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GESTION DES DECHETS RADIOACTIFS AUX USA

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Journées thématiques de la SFRP
1er et 2 octobre 2013

Where do the wastes come from?

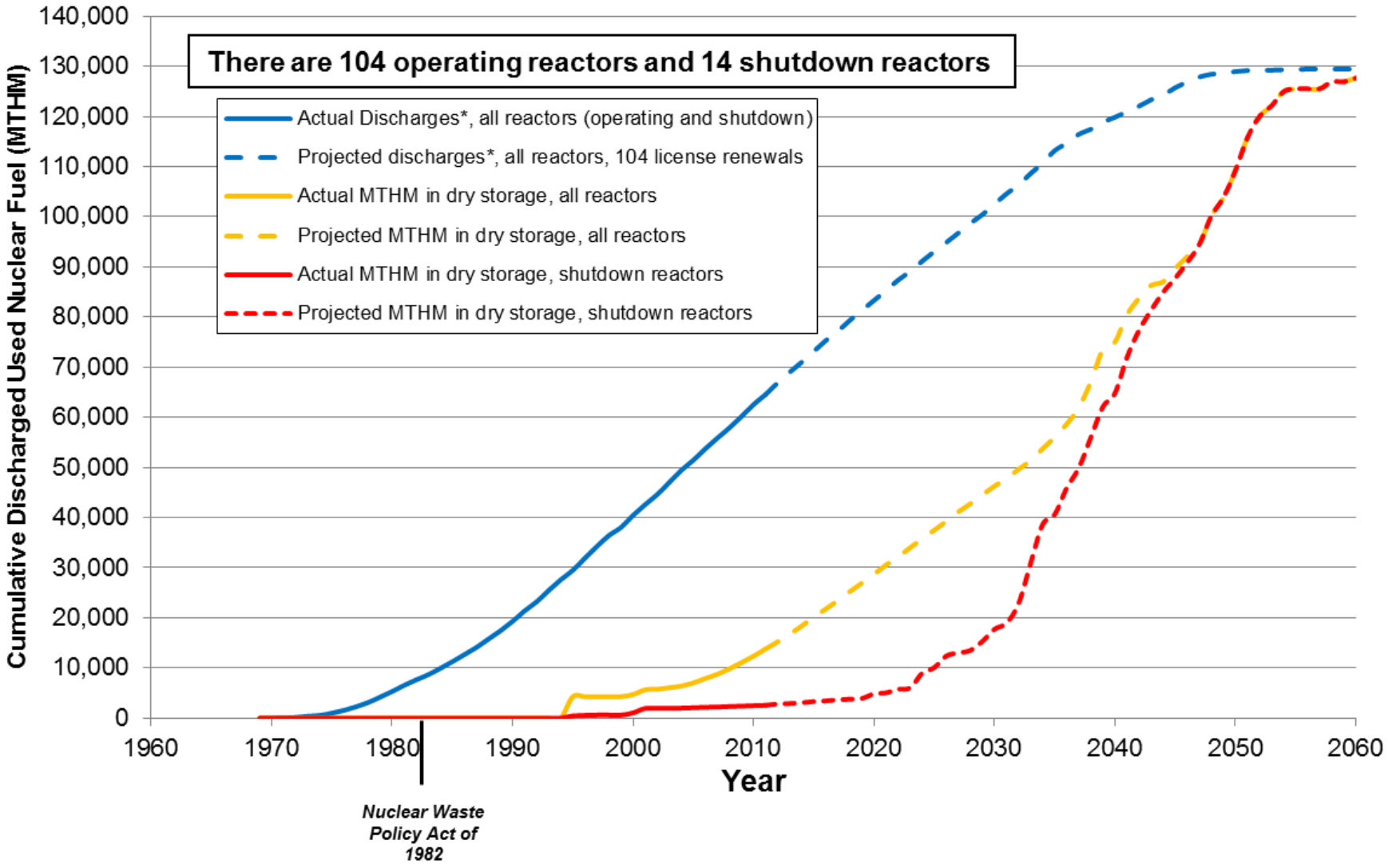
- **Commercial wastes**: few amount arisen from reprocessing activities in the 60s-70s and large amount of SNF (currently 70000 Mt). 104 reactors in operation, 800 TWh/y, 20% of electricity
- **Defense wastes**: TRU disposed in WIPP and a huge amount of wastes that need to be treated (mainly at Hanford and Savannah River): 10-15M m^3 (including dismantling of shutdown facilities)
- A DOE issue

Transuranic Waste

- U.S. TRU is disposed of at Waste Isolation Pilot Plant (WIPP)
  - "…defense related waste containing more than 100 nCi of alpha emitting transuranic isotopes per gram of waste, with half lives greater than 20 years…"
- WIPP is the worlds first operating deep geologic repository
  - 650 deep disposal into a 250 million year old, 600m-thick salt bed
- To date (Dec 2012) WIPP has
  - received 11,459 shipments
  - disposed of 87,681 m^3 of TRU waste (87,340 Ci)

WIPP receives first waste shipment in March 1999

Commercial Used Nuclear Fuel

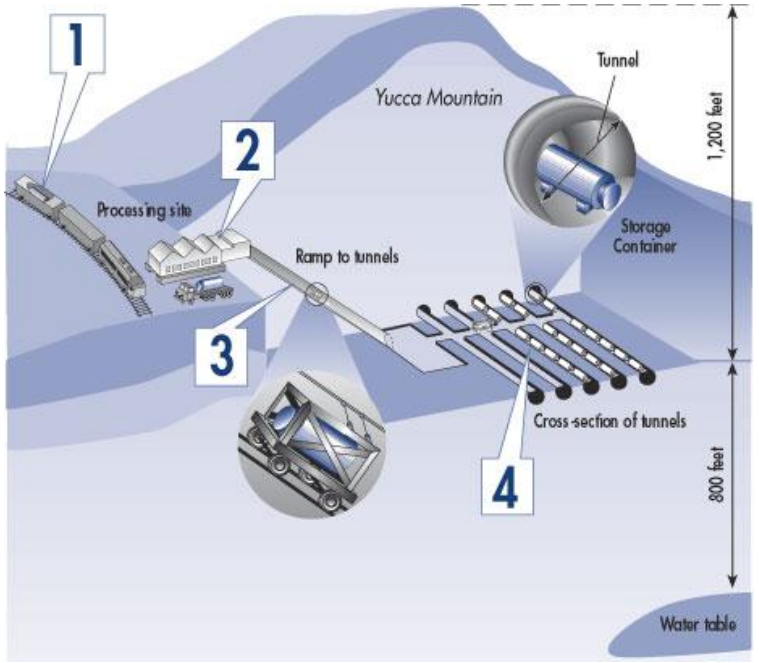


Source: Based on actual discharge data as reported through 12/31/02, and projected discharges, in this case for 104 license renewals

