U.S. Department of Energy

Office of River Protection

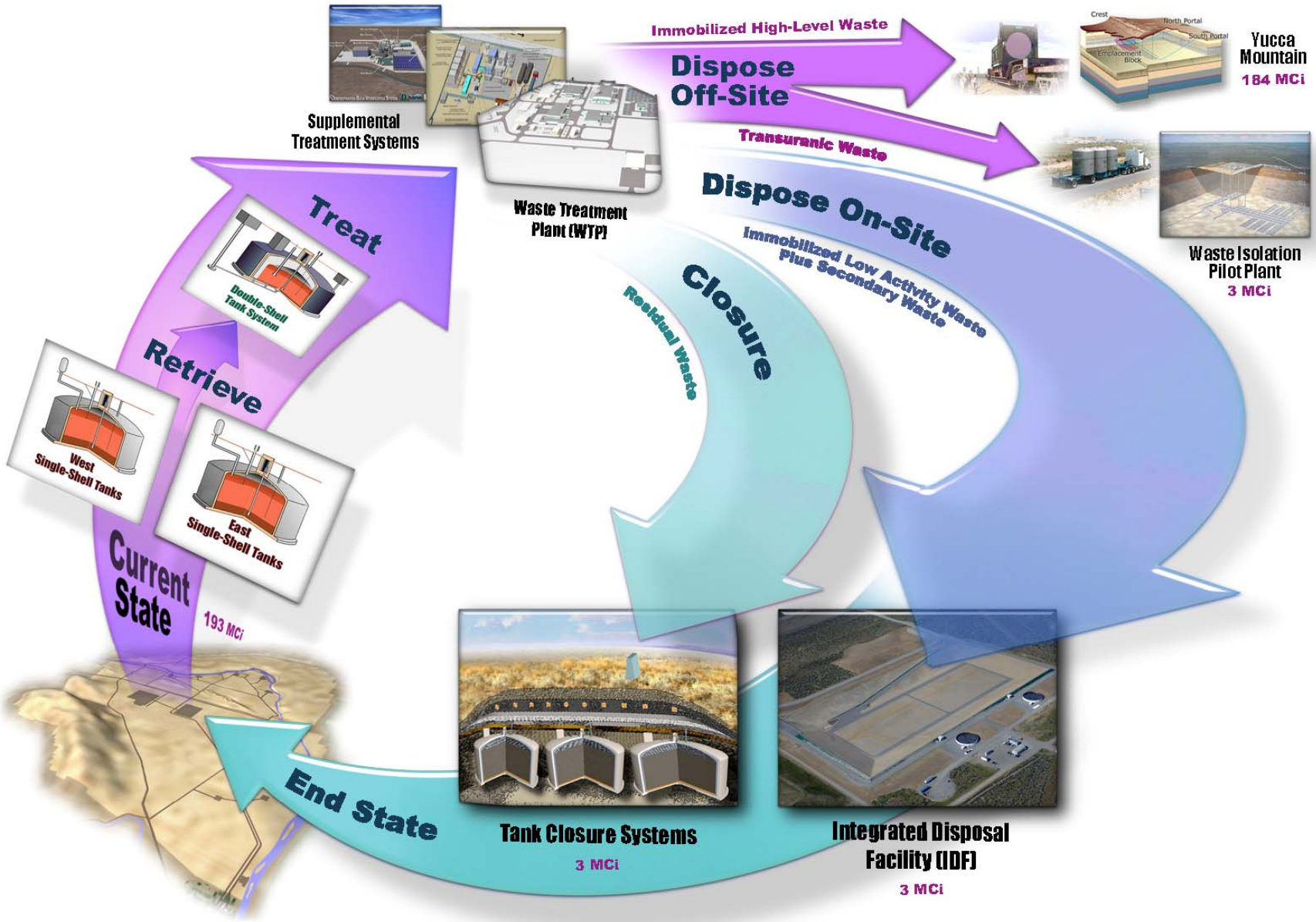
CH2MHILL
Hanford Group, Inc.

Hanford HLW Program – Challenges to Cleanup

Jim Honeyman,
CH2M HILL Hanford Group, Inc.

