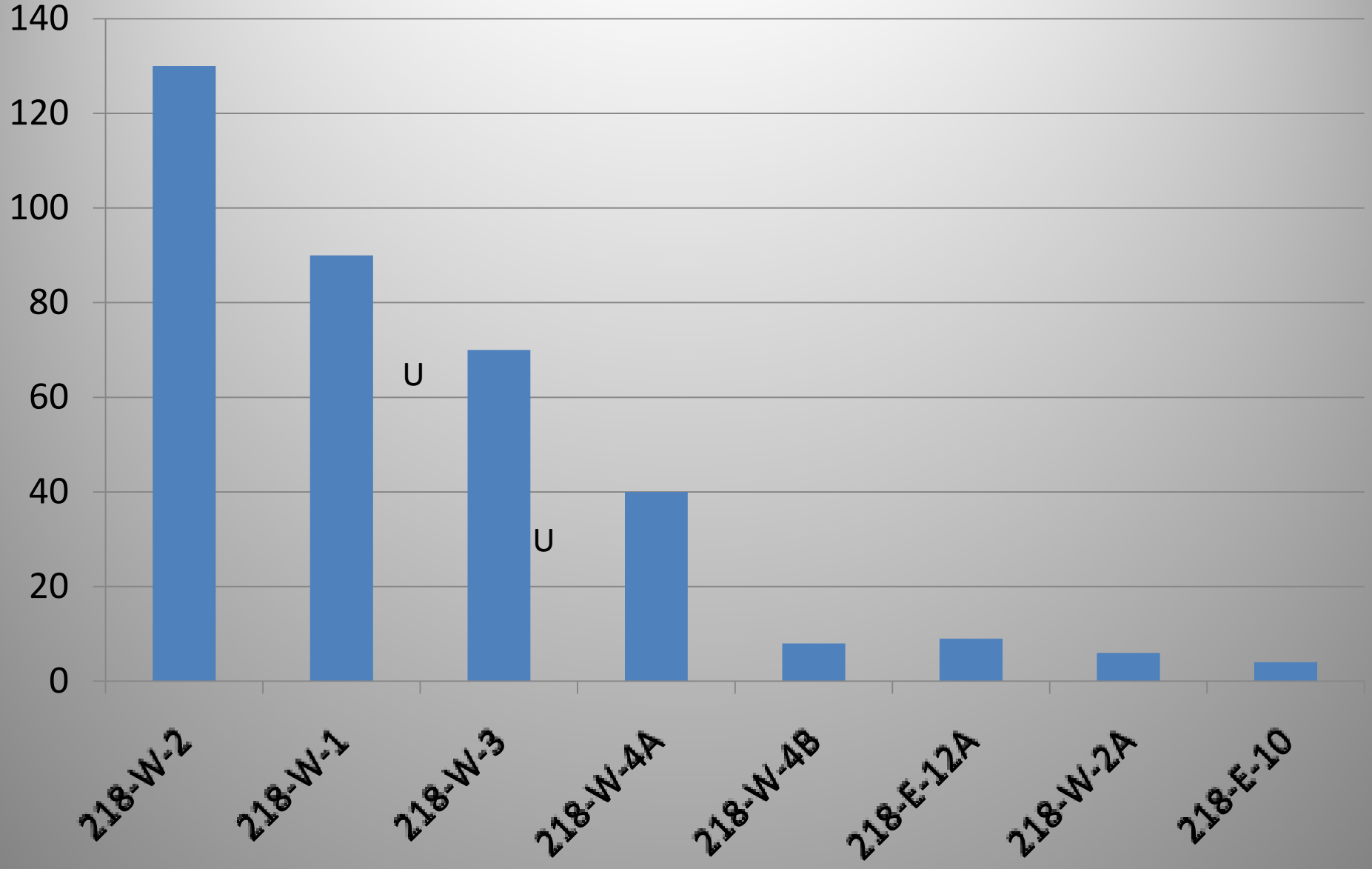
Figure 1-4. Location of 200-SW-2 Operable Unit Landfills in the 200 East Area.