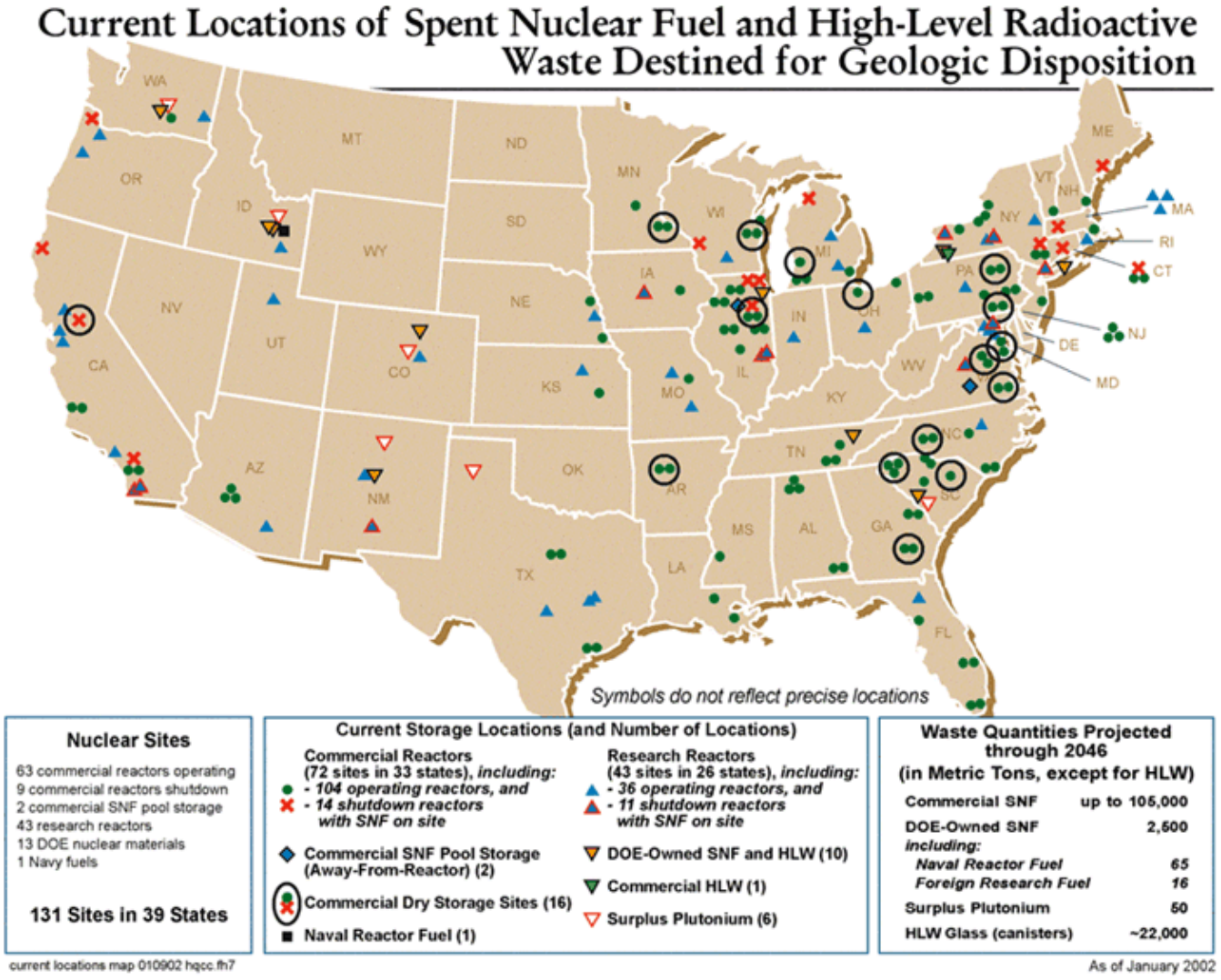
Geological disposal

- **WIPP** (New Mexico): TRU waste stored since 1999. Salt formation, 600m below the surface. Sized for 700,000 m^3

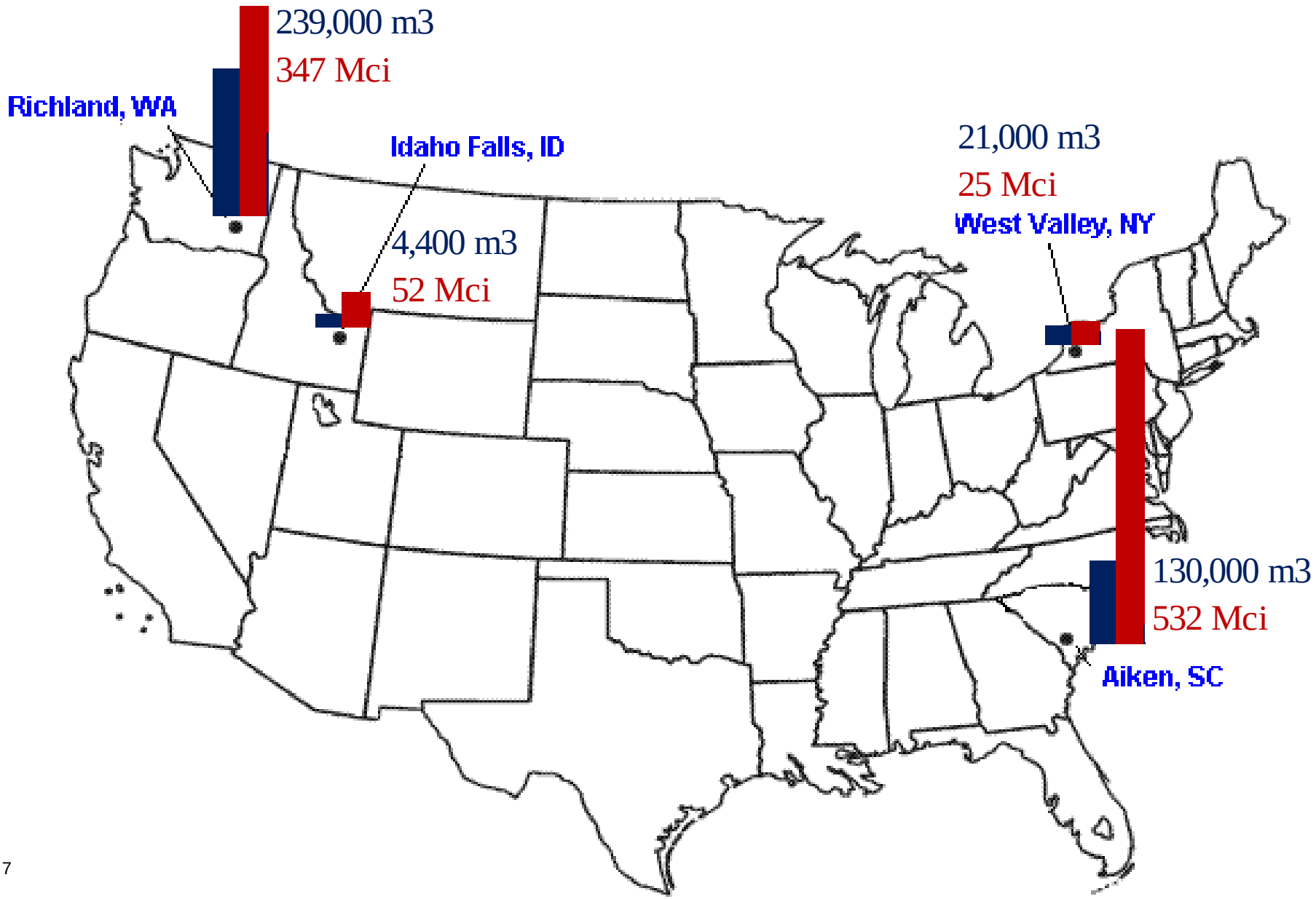
- **Yucca Mountain** (Nevada): First investigations in 1983, unsaturated medium in volcanic tuf, selected for HLW in 1987, URL built in the 90s, ~ 15 B$ spent and eventually abandoned in 2009.



High Level Waste and Used Nuclear Fuel in the U.S.

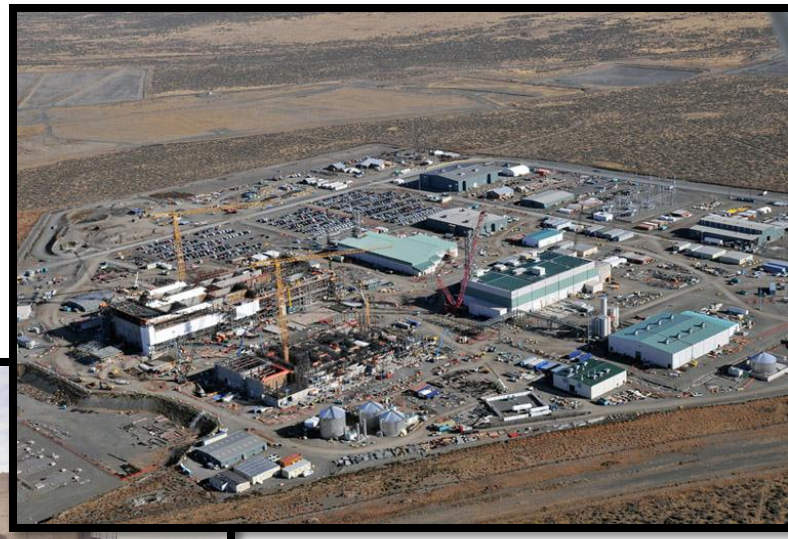


U.S. High Level Waste



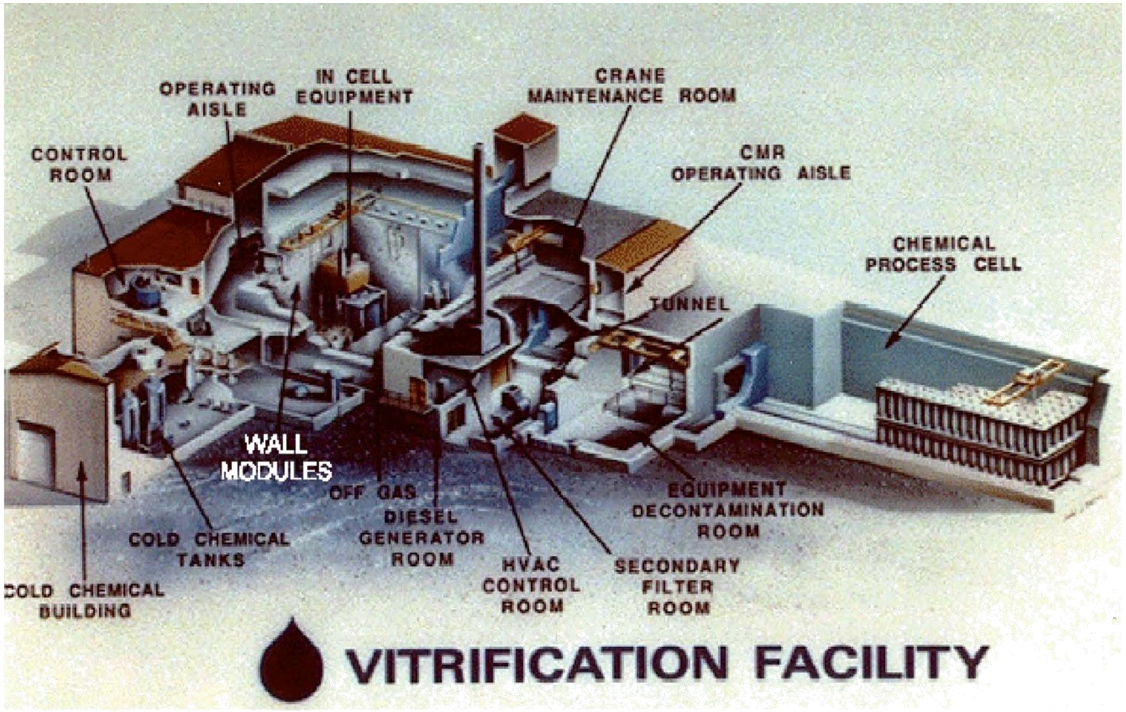
High-Level Waste Treatment

- West Valley Demonstration Project (WVDP)
- Savannah River Site Defense Waste Processing Facility (DWPF)
- Hanford Tank Waste Treatment and Immobilization Plant (WTP)



