Hanford Waste Treatment and Immobilization Plant Project

Presented at the SRS/Hanford/Idaho Technical Exchange

Atlanta, Georgia

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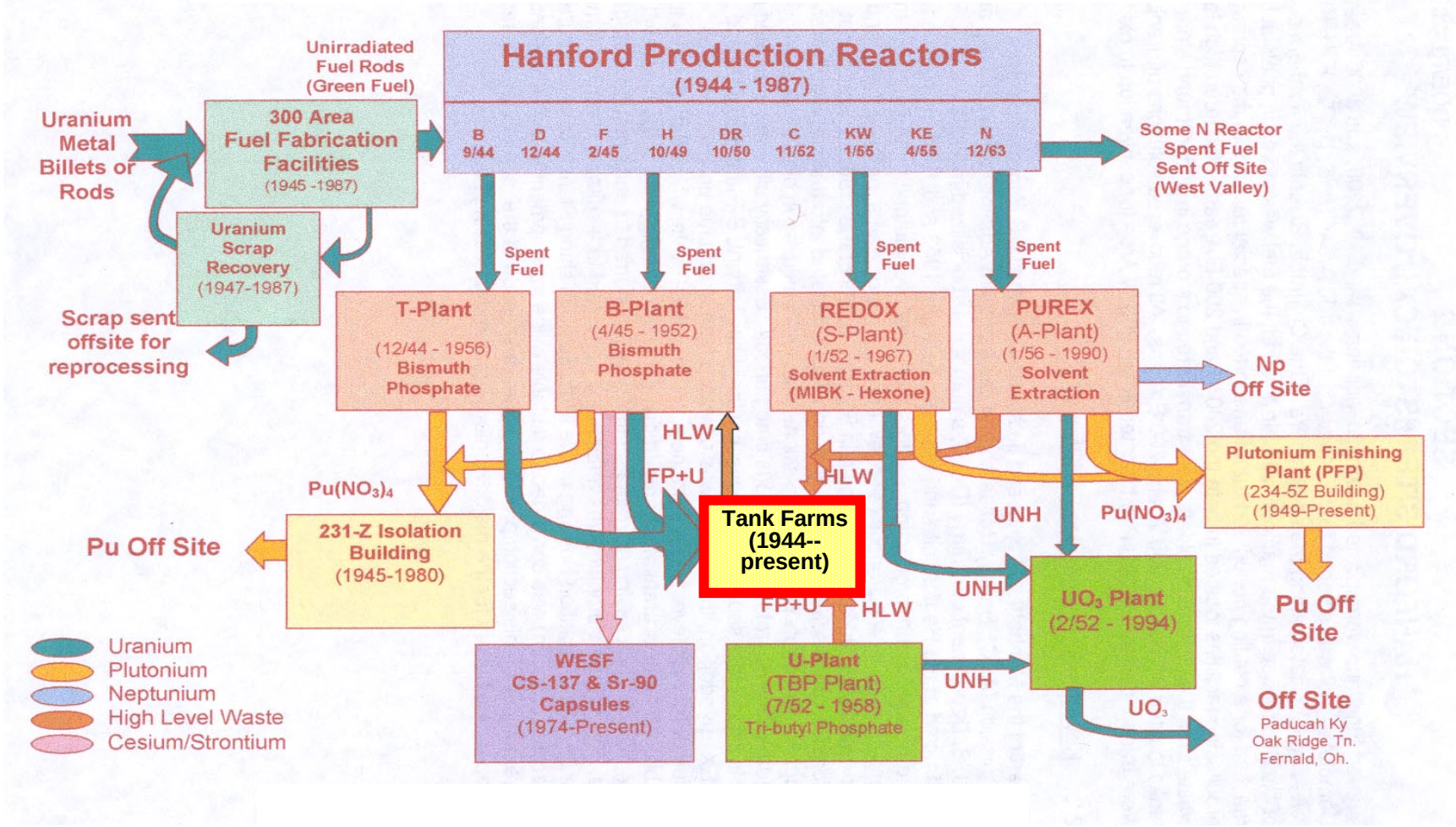
Outline