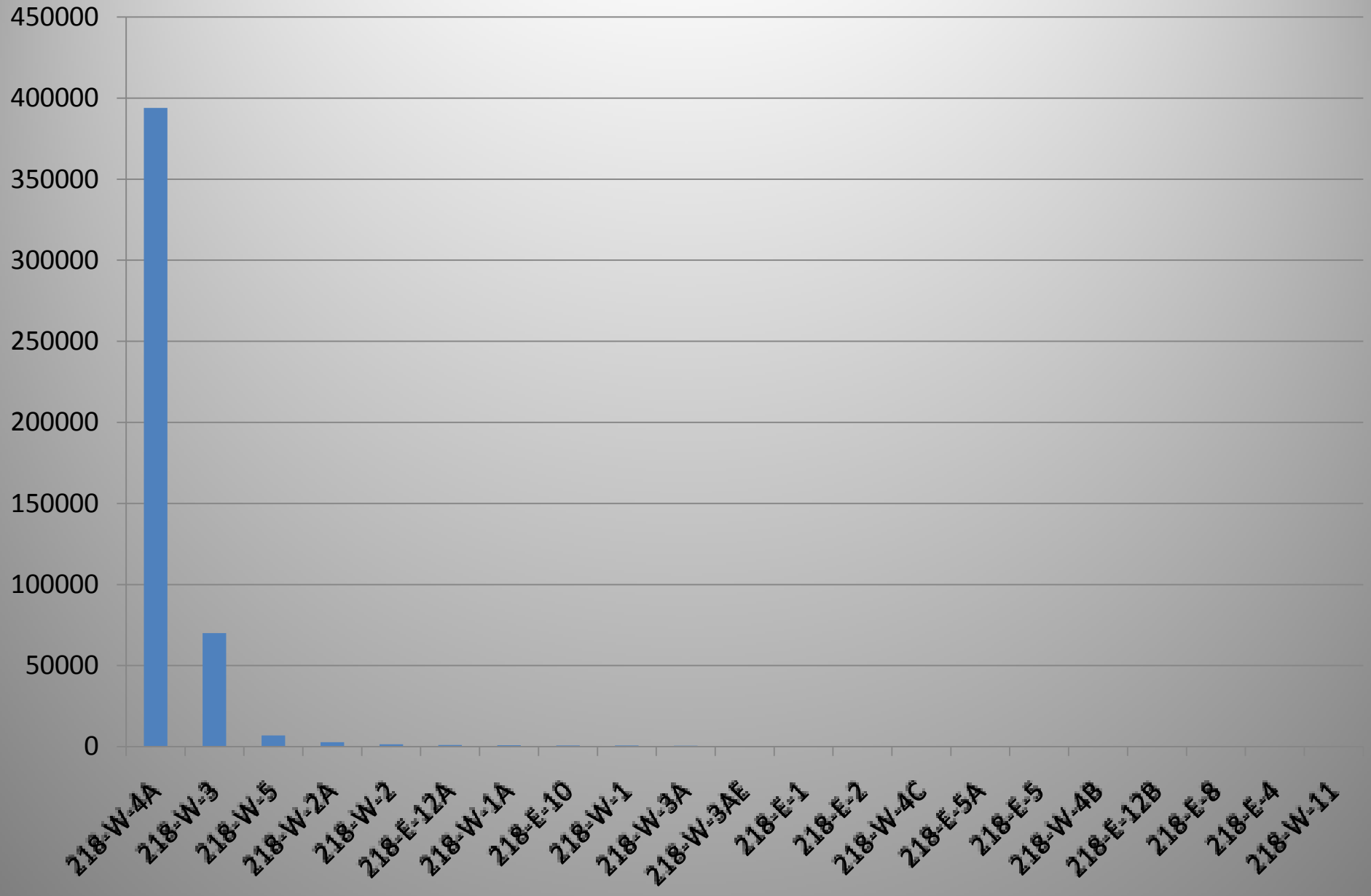
Trench 94
Nuclear submarines/cruisers

218-W-3
218-W-3A
218-W-2A
Dike
216-T-4B Pond
216-T-4-2 Ditch
218-W-3AE