West Valley Demonstration Project

- 1954: “Atoms for Peace”: Private industry to participate in reprocessing used nuclear fuel
- 1959: New York State identifies nuclear fuel reprocessing as a viable commercial activity
- 1961: Western New York Nuclear Service Center established
- 1962: Nuclear Fuels Services (NFS) begins construction of commercial reactor fuel reprocessing plant
- 1966: Fuel reprocessing begins
- 1972: Reprocessing operations cease → 640 metric tons of fuel reprocessed producing 2500 m3 of waste
- 1980: US Congress passes West Valley Demonstration Project Act to solidify waste
- 1985: Begin vitrification testing
- 1996: Begin processing waste in vitrification facility (June 1996)



Savannah River Site

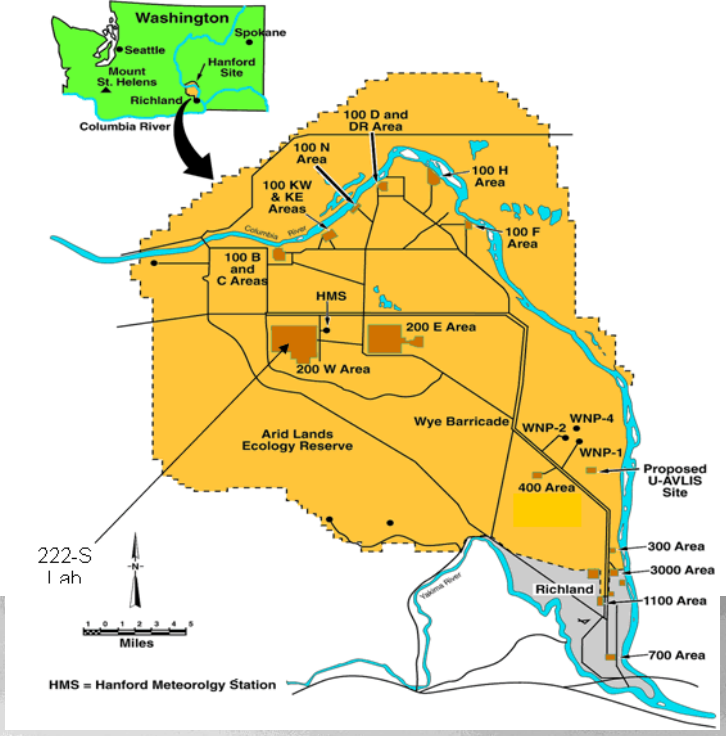
- 1951: Plant construction begins
- 1953-1955: R-, P-, L-, K-, and C-reactors go critical
- 1954-1955: F-, H-canyons begin operation
- 1981: Environmental cleanup begins
- 1991: Production of weapons materials ceases → produced 130000 m^3 of tank waste
- 1996: DWPF (vitrification) begins operation

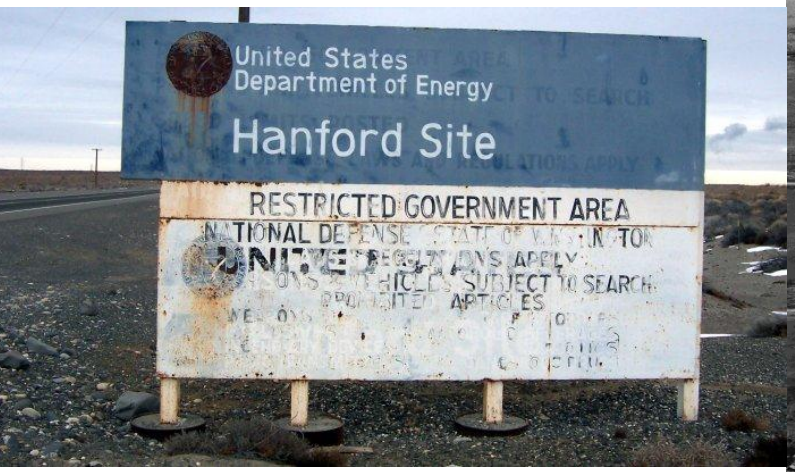
Defense Waste Processing Facility, cont.

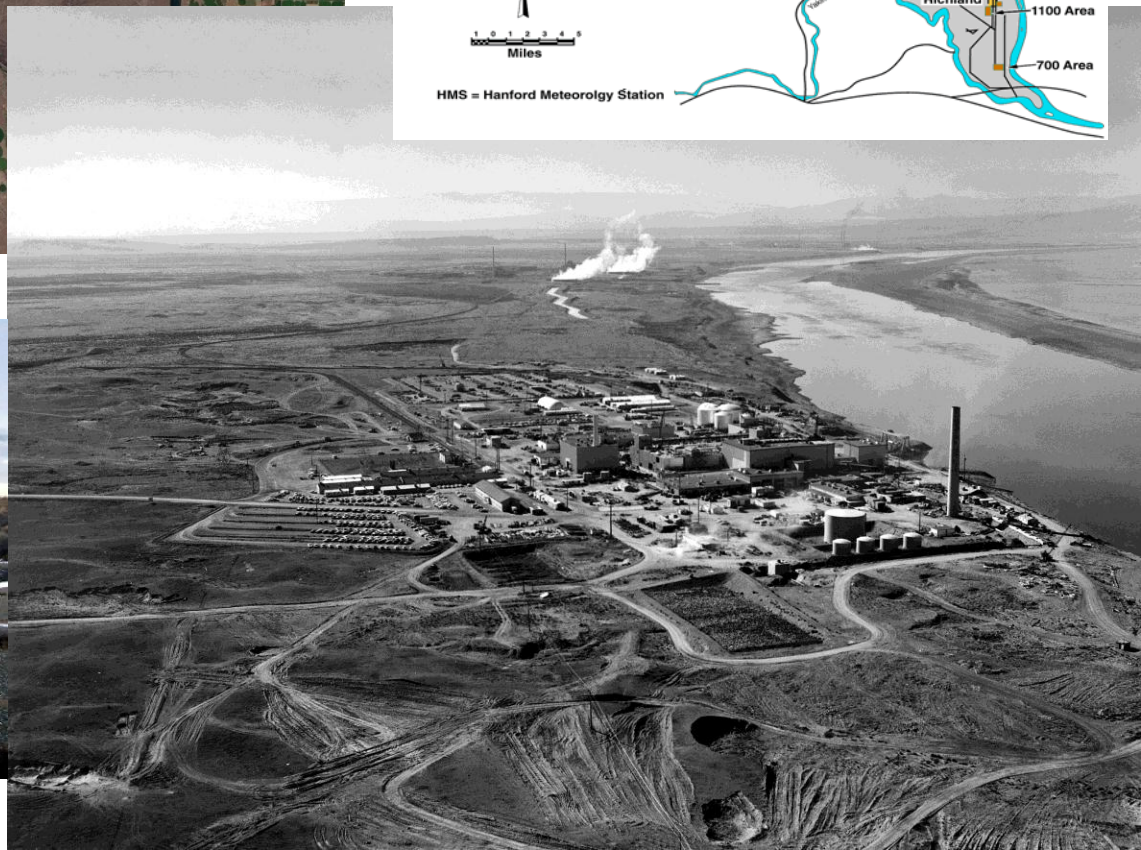
- March 1996: Hot startup of DWPF

	Melter # 1	Melter # 2	Total
Years Operated	8.5 y (6.5 y rad op) (05/94 to 11/02) (03/96 to 11/02 rad)	10 y (03/03 to …)	16.5 y
Canisters Produced	1339	2264	3603
Glass Produced	2300 M t	3900 M t	6200 Mt
Waste Processed	5 MCi	45 MCi	50 MCi

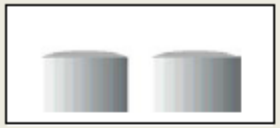
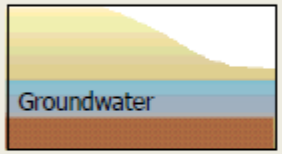
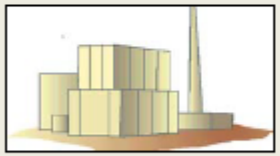
Hanford


Washington
Spokane
Seattle
Mount St. Helens
Hanford Site
Richland
Columbia River
100 D and DR Area
100 N Area
100 H Area
100 KW & KE Areas
100 F Area
100 B and C Areas
HMS
200 E Area
200 W Area
Arid Lands Ecology Reserve
Wye Barricade
WNP-2
WNP-4
WNP-1
Proposed U-AVLIS Site
400 Area
222-S Lab
300 Area
3000 Area
Richland
1100 Area
700 Area
Miles
HMS = Hanford Meteorolgy Station