October 31, 2007

RPP Mission Life-Cycle



CH2M HILL Roles for Technology Acquisition

- Contracted to assist ORP in Planning and Optimization of the Lifecycle Mission
  - Lead technology roadmapping efforts with ORP
  - Develop Lifecycle Systems Planning for ORP
- Work within DOE's EM-20 Programs for directed science and technology programs
  - FIU and HCET University programs
  - Technical Assistance Teams
  - Management of Technology Demonstration Programs for EM
    - Fractional Crystallization
    - Spin Tek Demonstration for Hanford Simulants
  - ART Projects
    - Provide site data and comments to selected contractors

CH2M HILL Roles for Technology Acquisition (cont)

- Cleanup Project Directed technology applications (direct funded)
  - "Commercial" tools and technology
    - TMR, SA Robotics, Non-Entry Systems Limited➔ targeted technology adaptation for heel retrieval issues
      - successful technology deployments; shortened deployment time to less than 6 months by use of the Cold Test Facility
    - AMEC Bulk Vitrification Technology
    - Tank In service inspection -- AREVA UT
    - Subsurface Characterization
  - Contract Consultation And Technical Support
    - PNNL➔ tank chemistry, corrosion chemistry, tank structural and seismic evaluations; slurry and fluid flow; tank vapor characterization and toxicology; vadose zone modeling, radioactive glass formulation; waste product performance evaluation, etc.
    - SRNL ➔ fractional crystallization pilot scale testing, Spin Tek simulant testing; corrosion control, tank closure technology
    - Corporate Expertise, Other National Labs, and Experts ➔ seismic data, performance assessment, temporary surface barriers, barrier design, Expert Panel reviews

Significant Science and Technology Challenges – Tank Farms

- SST Retrieval
- DST Space Management
- Tank Integrity
- Waste Phase Chemistry
- Supplemental Pretreatment/Treatment
- Secondary Waste Disposal (Tc-99, I-129)
- Tank Closure
- Deep Vadose Zone Characterization and Treatment

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Hanford Tank Cleanup Status

Office of River Protection

Retrieval Summary Updated through September 1, 2007

RETRIEVED

S-112
- Capacity of tank: 758 Kgals
- Completion date: March 28, 2007

C-202
- Capacity of tank: 55 Kgals
- Completion date: August 11, 2005

C-204
- Capacity of tank: 55 Kgals
- Completion date: December 11, 2006

C-203
- Capacity of tank: 55 Kgals
- Completion date: March 24, 2005

C-103
- Capacity of tank: 530 Kgals
- Completion date: November 1, 2006

C-106
- Capacity of tank: 530 Kgals
- Completion date December 31, 2003

C-201
- Capacity of tank: 55 Kgals
- Completion date: March 23, 2006

IN PROGRESS

C-109
- Capacity of tank: 530 Kgals
- Retrieval started: June 19, 2007
- Volume of waste to be removed: 83 Kgals

C-108
- Capacity of tank: 530 Kgals
- Retrieval started: December 29, 2006
- Volume of waste to be removed: 88 Kgals

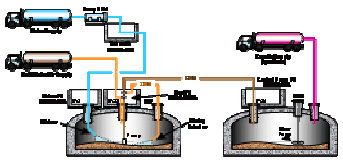
S-102
- Capacity of tank: 758 Kgals
- Retrieval started: December 17, 2004
- Volume of waste to be removed: 484 Kgals

NEXT IN LINE

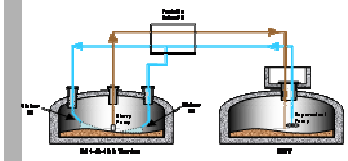
C-104
- Capacity of tank: 530 Kgals
- Volume of waste to be removed: 250 Kgals
- Retrieval to begin: FY 2008

C-110
- Capacity of tank: 530 Kgals
- Volume of waste to be removed: 178 Kgals
- Retrieval to begin: FY 2008

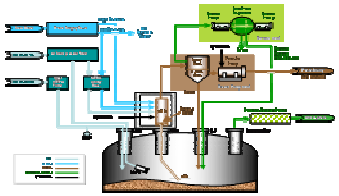
Acid Dissolution



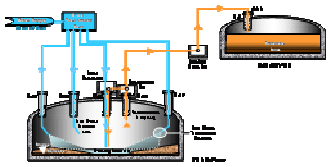
Modified Sluicing



Vacuum Retrieval



Saltcake Dissolution

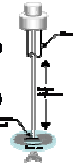


Remote Water Lance (Salt Mantis)

Mobile Retrieval Tool (Sand Mantis)

Mobile Retrieval Tool (Foldtrack)

High Pressure Mixer (Rotary Viper)



