Savannah River Remediation

We do the right thing.

HLW Treatment and Disposal Program Review

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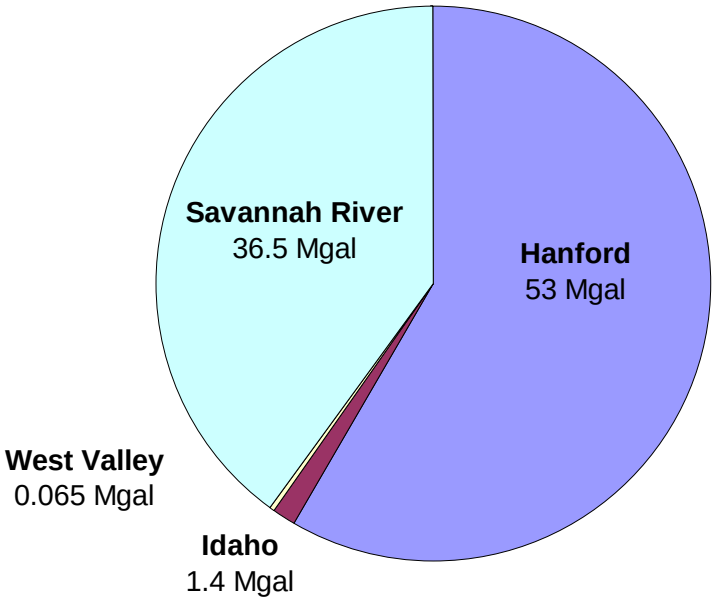
Contents

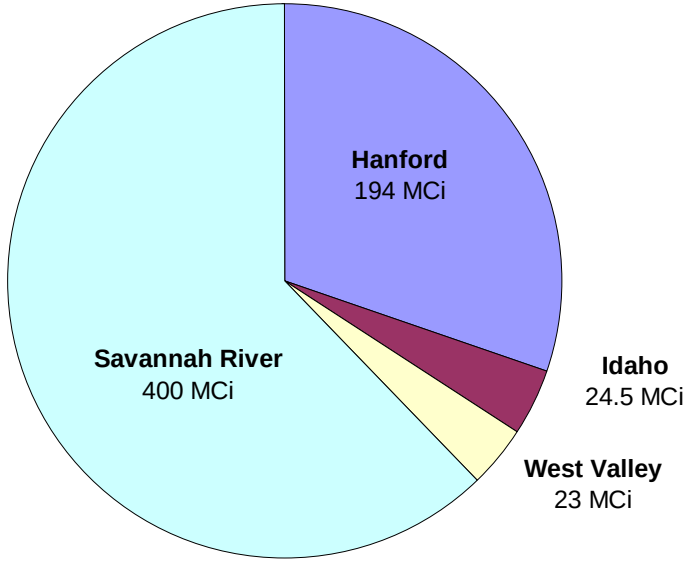
- Overview of EM High Level Waste Complex
- Site-specific reviews:
  - Waste origin
  - Processing plan
  - Waste disposition
  - Issues
- For:
  - West Valley
  - Idaho
  - Savannah River
  - Hanford

HLW by Site

- High Level Waste (HLW) is derived from first cycle fuel reprocessing
  - Dissolved fuel assemblies
  - Radionuclides of interest recovered
  - Cladding and fission products stored in tanks
- Ultimate disposal of this waste must be in a Federal Repository



Volume



Radioactivity

HLW by Site

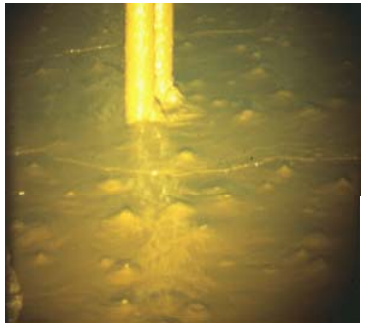
- HLW is typically stored on an interim basis in heavily shielded below grade tanks
- Most of the tanks are >30 years old and some are 60 years old
  - Many are carbon steel
  - Some are in or near the groundwater table
  - Some have no secondary containment
- Hence the need to remove this waste, treat it, place it in a stable waste from and dispose of it

Site	Number of Tanks
Hanford	**177**
Savannah River	**51**
Idaho	**15/44***
West Valley	**4**