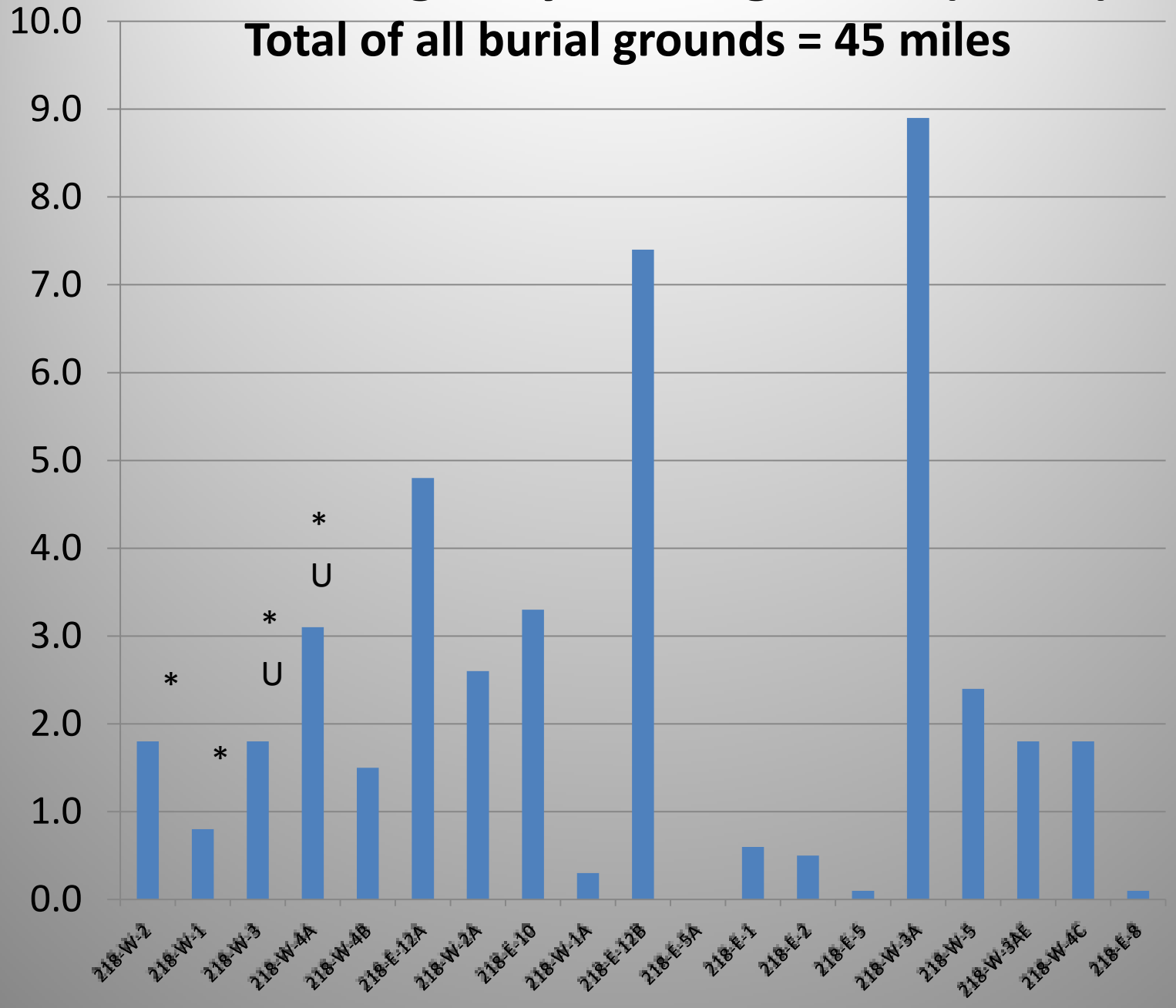
Plutonium inventory by burial ground (kg)



Uranium inventory by burial ground (kg)



Trench length by burial ground (miles)