United States
Department of Energy
Hanford Site
RESTRICTED GOVERNMENT AREA



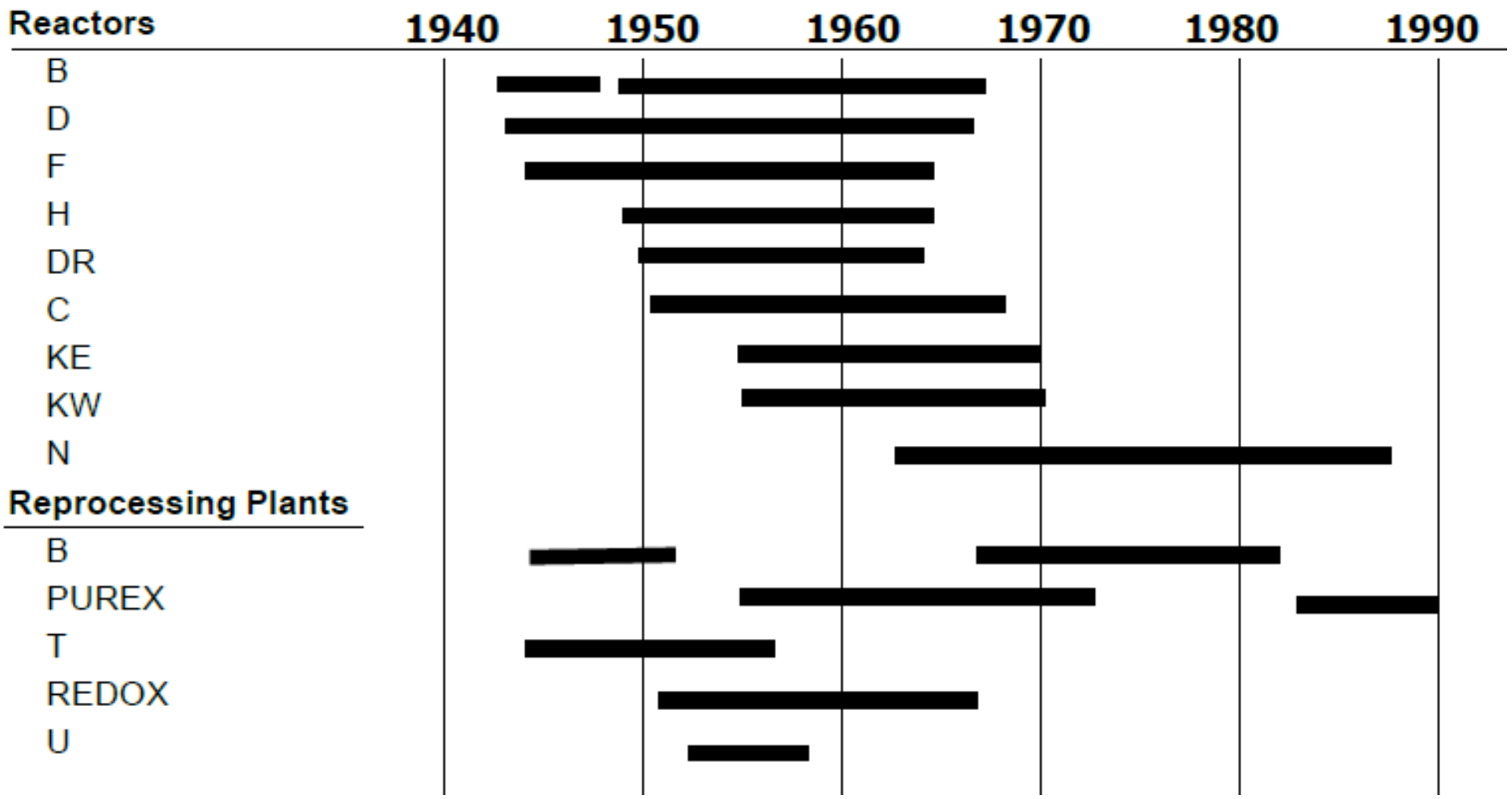
Waste remaining from Hanford nuclear activities

	Volume	Curies[1]	Chemicals[2]
 **Tank Waste**	200,000 m^3	195 million	170,000 MT
 **Solid Waste**	700,000 m^3	6 million	65,000 MT
 **Soil and Groundwater**	1 billion m^3	<1 million	100,000 to 300,000 MT
 **Facilities**	5.5 million m^3	1 million	----
 **Nuclear Material**	700 m^3	150 million	----
	Total	**~350M Curies**	**~330K to 530K MT**

(1) Nuclear materials include SF from K-Basins and Cs/Sr capsules.

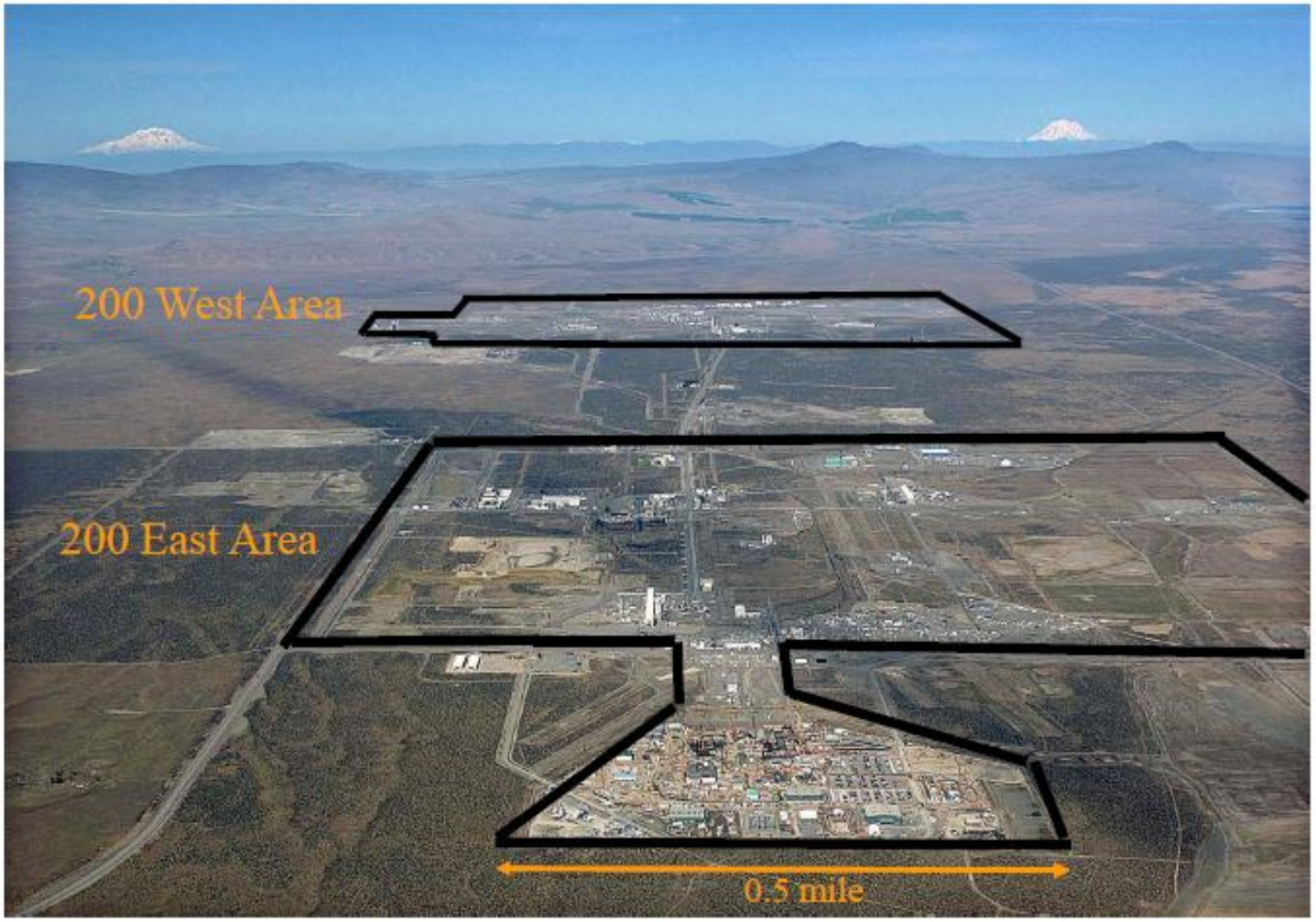
(2) Examples: NO_3, PO_4, Na, CCl_4, TCE, $Na_2Cr_2O_7$