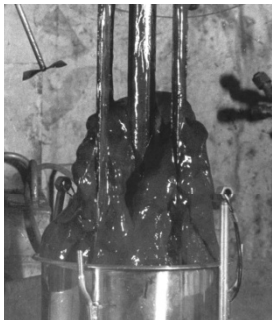
* Idaho also has 44 bins in 6 binsets

HLW by Site

HLW is stored in several different forms



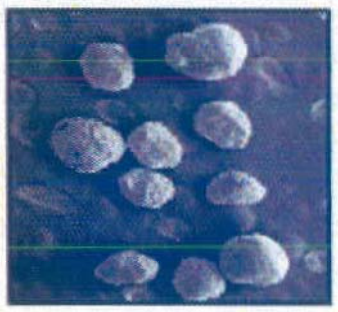
Sludge in the tank
Oxides and hydroxides of various cladding metals and most fission products



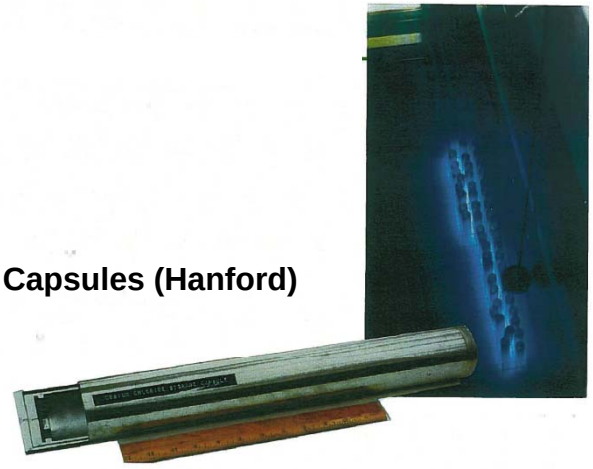
Sludge in the lab

Saltcake in the tank
Na salts (OH, NO_2, NO_3)

Supernate in the tank
NaOH liquor and most Cs-137



Calcine (Idaho)



Cs/Sr Capsules (Hanford)

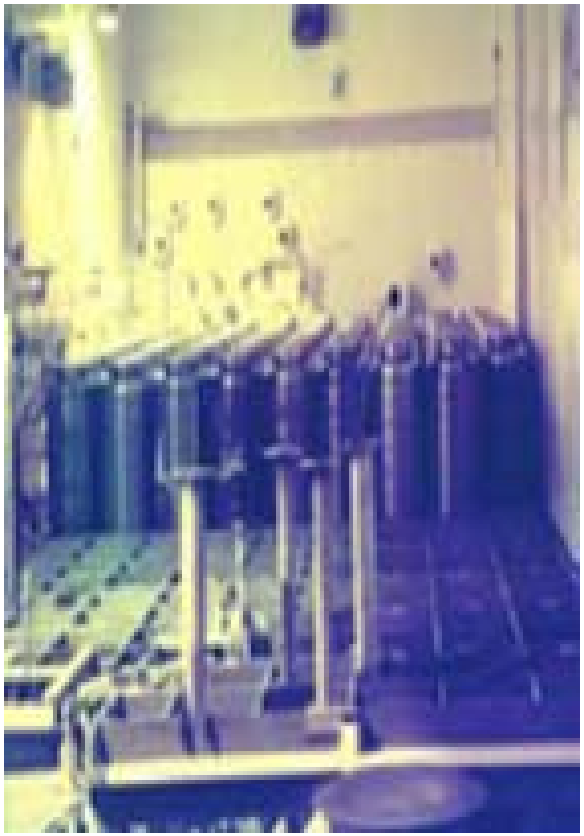
Site History

- Waste derived from reprocessing spent reactor fuel 1966 - 1972
  - 640 MT reprocessed
  - Solvent extraction to recover U and Pu
  - Generated 660 kgal HLW
- Stored in 4 tanks
  - 2 carbon steel 750 kgal tanks
  - 2 stainless steel 15 kgal tanks
  - ~23,000,000 Ci