Dry waste landfills

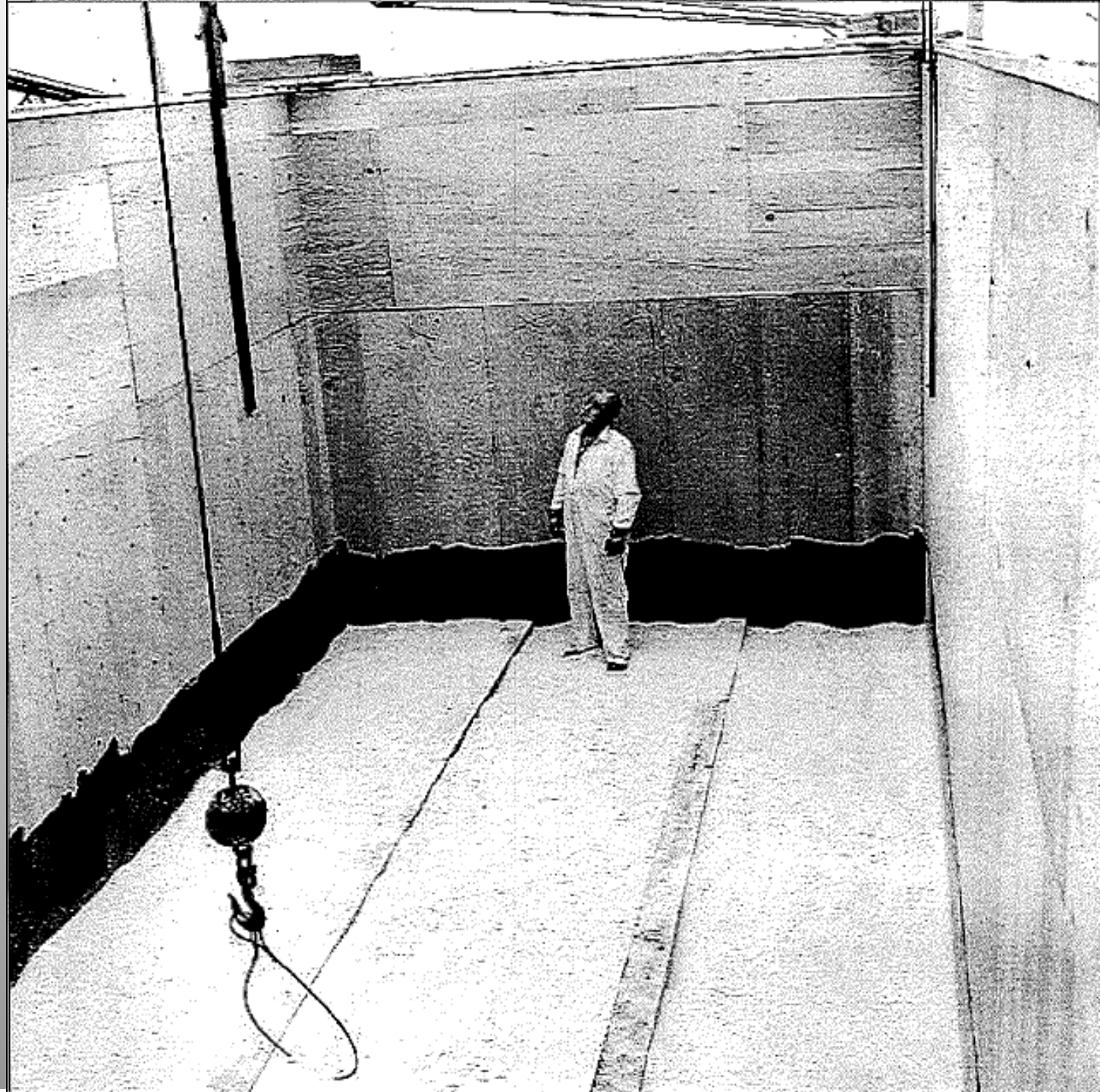
Contain contaminated soils, potentially contaminated rags, paper, wood, contaminated small equipment, and comprise 90% of plutonium inventory – 4 burial grounds