Hanford History Processing History

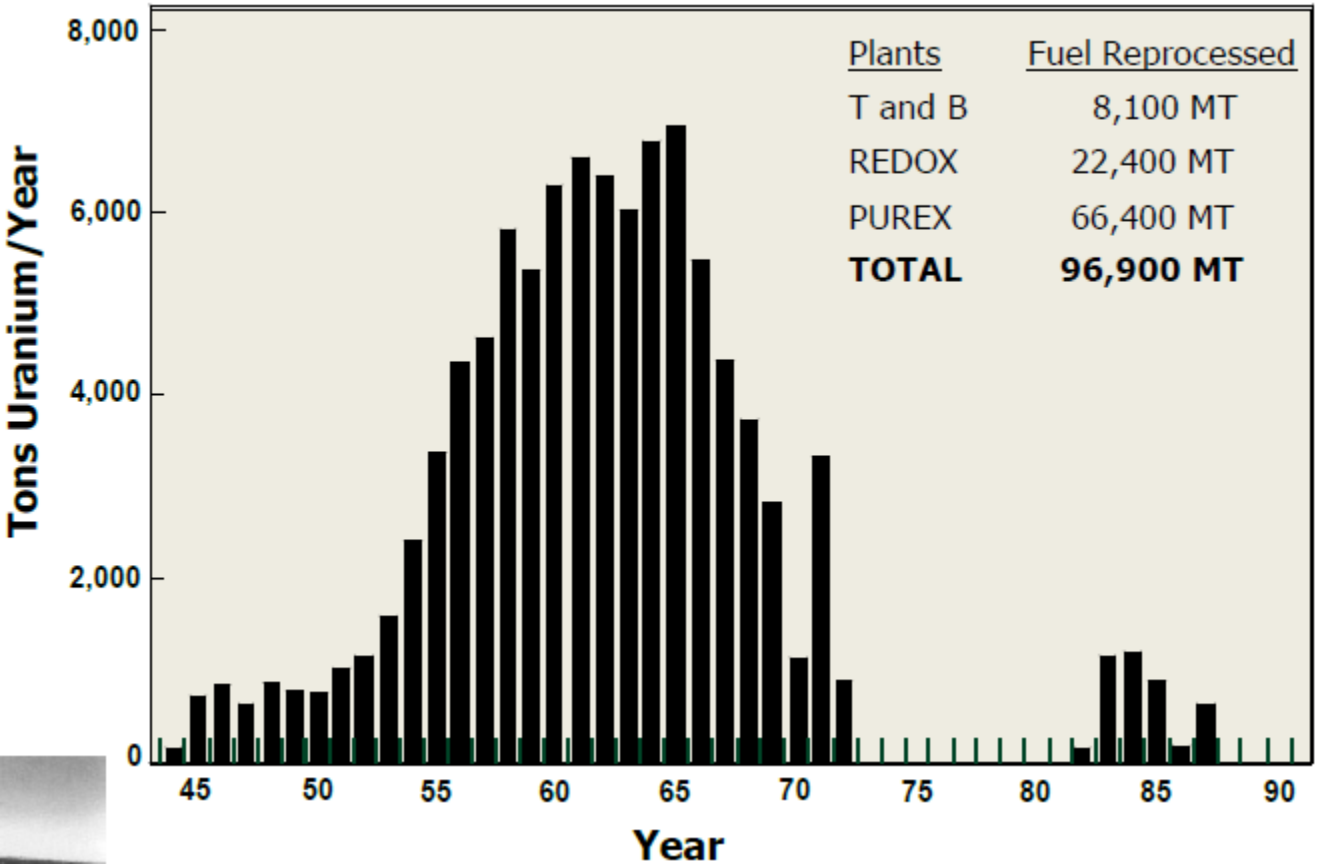


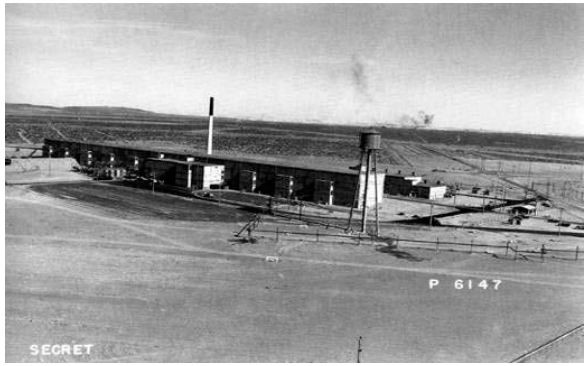
Two of the nine reactors

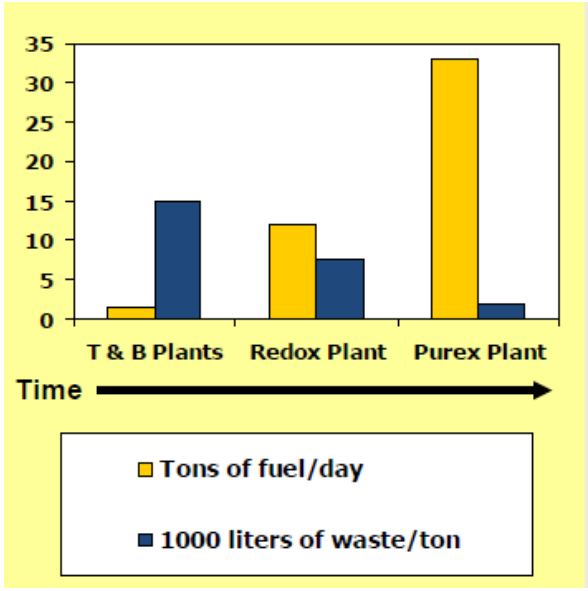
Reprocessing plants



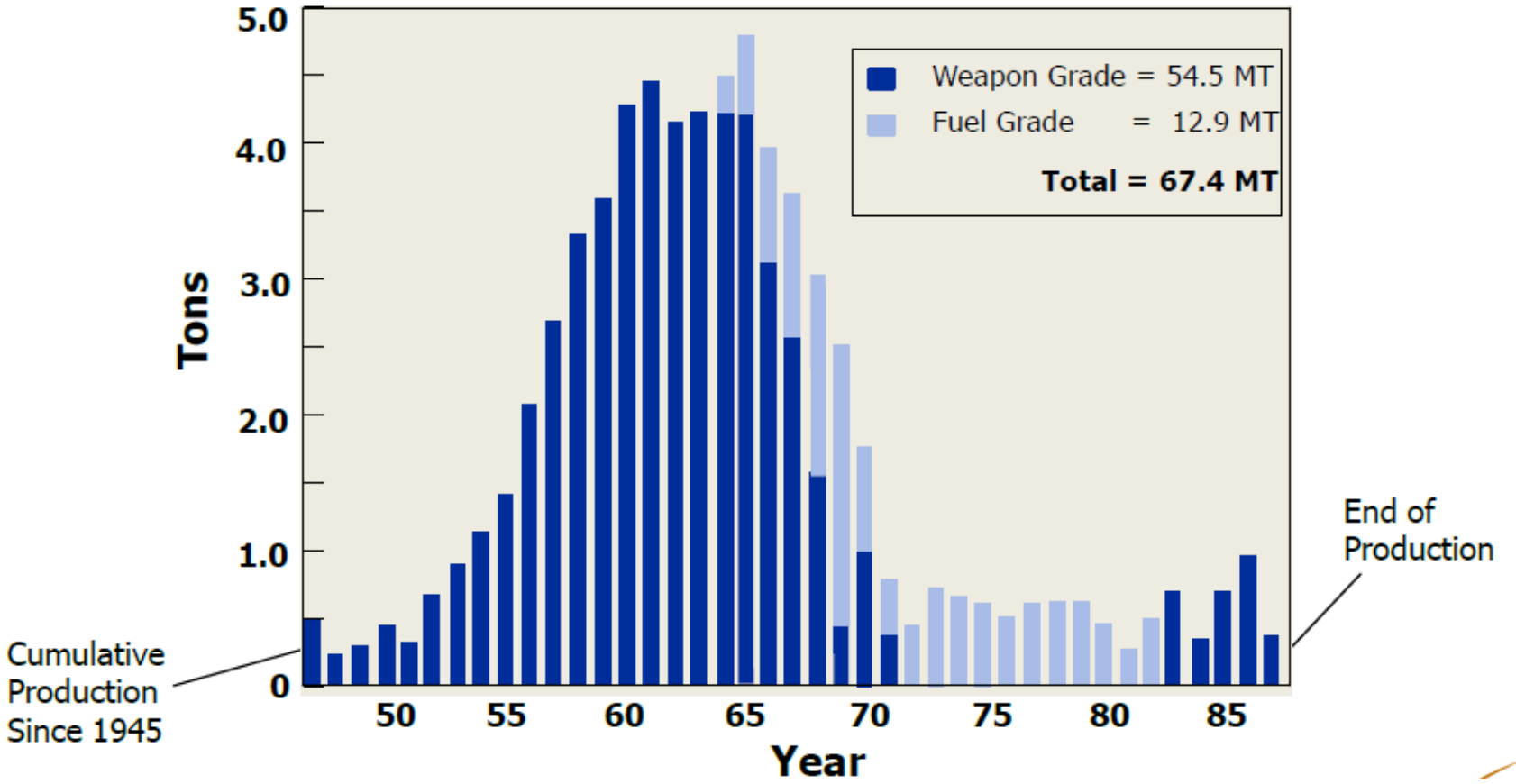
Hanford History, cont.