West Valley

Waste Processing

- This part of the site mission is virtually complete
- Cs-137 removed from dissolved salt and supernate via ion exchange with zeolite resin
  - Decontaminated salt solution mixed with grout in 19,877 drums (71 gal each) that were disposed at Nevada Test Site
- Sludge and zeolite vitrified similar to Savannah River
  - 275 canisters stored at West Valley awaiting Federal Repository
- Remaining issues associated with:
  - decommissioning and closing the empty tanks and process buildings
  - managing sub-surface contamination



Stored Canisters

Idaho

- Original site mission was Reactor Test Station
  - 52 different reactors
- HLW generated and stored as a liquid
- Most was later calcined
  - Stored in binsets
- Remaining waste is called Na Bearing Waste
  - Stored in tanks
  - Tank closure in progress

Tanks being Grouted

Idaho

- Na Bearing Waste
  - 900,000 gal
  - Maintained in acidic form
  - Primary rad is Cs-137
- 4 small tanks
  - 30 kgal
  - All emptied and closed
- 11 large tanks
  - 300 kgal stainless steel (acid waste)
  - 7 tanks closed, 4 tanks still in service
- Selected treatment is Fluidized Bed Steam Reforming (FBSR)
  - destroys Na salts and organics
  - produces harmless N, O and H_2O in the offgas and a solid carbonate product
    - Cs-137 remains with the solids
- Solid product will be stored until disposition is finalized

FBSR Test Facility

Idaho

- Calcine Waste
  - 8-9 Mgal of liquid waste was treated via a fluidized bed calcination process
  - Produced ~4,400 M^3 (1.17 Mgal) of dry calcine
  - Stored in 6 underground concrete-shielded binsets with 44 individual bins
- Treatment options under evaluation:
  - Direct dispose (need RCRA exemption)
  - Hot Isostatic Pressing (reduces volume, monolithic waste form)
  - Fluidized Bed Steam Reforming (via FBSR from Na Bearing Waste)
  - Direct Vitrification (expands volume, very stable waste form)

Binset Model

HIP Waste Form

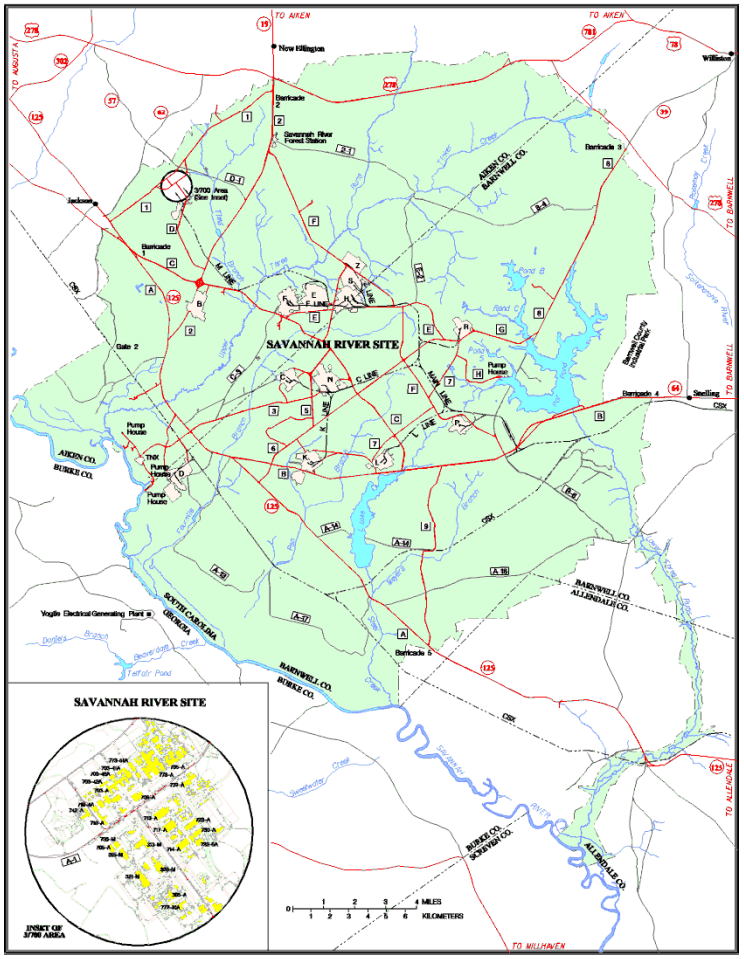
Issues:

- Na Bearing Waste
  - Disposal path for FBSR carbonate product not final
  - Must complete treatment by 12/31/2012
- Calcine Waste
  - Process selection
  - Must be treated and ready to ship 12/31/2035

Savannah River

Site History

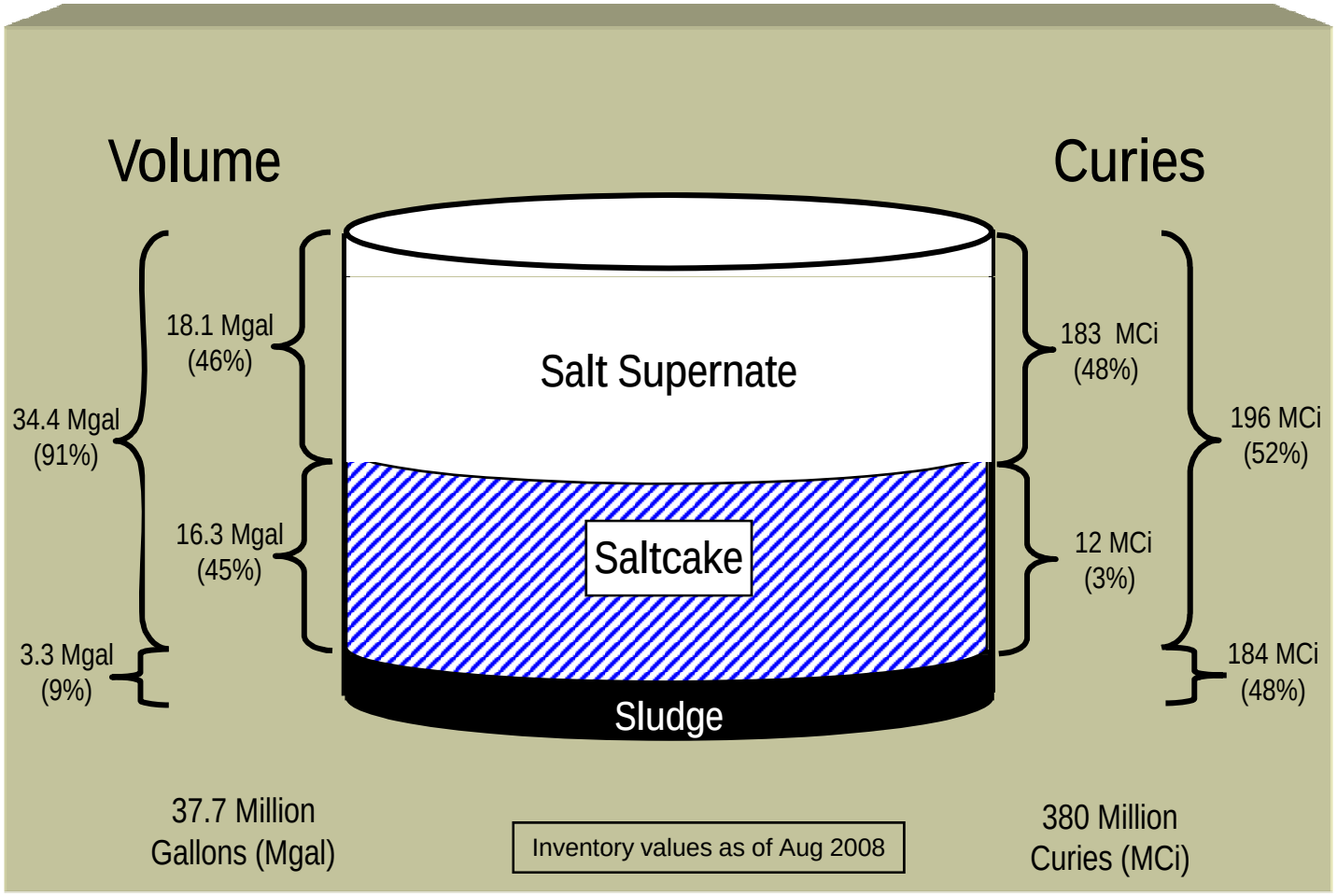
- Site Construction begins Feb'51
- D-Area Heavy Water, operations begin Aug'52
- M-Area Fuel & Target fab, slugs produced Dec'52
- 100 Areas R-Reactor goes critical Dec'53
- 200 Areas Separations
  - –F Canyon operations begin Nov'54
  - –H Canyon operations begin Jul'55
- Tank Farms
  - –F-Area Tanks 1-8 built 1951-1953, received first waste 1954
  - –H-Area Tanks 9-12 built 1951-1953, received first waste 1955