Industrial waste landfills

Large failed equipment from processing buildings

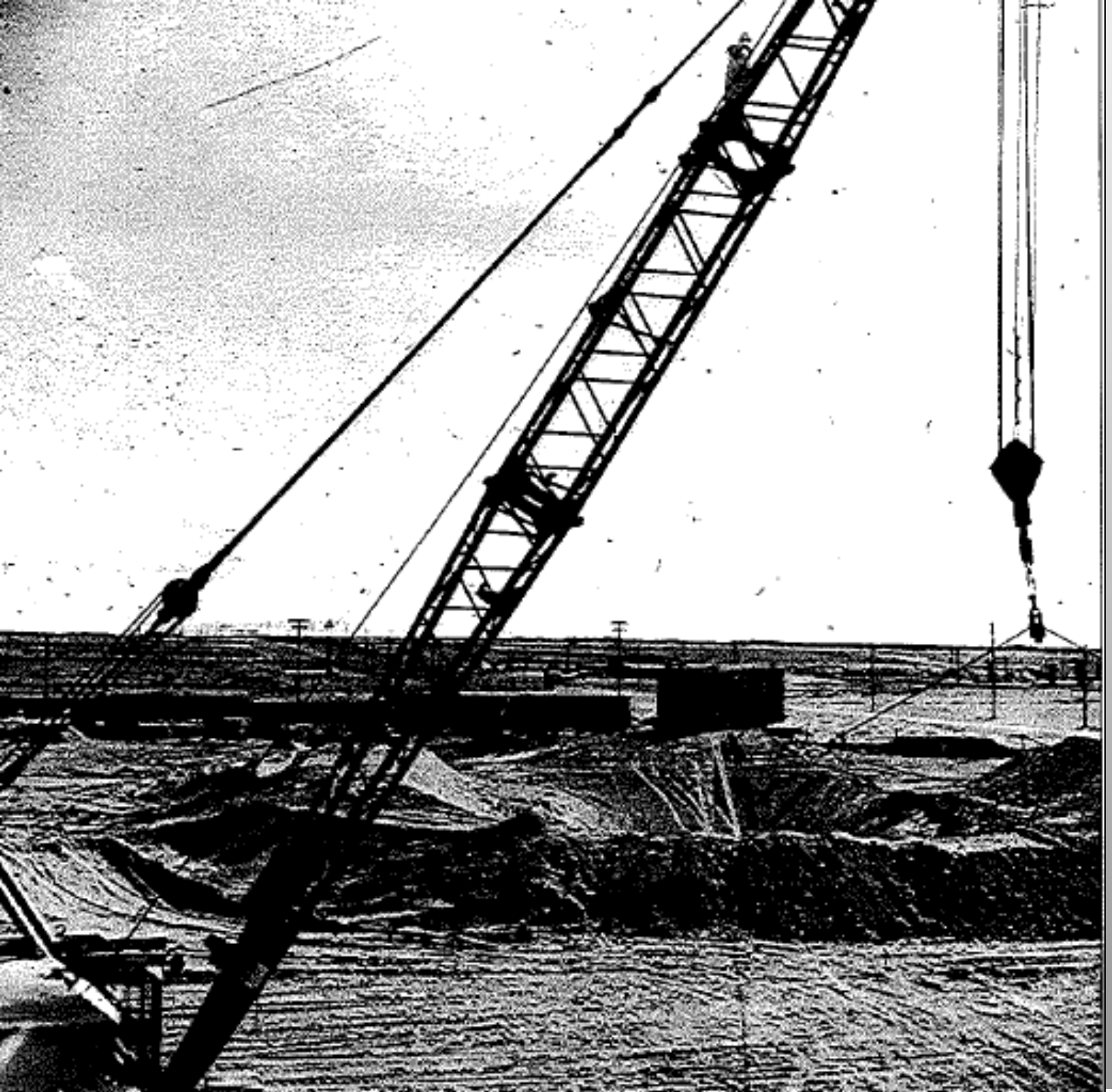
Burial Ground near Redox, 200 West

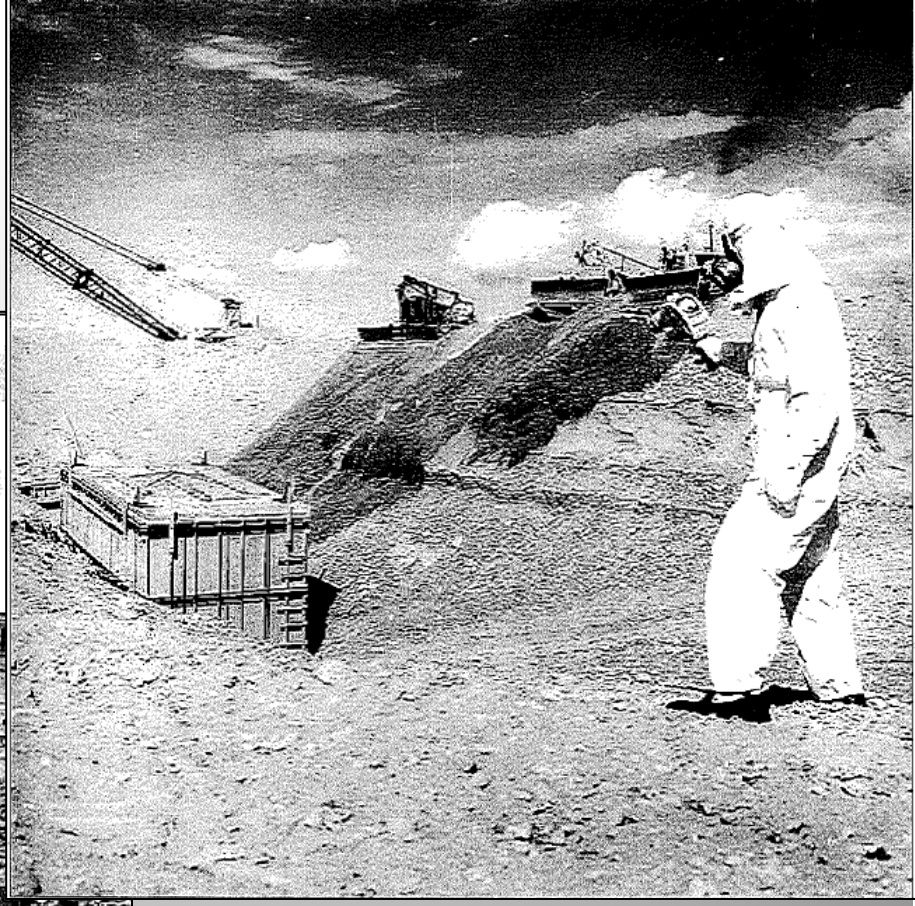
Waste box for failed industrial equipment



Monitoring radiation outside a Canyon building