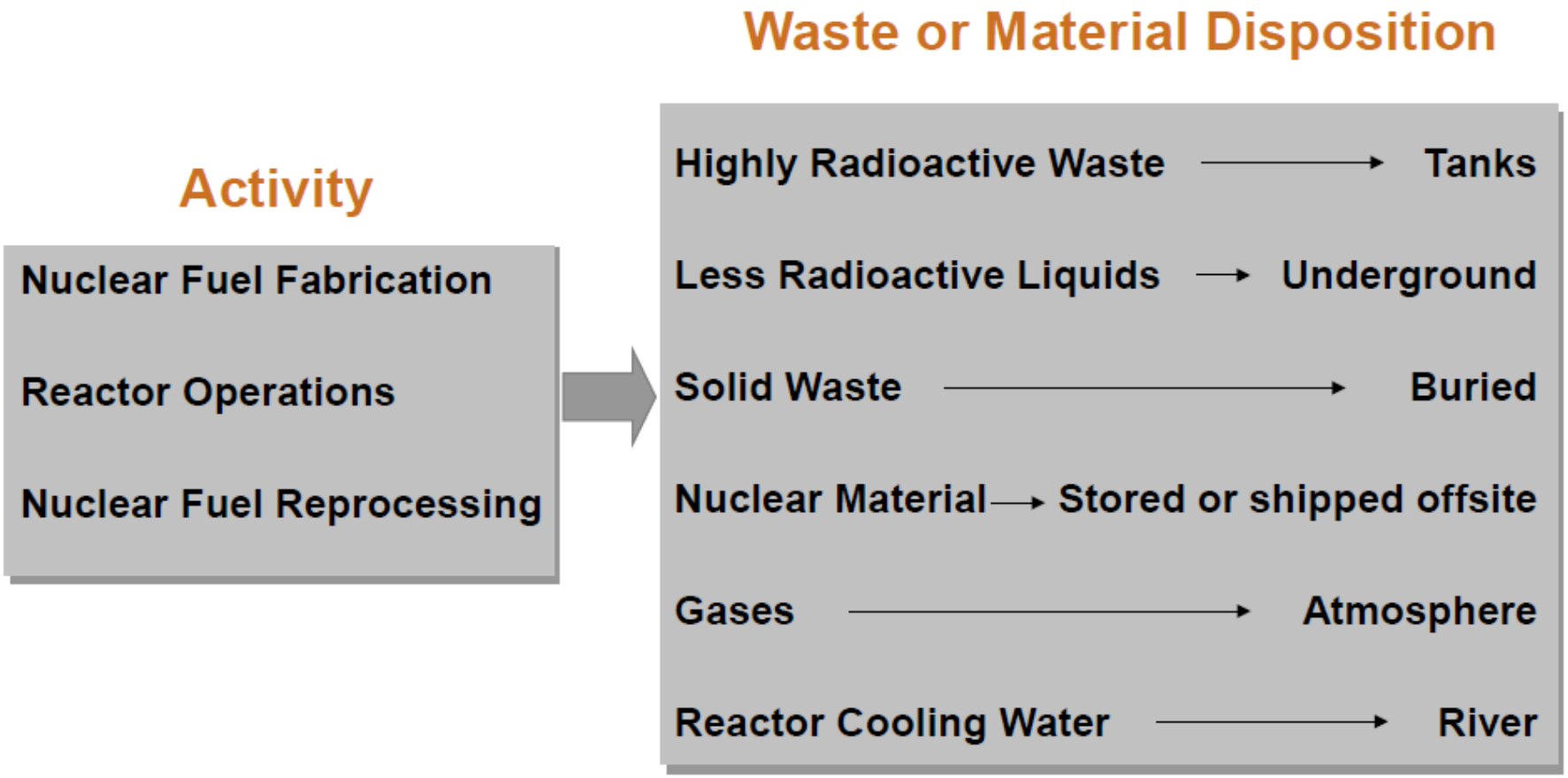




Plutonium production at Hanford



Hanford waste management

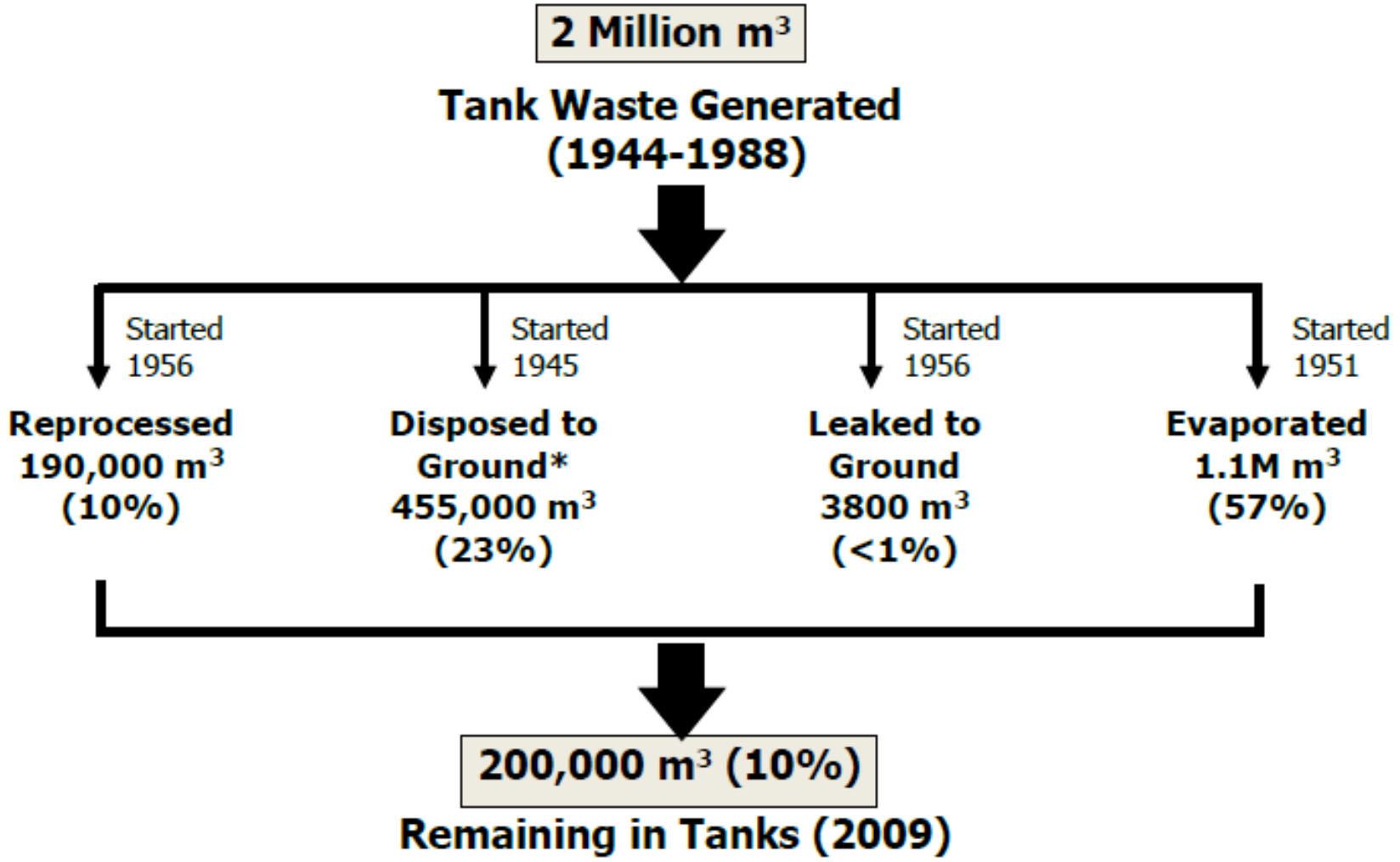


Highly radioactive wastes piped into underground tanks

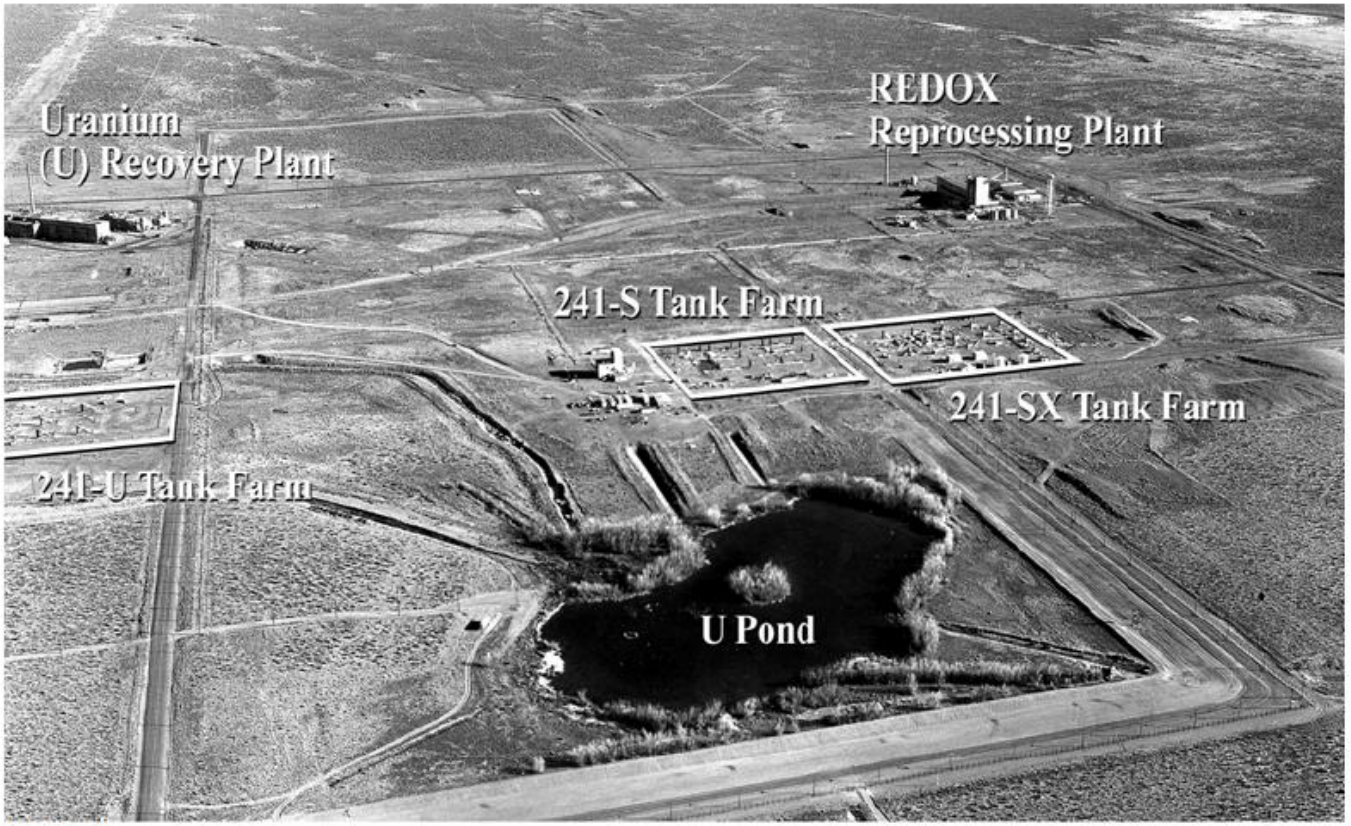
- 149 single-shell tanks in 12 tank farms
- Built 1943 to 1964
- 210 to 3800 m^3 (55K to 1 M gal) capacities
- 67 leaked/suspected <5700 m^3 (1.5 M gals)