HLW originated from:

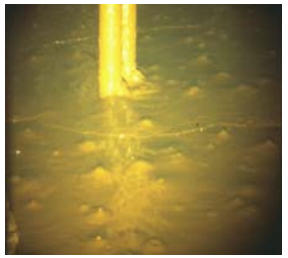
- Pu-239 recovery
  - Depleted uranium targets dissolved in nitric acid and processed through solvent extraction
- U-235 / Np-237 recovery
  - Uranium fuel dissolved in nitric acid and processed through solvent extraction
- Pu-238 recovery
  - Neptunium targets dissolved in nitric acid and processed through solvent extraction
- All 3 processes
  - Created an acidic waste that was evaporated and neutralized, and
  - generated significant fission products

Savannah River Inventory



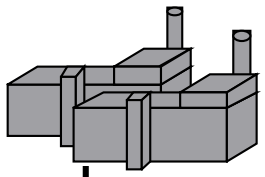
Salt Supernate

Saltcake



Sludge

Savannah River Flowsheet



DOE Complex
Legacy Materials

SRS & other
Spent Fuel

H Canyon

recycle

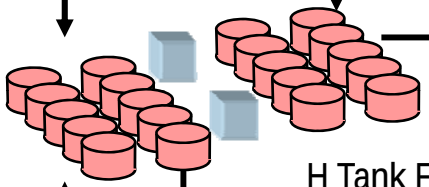
sludge

- Aluminum Dissolution
- Sludge Washing

Sludge Preparation

DWPF

GWSBs



H Tank Farm

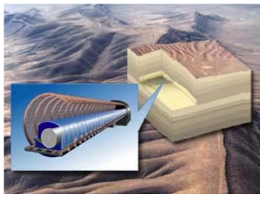
6,334 cans
395 MCi (>99%)

salt sol'n

- DDA
- ARP/MCU
- SWPF (future)

Salt Processing

Cs, Sr & Actinides

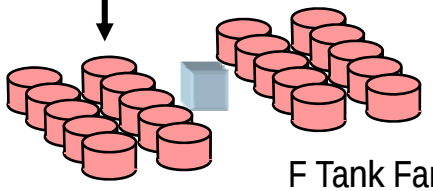


Federal Repository

DSS
97 Mgal
~3.0 MCi (0.6%)

Saltstone

Vaults



F Tank Farm

Empty Tanks -> Closure
0.6 MCi (0.14%)

DDA – Deliquification, Dissolution and Adjustment
DWPF - Defense Waste Processing Facility
GWSB - Glass Waste Storage Building
DSS – Decontaminated Salt Solution

HLW Management:

- ~120 Mgal HLW generated
- Volume reduced via evaporation to 36-37 Mgal
- Stored in 51 tanks
  - 2 closed (Tanks 17, 20)
  - 5 in closure process (Tanks 5,6,16,18,19)
  - 44 in active service
  - Underground
  - Heavily shielded
  - 43 of 51 have secondary containment

3H Evaporator

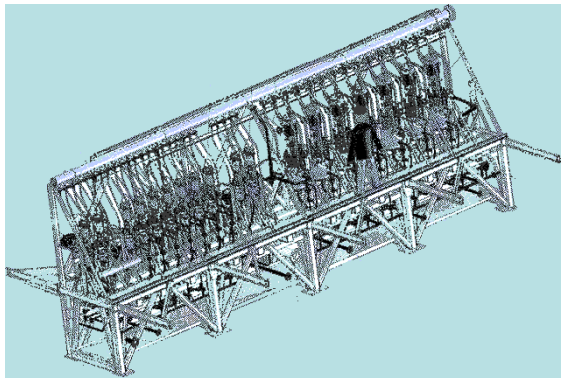
Tank under construction

HLW Disposition:

- Sludge - DWPF
  - –Pretreat to reduce Al and Na, then blend
  - –Treatment method is vitrification
  - –Waste form is borosilicate glass in a SS canister
  - –Disposition is in a Federal Repository
- Interim Salt – DDA
  - –Treat to reduce Cs-137 and actinides
  - –Low level fraction to grout, HLW fraction to glass
- Interim Salt – ARP/MCU
  - –Treatment methods:
    - adsorption/filtration to remove Sr-90 and actinides
    - Caustic Side Solvent Extraction to reduce Cs-137
  - –Low level fraction to grout
  - –HLW fraction to glass
- Long Term Salt – SWPF
  - –Same process as ARP/MCU
  - –3X throughput, 5X Cs-137 concentration in feed

DWPF

Canister



MCU Contactors

DWPF – Defense Waste Processing Facility
DDA - Deliquification, Dissolution and Adjustment
ARP – Actinide Removal Process
MCU – Modular Caustic Side Solvent Extraction
SWPF – Salt Waste Processing Facility

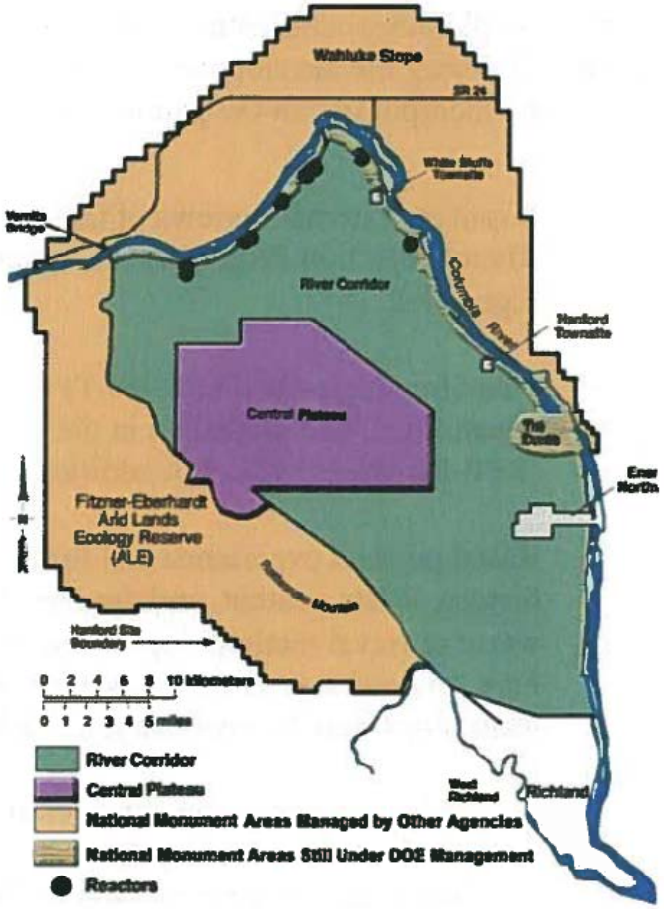
Issues:

- Flowsheet imbalance
  - All sludge can be vitrified before salt processing is complete
- Salt Processing schedule
  - Schedule uncertainty in this nearly first-of-a-kind facility
  - Delays increase the flowsheet mismatch
- Pu limit in glass
  - Limit in Yucca License Application reduces waste loading
  - Could extend life cycle
- Tank Closure
  - Uncertainty in Maximum Extent Practical evaluation

Hanford

Site History

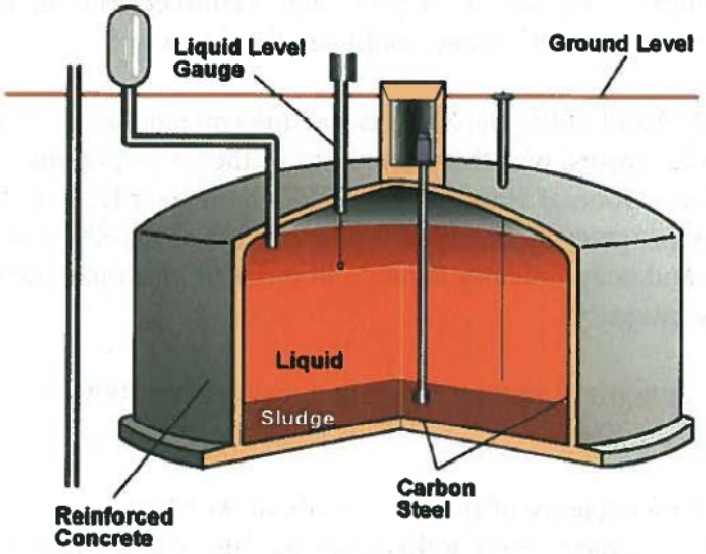
- Construction start 1943 as part of the Manhattan Project
- 9 reactors produced Pu and other rad materials mainly for national defense
- Irradiated fuel sent to 6 separations facilities from 1944-1989
- Special nuclear material recovered
- Waste neutralized and sent to tanks
- Significant fission product inventory in tanks
  - –~1/3 of original stored in a pool as capsules