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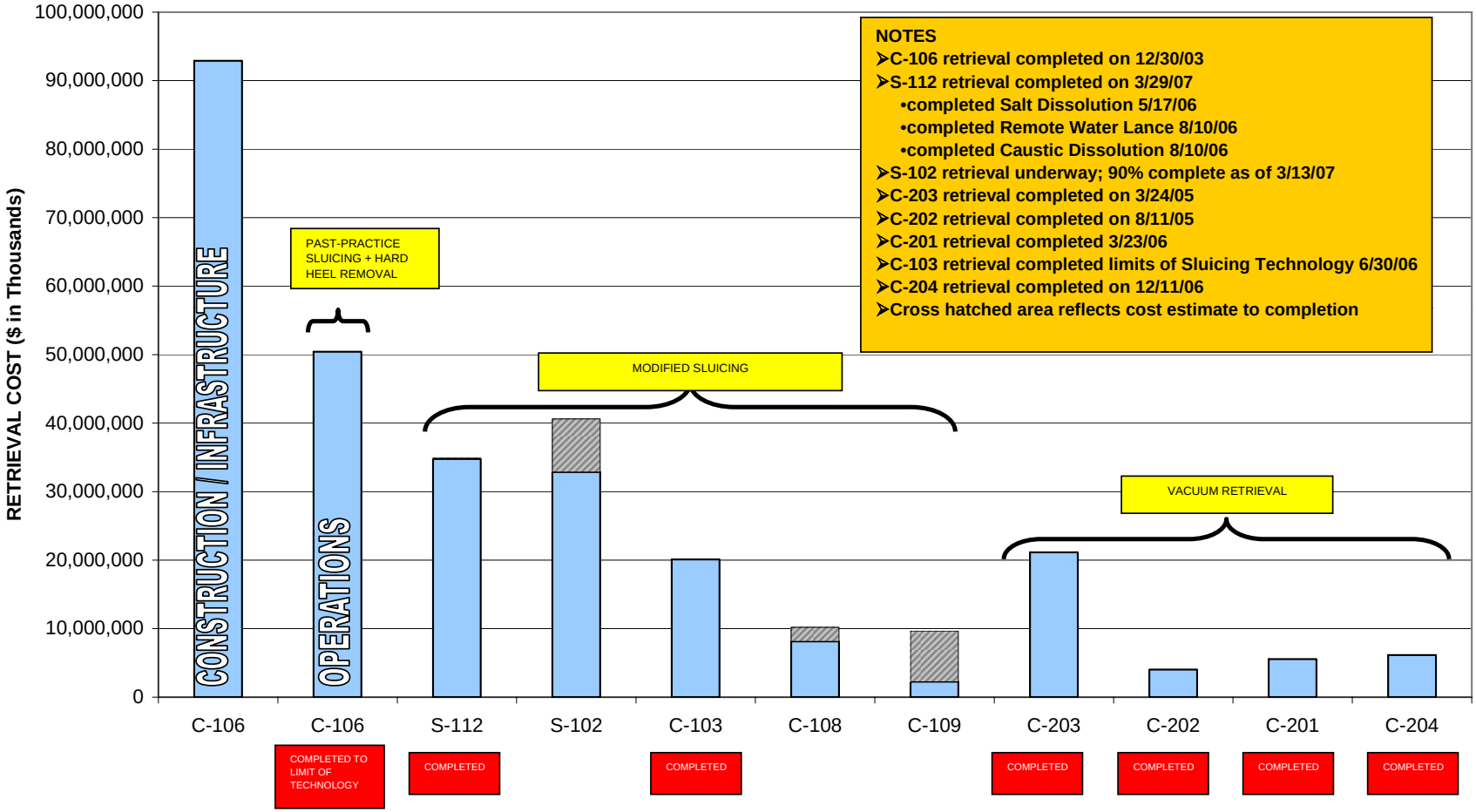
Retrieval Cost By Tank



NOTES

- C-106 retrieval completed on 12/30/03
- S-112 retrieval completed on 3/29/07
  - completed Salt Dissolution 5/17/06
  - completed Remote Water Lance 8/10/06
  - completed Caustic Dissolution 8/10/06
- S-102 retrieval underway; 90% complete as of 3/13/07
- C-203 retrieval completed on 3/24/05
- C-202 retrieval completed on 8/11/05
- C-201 retrieval completed 3/23/06
- C-103 retrieval completed limits of Sluicing Technology 6/30/06
- C-204 retrieval completed on 12/11/06
- Cross hatched area reflects cost estimate to completion