Multi-ton shield door
Purex tunnel





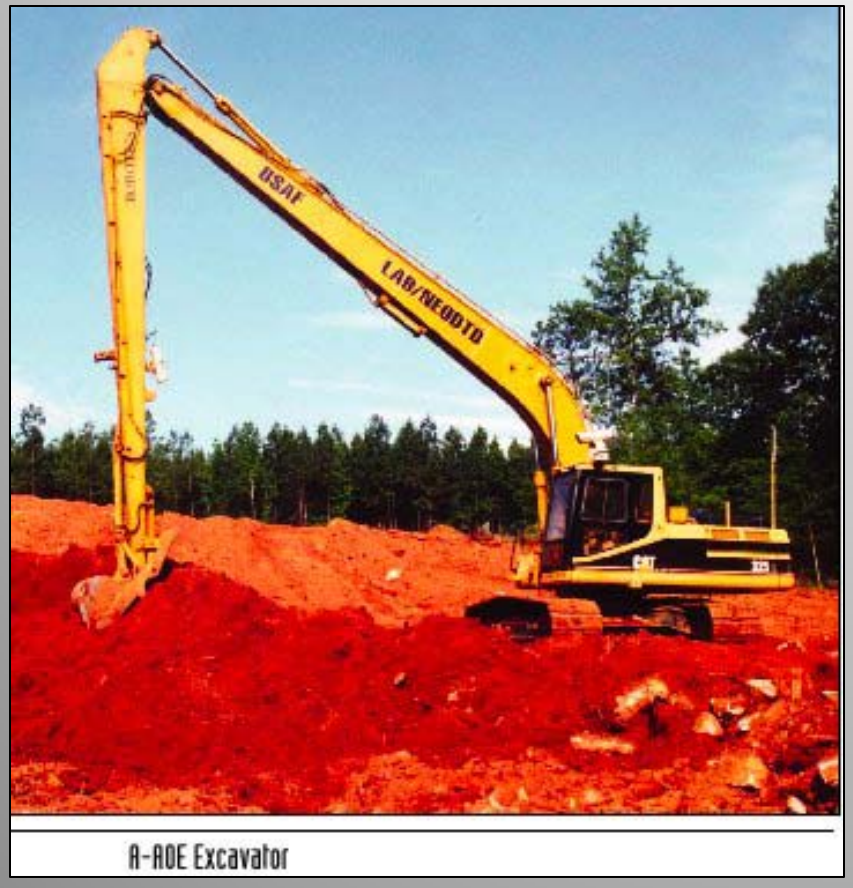
HERE
LIES
"J 1"
JUNE - 1951
APRIL - 2 - 1955

Retrieving dry waste
Pit 4 – USDOE Idaho site

Excavating waste inside the Containment Building

Hand-sorting inside a glove box

What about robots?
Remotely controlled excavators?