Site Map

HLW Management:

- Current ~57 Mgal and ~194 MCi
- Stored in 177 tanks
  - –all underground, shielded, carbon steel
  - –149 Single Shell Tanks built 1943-1964
    - 0.065 - 1 Mgal capacity
    - do not meet requirements
    - nearly all free liquids removed
    - focus of waste removal activities
  - –28 Double Shell Tanks built 1968-1986
    - 1 - 1.25 Mgal capacity
    - full secondary containment
    - meet current requirements
- Sludge, saltcake, salt supernate and capsules



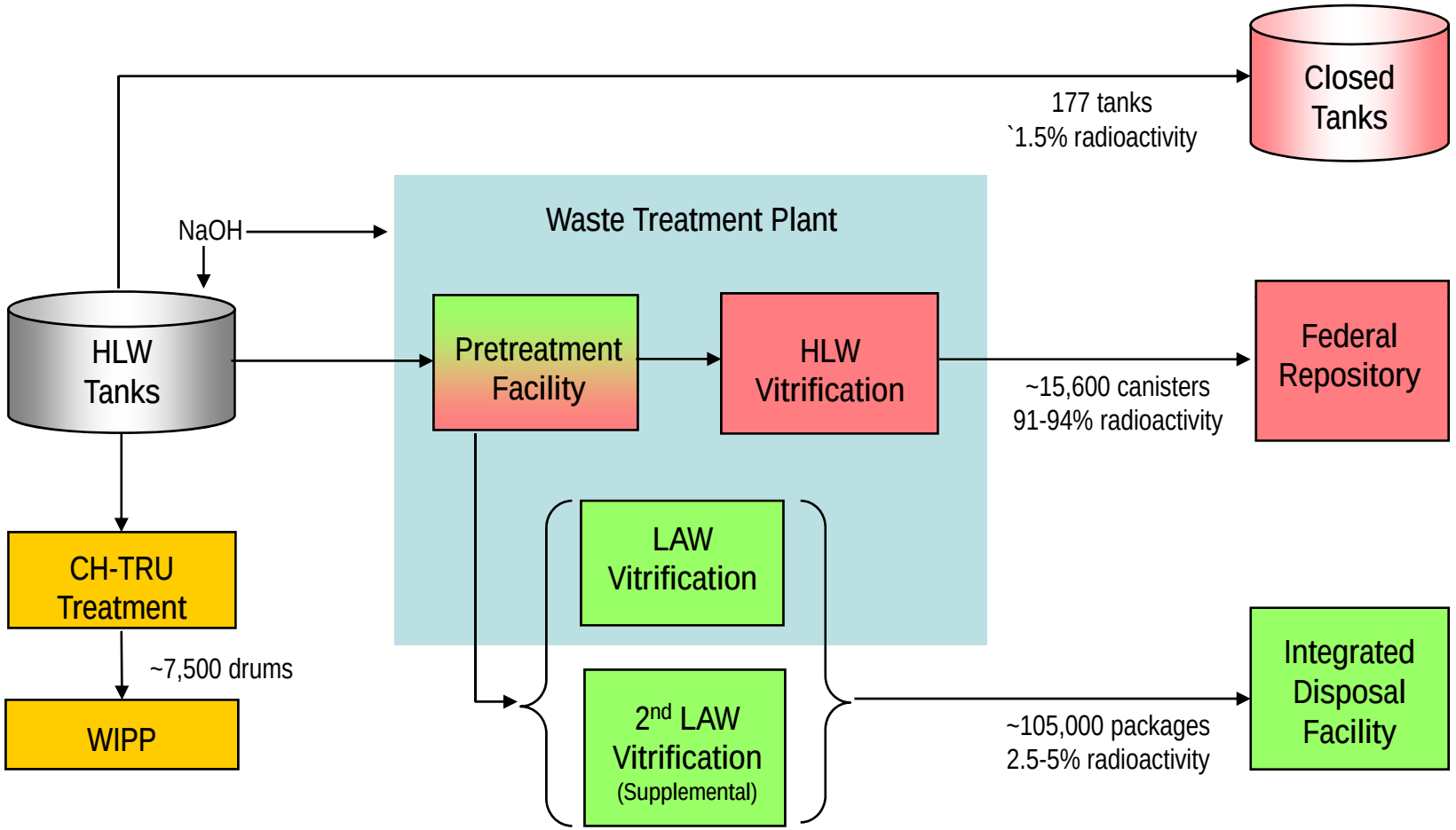
Single Shell Tank

HLW Disposition:

- Capsules produced from 1974-1985
  - 3” diameter, 21” long
  - double contained 316 SS
  - 130 MCi total
  - 1,335 Cs (as Cesium chloride)
  - 601 Sr (as Sr fluoride)
  - Plan to go to Federal Repository
- TRU
  - 20 tanks have waste that could be classified as TRU
    - 11 Contact Handled, 9 Remote Handled
  - Could be dried, packaged and shipped to WIPP
  - Requires favorable EIS ROD and WIPP RCRA Part B permit change