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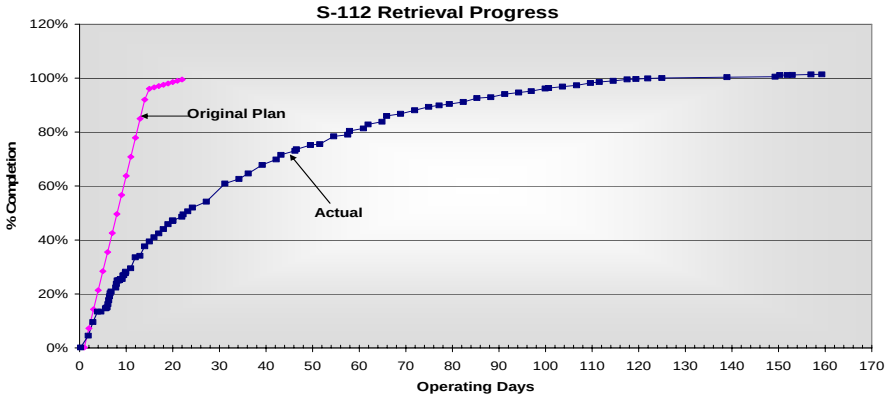
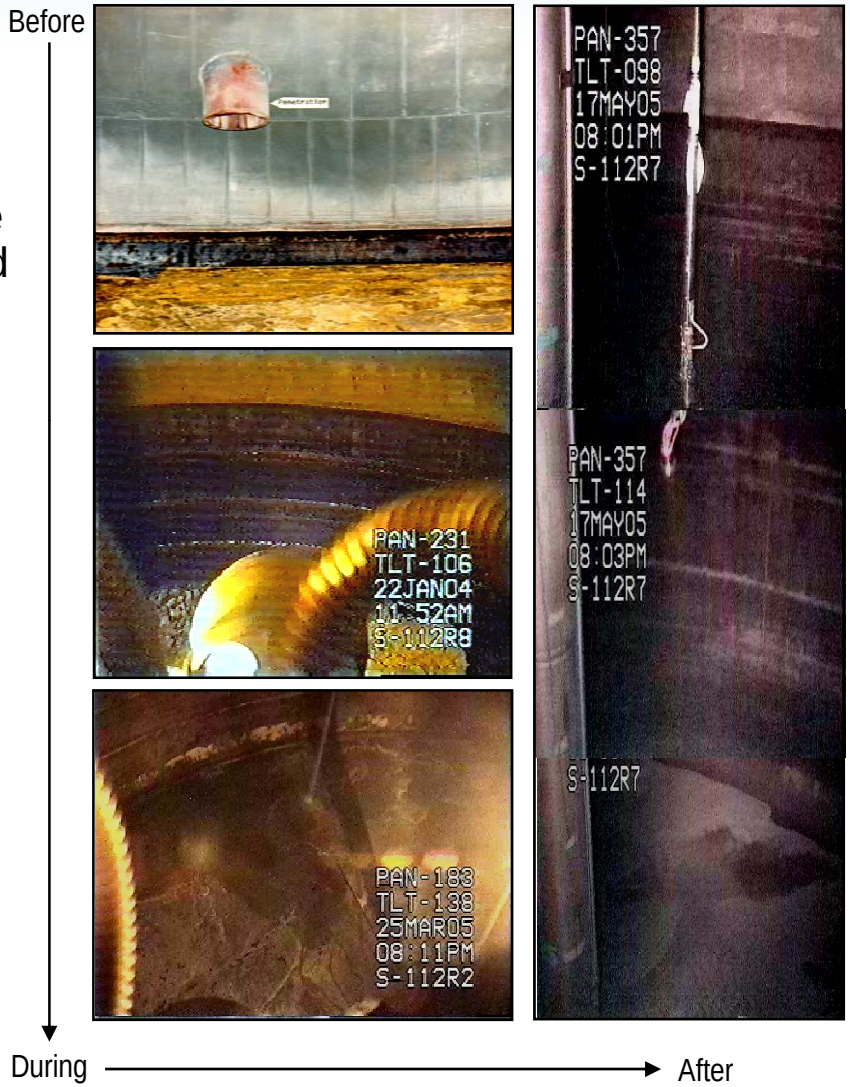
Tank S-112 Retrieval

- Completed S-112 retrieval to limits of technology on March 2, 2007.
- Technology: modified sluicing and saltcake dissolution, salt mantis for breaking up hard layers, and caustic dissolution.
- 612 Kgal of waste retrieved; 99.6 % of pre-retrieval volume.
- Less than 2390 gal (333 cu. ft.) of waste remains meeting TPA volume goal.





S-112 Retrieval – Before, During, and at Limits of Technology

SST Retrieval Challenges

- Size Reduction of residual “clinkers”, “gravel”, and “sand”
- Moving the “sand” and “mud” to the pump intakes is inefficient –move the pump intake to the “sand” and “mud”
- Breakup and dissolution of thick, impermeable salt layers
  - Ostwald Ripening or Sedimentation/Cementation processes occurring over decades as tanks slowly cool
  - Salt Mantis (high-pressure water jet) effective, but slow
- Some sludge mixtures are shear-thickening (S-102)
- Deployed low-water retrieval techniques for known tank leakers are very inefficient in both time for retrieval and waste volume generated