- 28 double-shell tanks in 6 tank farms
- Built 1968-1986
- 3800 to 4200 m^3 (1 to 1.1 M gal) capacities
- No leaks

Hanford History, cont.



Methods of releasing liquids into the ground



1962 Photo

30 surface ponds and ditches covering ~ 1.3 km^2 (1/2 mile^2) built in central Hanford released 1.7 trillion liters (450B gallons) of liquids into ground.

Inventories estimates from liquid release

Radionuclides	Discharges to Soil (Curies)	Tank Leaks to Soil (Curies)	Total (Curies)
Cs-137	75,000	150,000	**225,000**
Sr-90	38,000	14,000	**52,000**
Tc-99	600	100	**700**
I-129	4.6	0.1	**4.7**
Am-241	28,700	-	**28,700**
U (total)	270	15	**285**
Np-237	55	-	**55**
Pu (Pu-239, -240, -241)	52,000	-	**52,000**

Buried and stored solid wastes

Early Years

Later Years

- 700,000 m^3 of low-level and transuranic waste (~60% buried pre-1970)
- 10% transuranic contaminated
- 75 solid waste burial grounds (8 active)
- 6 million curies; 65,000 MT chemicals

Key RN relases into the atmosphere

32M curies released

- 12M curies from reactors (99% Ar^{41})
- 20M curies from reprocessing plants (90% Kr^{85})

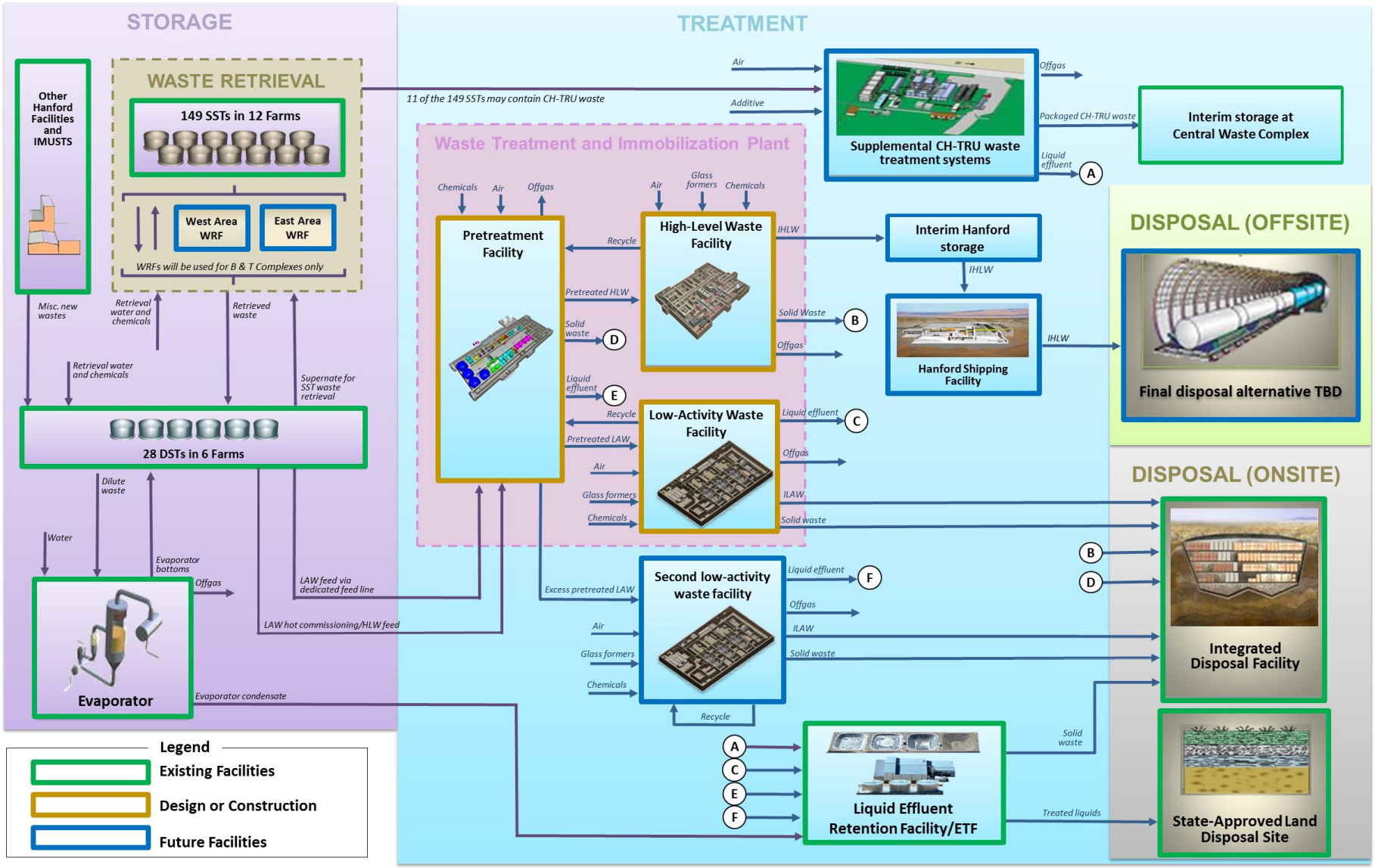
Key Radionuclides Contributing to Radiation Dose (curies)

Year	I-131	Ru-103/-106	Ce-144	Sr-90	Pu-239
1944-1949	697,000	290	1740	30	2
1950-1959	43,000	1130	630	10	<1
1960-1969	460	130	1350	25	<1
1970-1972	<1	1	50	2	<1

99% of dose from I-131

1% of dose from these radionuclides

Hanford Project Flowsheet



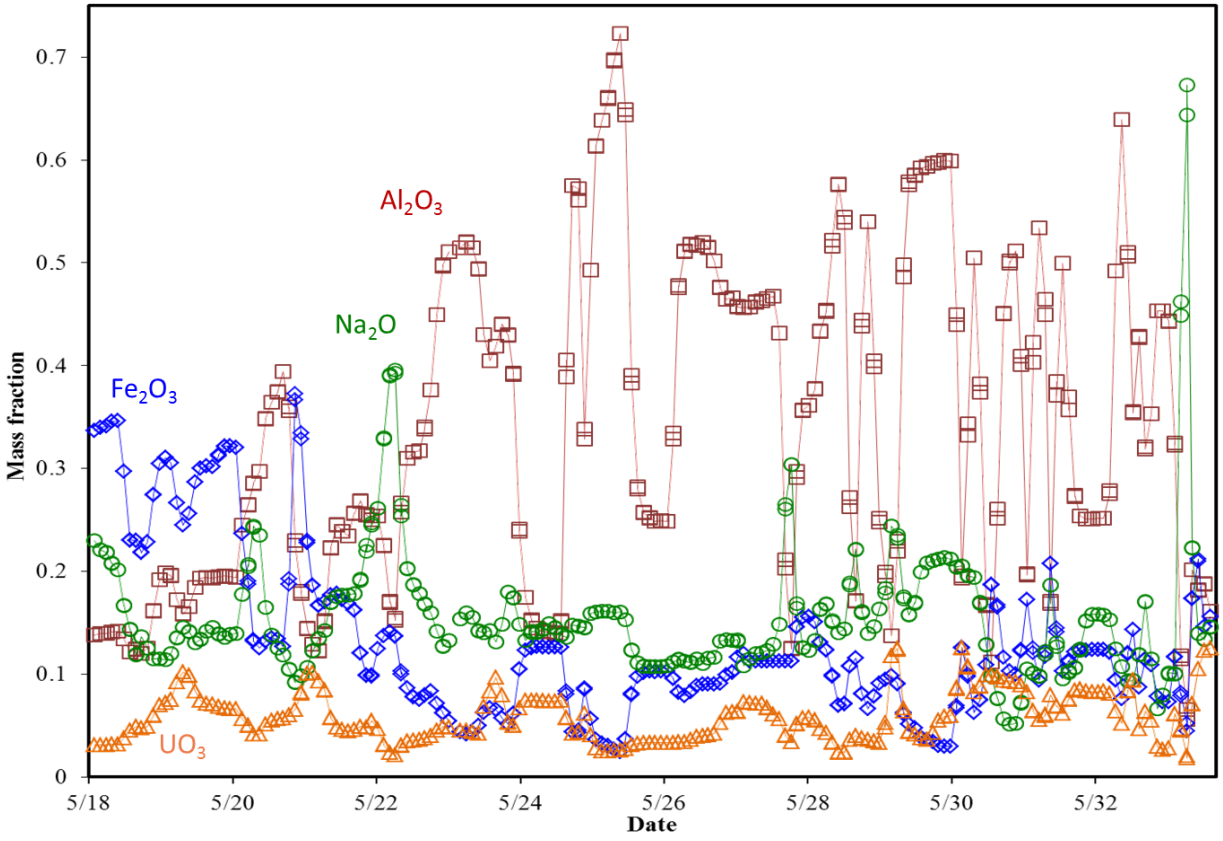
Waste Treatment Plant 65% Complete (2012)