Automated Ordnance Excavator
US Army Jefferson Proving Ground

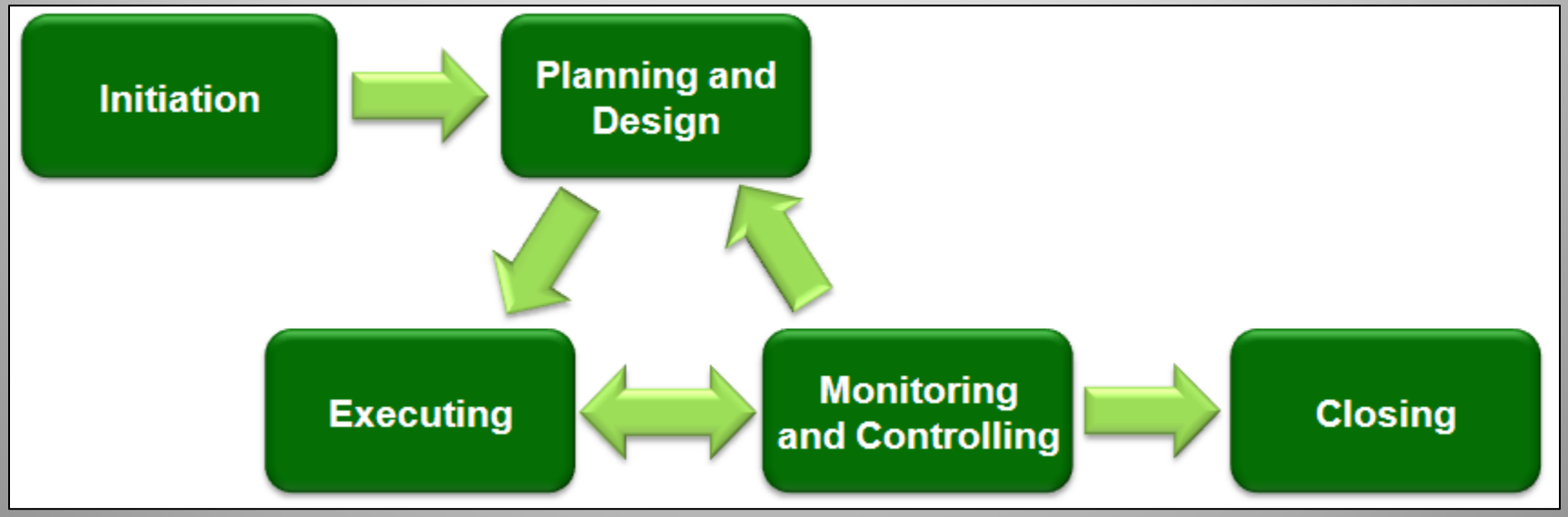
- Caterpillar 325L model excavator
- Typical 2-yard bucket
- 160,000 cubic meters (or more) = nominal 80,000 “scoops”

“Getting on with it”
Transportation

“Getting on with it”
Cost

- Each cubic meter of transuranic waste costs $25,000 to $50,000 to retrieve, package, ship, and dispose at WIPP
- Vs. $100 to $1,000 per cubic meter of Hanford low-level waste excavated and disposed at ERDF

Opportunities to influence public works projects (generic)



Hanford by the numbers

- 2,400 waste management units/areas of concern
- 100 cleanup cost, in billion $
- 80 square miles of groundwater contaminated above drinking water stds.
- 72 radioactive landfills
- 43 miles of landfill trench