DST Space Management

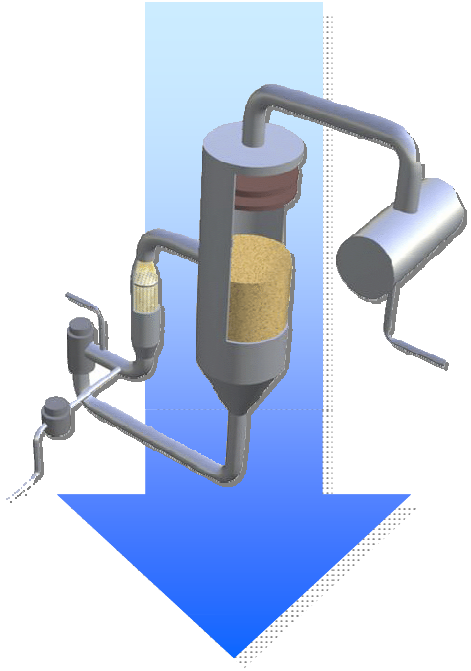
- Concentration of retrieved waste is key for waste volume management in DST's
- Extent of concentration of waste is limited by complex interaction between waste chemistry and physical properties
  - Flammable gas retention in tanks containing solids
- Waste compatibility limits preclude blending of certain wastes
- Increased the effective fill heights of selected DST's to increase the usable space
- Key research area
  - Refine flammable gas controls to allow more flexible operating conditions in mixed supernate and sludge tanks

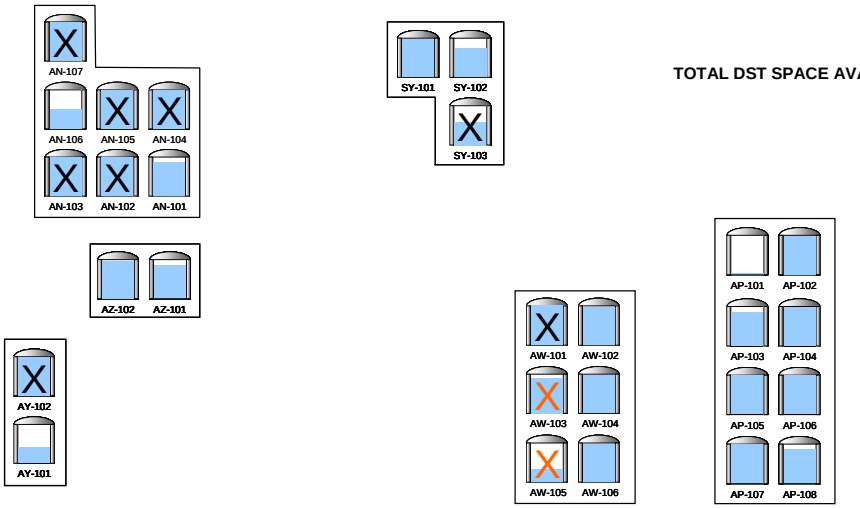
Available DST Space and Waste Concentration Potential

	AW-102	AW-103 AW-105	AW-104	AW-106	AY-101	AY-102	AZ-101	AZ-102	SY-101	SY-102
Available Space	1013 kgal	777 kgal	76 kgal	15 kgal	138 kgal	12 kgal	162 kgal	55 kgal	37 kgal	575 kgal
Planned use of the space	242-A feed tank	RH-TRU restrict; Use as emrgncy space	No near term plan	242-A feed stage	C Farm Retrieval after current waste transferred	WTP Com m. Feed	C-102 retrieval	Liquid to be blended for WTP feed	X-site transfer S-102 retrieval DBVS support	S-102 retrieval

	AN-101	AN-106	AP-101	AP-102	AP-103	AP-104	AP-105	AP-106	AP-107	AP-108
Available Space	0 kgal	386 kgal	4 kgal	56 kgal	107 kgal at 454 in	650 kgal	8 kgal	13 kgal	17 kgal	1 kgal at 454 in
Planned use of the space	C Farm Retrieval after current waste transferred	C Farm retrie val	242-A feed stage	242-A product; WTP Feed	242-A product; WTP Feed	242-A product; WTP Feed	242-A feed stage	No near term plan	242-A feed stage	242-A product WTP feed

	AW-102	AP-104	AP-105	AP-101	AP-107	AW-106	AZ-102
Dilute Volume (kgal)	1,000	1061	977	1120	1035	826	760
Waste Volume Reduction Factor	.83	.36	.33	.46	.36	.41	.68





TOTAL DST SPACE AVAILABLE = 4100 kgal

	AW-102	AP-104	AP-105	AP-101	AP-107	AW-106	AZ-102
Projected Concentrated Volume (kgal)	170	675	651	605	666	484	243
Projected DST Volume Recovered (kgal)	830	386	326	515	369	342	342

CONCENTRATION OF AW-102 AND AP-104 COMPLETED IN FY 2007
PLANNED ADDITIONAL VOLUME RECOVERY ~ 2,100 Kgal

X Tank is full or has restricted use due to safety basis or waste compatibility constraint