High Level Waste Glass

- WTP to start in 2018 (hot ops in 2019)
- Processing complete in ~2045
- Produce 10,000 – 15,000 canisters
  - 14.8 ft tall, 2 ft diameter
  - 3 MT glass per canister
  - ~5.25 MT glass/day on average
- Roughly 35 wt% waste loading
- Store on-site until repository is available

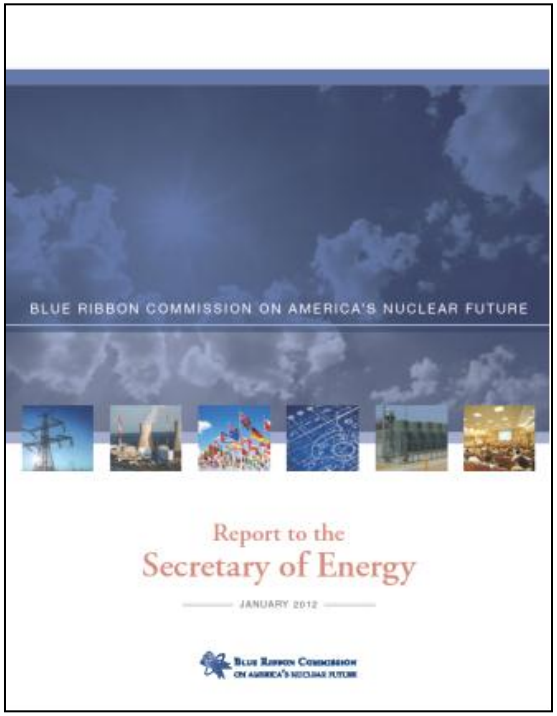
WTP Issues

- Mixing and transport of concentrated slurries
- Cleaning of tanks to sufficient level for closing
- Efficiency of pretreatment process
- Need for supplemental low activity waste treatment
- “black cells”
- Very broad range of waste chemistry/characteristics



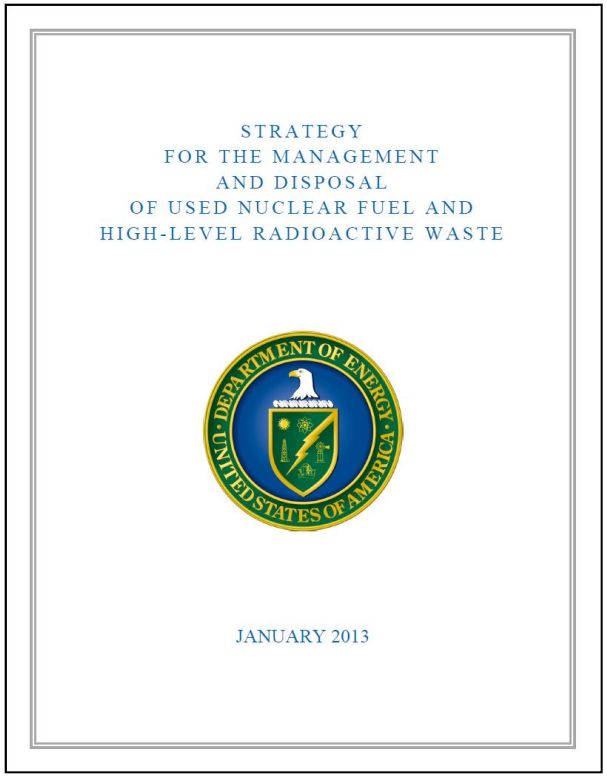
Storage, Transportation, and Disposal

- DOE submitted application for license to design/construct Yucca Mountain Repository June 2008 and filed motion to withdraw application March 2010 citing "…a geologic repository at Yucca Mountain is not a workable option for long-term disposition of these materials."
- Blue Ribbon Commission empaneled in January 2010 and issued recommendations in January 2012:
  1. A new, consent-based approach to siting future nuclear waste management facilities.
  2. A new organization dedicated solely to implementing the waste management program and empowered with the authority and resources to succeed.
  3. Access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management.
  4. Prompt efforts to develop one or more geologic disposal facilities.
  5. Prompt efforts to develop one or more consolidated storage facilities.
  6. Prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available.
  7. Support for continued U.S. innovation in nuclear energy technology and for workforce development.
  8. Active U.S. leadership in international efforts to address safety, waste management, non-proliferation, and security concerns.



Current Plan to Manage Wastes

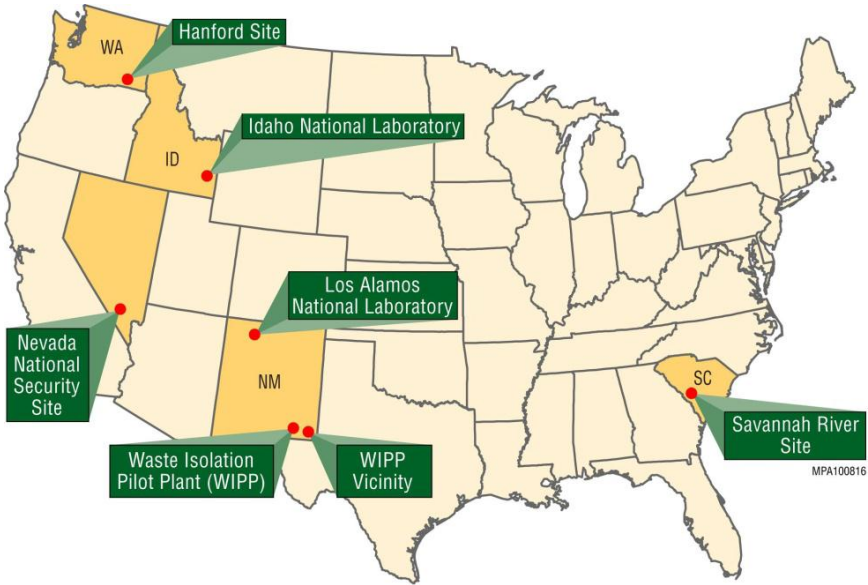
- Administration issues plan to manage SNF and HLW in January 2013:
  - Statement of Administration policy regarding the importance of addressing the disposition of UNF and HLW
  - Response to the final report and recommendations made by the Blue Ribbon Commission
  - Initial basis for discussions among the Administration, Congress and other stakeholders
  - 10-year program of work that:
    - Sites, designs, licenses, constructs and begins operations of a pilot interim storage facility
    - Advances toward the siting and licensing of a larger interim storage facility
    - Makes demonstrable progress on the siting and characterization of geologic repository sites



Thank you for your attention!

Greater-than-Class-C (GTCC) Waste

- U.S. Regulations classify commercial generated wastes into SNF, HLW, and LLW (classes A, B, C, and GTCC)
- Currently operating disposal facilities can receive class A, B and C
- No facility is currently licensed to dispose GTCC
- Draft GTCC Environmental Impact Statement (EIS) issued in Feb 2011
  - dispose of ~12,000 m^3 with ~160 MCi
    - activated metals: 2,000 m^3 with 160 MCi
    - sealed sources: 2,900 m^3 with 2.0 MCi
    - other waste: 6,700 m^3 with 1.3 MCi
    - <10% currently in storage; most waste will not be generated for several decades
  - 6 sites considered
  - 5 disposal methods considered (no action, geologic repository, boreholes, trenches, and intermediate depth vaults)
  - currently, no preferred alternative



Hanford wastes compared to US nuclear complex

- 25% (1200) of waste storage and release sites
- 35% (350 million curies) of ~1 billion curies
- 60% (200,000 m^3) of tank waste volume
- 60% (76,000 m^3) of buried TRU solid waste
- 80% (2100 MT) of spent fuel

Nuclear Fuel Cycle Options being Considered