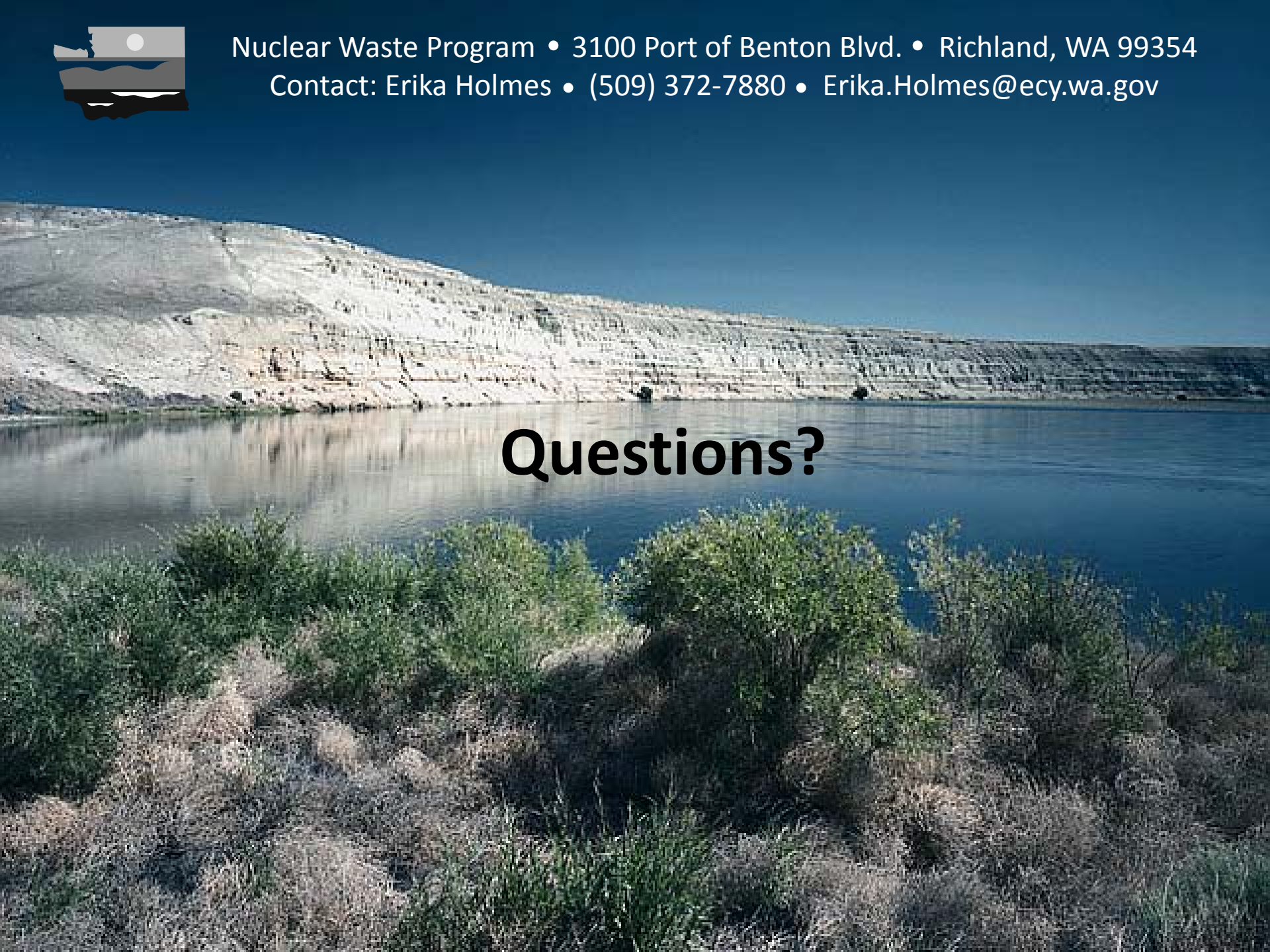
(remaining, Central Plateau)

- 1,000 approximate buildings/facilities
- 177 high-level waste tanks
- 9 plutonium production nuclear reactors
- 6 “canyon” processing buildings
- 2 sodium-cooled test nuclear reactors

What can *you* do about Hanford?

- Get informed. Visit Ecology's web page:
  - http://www.ecy.wa.gov/programs/nwp/index.html
- Stay informed. Join Ecology's listserve:
  - http://listserv.wa.gov/archives/hanford-info.html
- Go to a public meeting. Once a year, the Hanford "State of the Site" visits Seattle.
- Write congress and express your support to fund Hanford cleanup.

Nuclear Waste Program • 3100 Port of Benton Blvd. • Richland, WA 99354
Contact: Erika Holmes • (509) 372-7880 • Erika.Holmes@ecy.wa.gov



Questions?