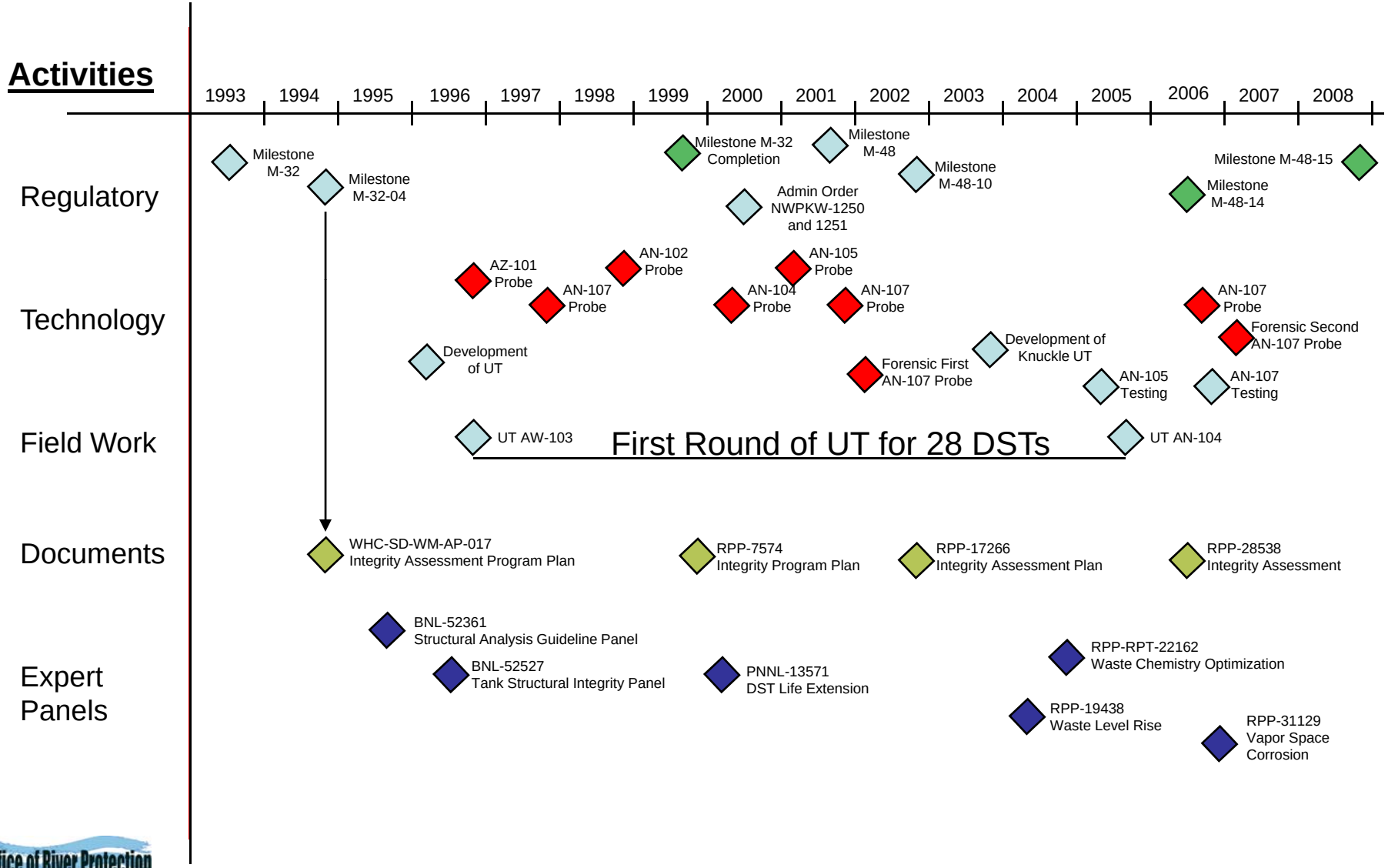
X Tank has restricted use due to TRU constraint

CHG0612-14
Data as of 10-11-07

Tank Integrity

- Extensive integrity program for DST's (tanks put in service 1971-1986)
  - Periodic UT inspections of inner tank wall and analysis of corrosion coupons placed in selected tanks
  - Real time corrosion monitoring in selected DST's with challenging chemistry
  - Research work to refine corrosion chemistry and mechanisms
  - Active waste compatibility program to control waste additions
  - Structural evaluations to support increased operating level rise in selected DST's
- SST's (tanks put in service 1943-1966)
  - Extensive dome and wall concrete sampling in early 1980's
  - Structural evaluations
  - Dome surveys to verify structural integrity
  - No ongoing integrity evaluation
  - Focus is on establishing historical leak baselines, and detecting any changes during retrieval operations
    - Sub-surface geophysical examination (SGE);
    - High resolution resistivity (HRR) measurements