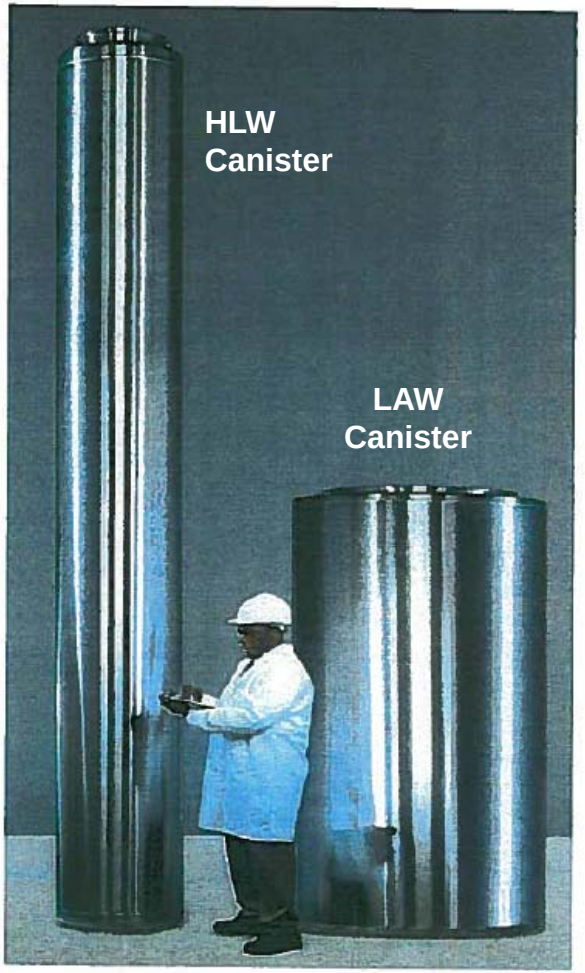
Capsule

Hanford Flowsheet



HLW Disposition:

- Salt Waste
  - ultrafiltration to reduce suspended solids prior to ion exchange
  - ion exchange using Spherical Resorcinol Formaldehyde resin to reduce Cs-137 concentration
  - Solids and Cs-137 to HLW vitrification
  - Decontaminated salt solution to LAW Vitrification
- Sludge
  - Pretreatment to reduce Na, Cr and Al content via caustic and oxidative leaching
  - Treated sludge solids to HLW vitrification similar to DWPF but larger canisters
  - LAW fraction to LAW vitrification



Issues:

- LAW Vitrification
  - Estimate of NaOH required to leach Al and keep it in solution has increased
  - Drives need for more LAW pretreatment and vitrification capacity
  - Critical decision as to how best to provide the extra capacity
- DST tank space
  - Limits rate of SST retrieval in near term
- WTP schedule
  - Additional discovery in first-of-a-kind processes could cause further delays