Double-Shell Tank Integrity Program Timeline



Tank Waste Phase Chemistry

- Retrieval, Transfer, Storage, Concentration, Mixing, Feed Staging, and Feed Delivery
  - Complex phase chemistry constraints in facilities (tanks) with few controls
  - Solid-Liquid Safety issues (e.g. hydrogen retention, shear- thickening mixtures, safe levels of evaporation)
  - Retrieval and transfer (Dissolution rates, temperature limits to prevent double salt formation and subsequent precipitation and line pluggage)
  - Particle agglomeration, size reduction during retrieval and feed staging to WTP

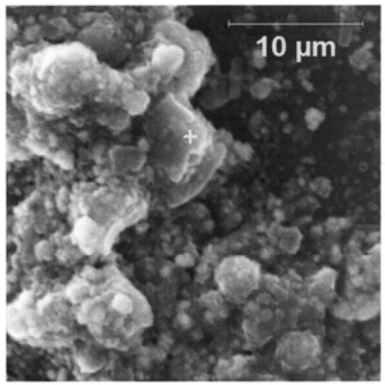


Figure D.45. Gibbsite/$Al(OH)_3$ from Tank AY-102[(a)]

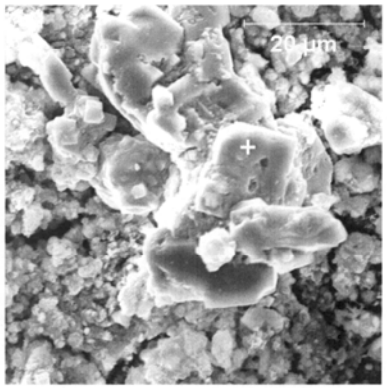


Figure D.46. Gibbsite/$Al(OH)_3$ from Tank AZ-102 (Warrant 2002)

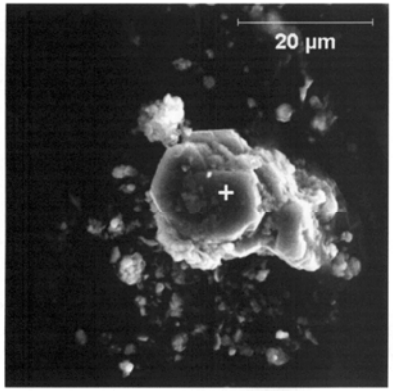


Figure D.47. Gibbsite/$Al(OH)_3$ from Tank C-101[(b)]

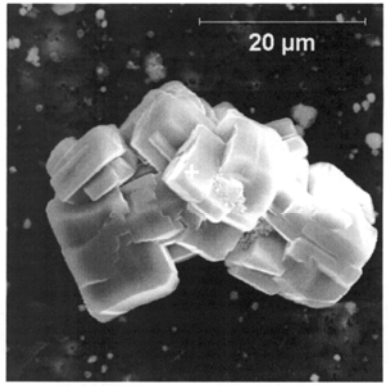


Figure D.48. Gibbsite/$Al(OH)_3$ from Tank C-103a[(c)]

(a) Warrant RW. "Results of Caustic Testing of Tank 241-AY-102 Core 319 Sludge Solids." 7S110-RWW-06-080, November 2006, CH2M HILL Hanford Group Inc., Richland, Washington.
(b) Frye JM. "Results of Caustic Testing of 241-C-101 & 241-C-107." 7S110-JMF-05-015, 4/29/2005, CH2M HILL Hanford Group Inc., Richland, Washington.

(c) Herting DL and GA Cooke. "Caustic Demand Test Results for Tank 241-C-103 Sludge." 7S110-DLH-04-015, 5/5/2004, CH2M HILL Hanford Group, Inc., Richland, Washington.

Supplemental Pretreatment/Treatment

- At or in-tank solids-liquid separation to support supplemental pretreatment
  - Spin Tek rotary filters (cold full scale testing)
- Supplemental at/in tank pretreatment technology development
  - Fractional crystallization (hot lab demo/cold pilot plant demo)
  - IX (hot lab demo/cold pilot plant demo)
- Bulk vitrification demonstration (DBVS)
  - Hot engineering/cold, full scale integrated demonstration
- Caustic management and recycle
  - Early cold development

DBVS Test 38D Successful

- The latest test, known as 38D, was an integrated test of the mixer/dryer, feed system and melter at full-scale.
  - Resolved all major issues
    - Expert Review Panel

- Systems worked well together
- Molten ionic salt issue resolved
- Now waiting for lab analysis of the glass

Secondary Waste Disposal (Tc-99, I-129)

- Final Disposal Criteria are not finalized for secondary waste disposal in IDF
  - Waste Management and Tank Closure EIS ROD expected 4/09
- Preliminary Performance Assessment work has identified Tc-99 and I-129 contained in secondary wastes co-disposed with LAW as the predominate source of long term health risk
- Alternative waste treatment scenarios (e.g. Early LAW, Bulk Vitrification, ETF ops) result in different levels of Tc and I incorporation in LAW glass➔balance ends up in secondary solid wastes
- Management options include
  - separations
  - alternative treatment strategies
  - improved secondary waste forms

Tank Closure

- Waiting for NEPA decision-making (ROD expected 4/09)
- Early in regulatory definition processes
- Technology demonstrations conducted to date assume landfill closure concept demonstrated at SRS for large tanks
- Little work done to address characterization or treatment of buried transfer lines, leaks, and ancillary facilities
- CH2MHILL, with Ecology, has developed a concept for an early, segmented closure demonstration to begin to identify needs and state of available technologies

Proposed C Farm Closure Demonstration

Project Management/Regulatory and Safety Documentation

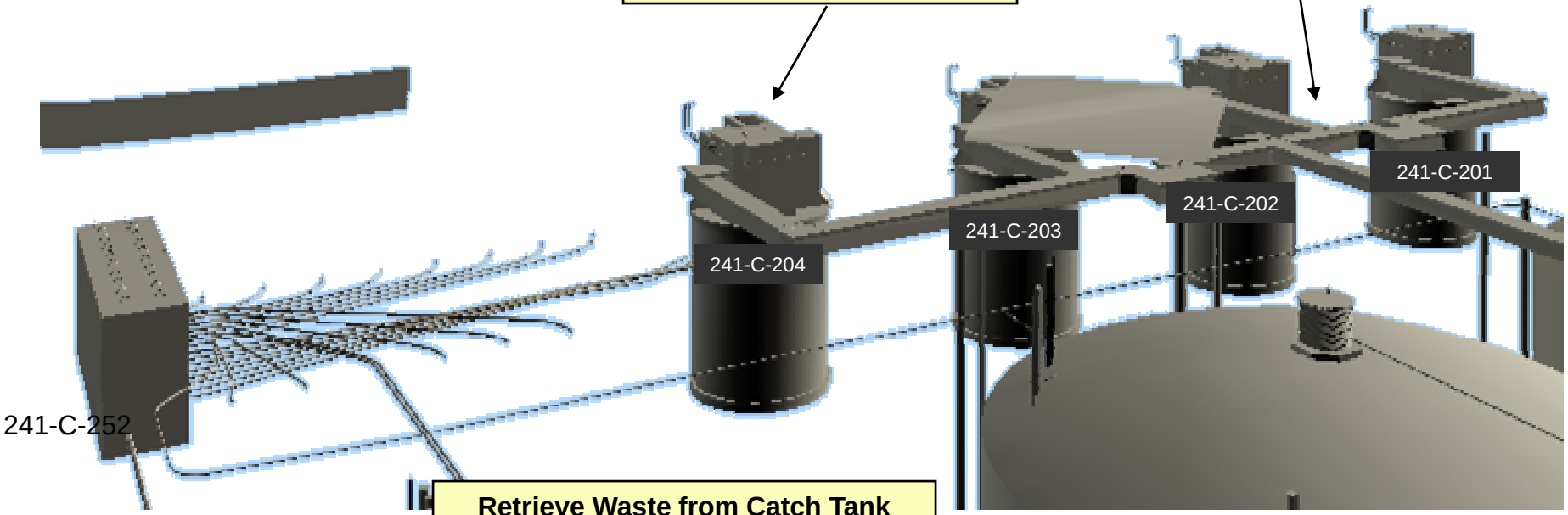
- RD&D Permit
- Waste Determination

Fill One C-200 Tank

- Isolate tank
- Fill with stabilizing grout (layer 1)
- Core sample/characterize mixing
- Fill void space (layer 2)
- Capping grout (layer 3)

Isolate Set of Encased Pipes

- Excavate
- Remove/characterize line segment
- Gamma log lines
- Isolate lines & encasement



Retrieve Waste from Catch Tank 241-C-301

- Sample/remove residual waste
- Determine closure pathway (grout or remove)

Deep Vadose Zone Characterization and Treatment

- Characterization
  - Developed and Deployed direct-push sampling method to improve efficiency and effectiveness
  - Deployed SGE technology to map existing plumes beneath 7 tank farms
  - Need for Cost Effective sub-surface characterization tools for the entire vadose zone (~200ft)
- Surface Barriers only demonstrated technical approach to slow transport of vadose zone contamination
  - Effective subsurface treatment for diffuse contamination could change the retrieval and closure strategy

Direct Push Unit

Summary

- Much of the tank waste program has advanced to the engineering/design/ construction/operations phases with ongoing technology testing/demonstration programs
- Key S&T challenges remain for EM technology roadmap; particularly where
  - activities continue for a long periods
  - treatment/disposal/closure decisions have not been finalized