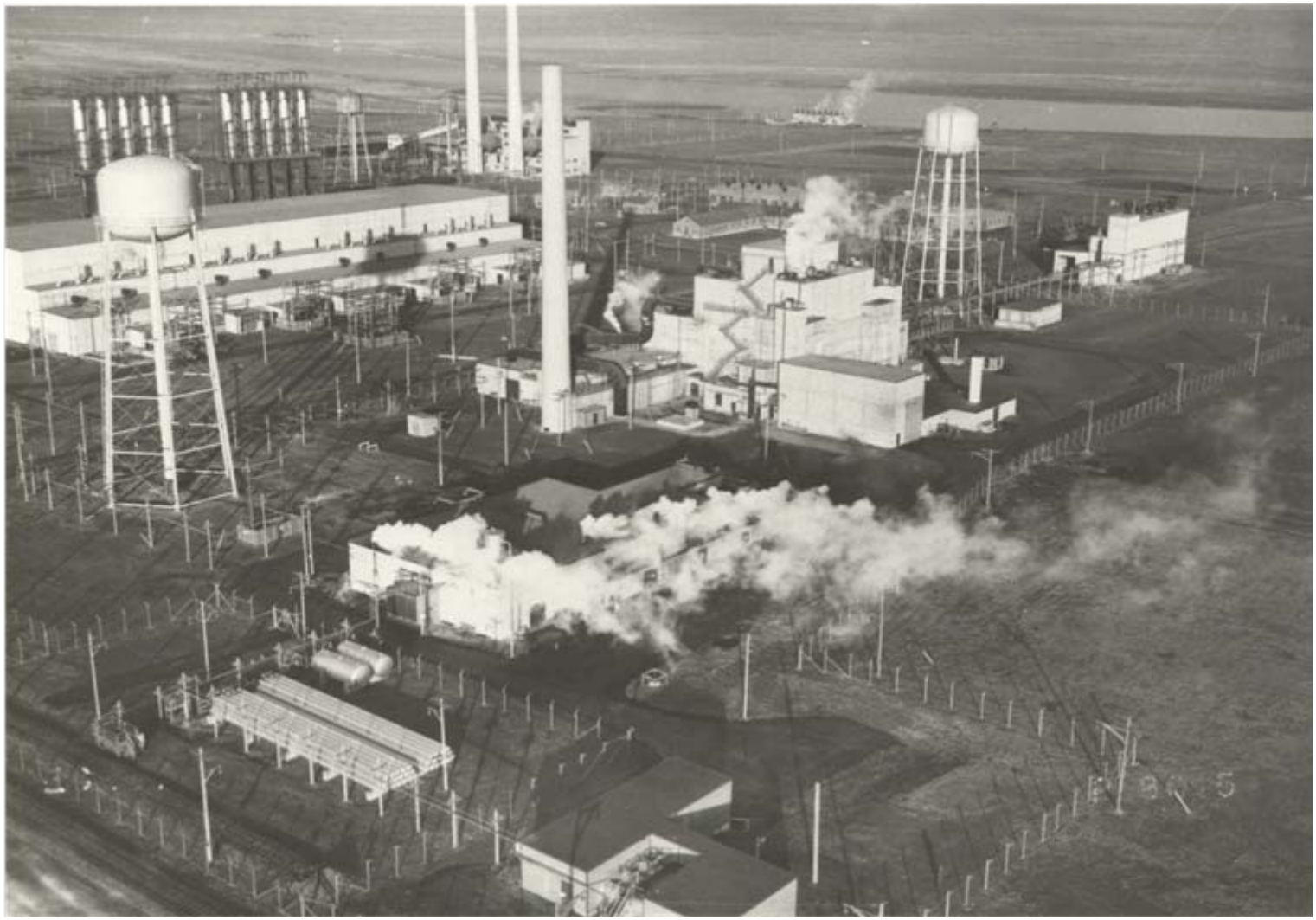
- Background
  - Waste Generation at Hanford
  - Waste Treatment and Immobilization Plant (WTP) Project
- Update
- Next Steps

Generation of Hanford Tank Wastes

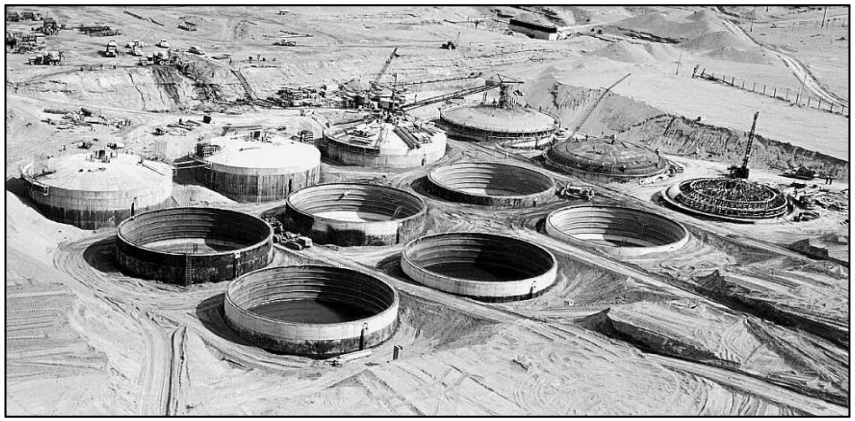


9 Reactors; 4 Fuel Reprocessing Flowsheets; 100,000 MT Fuel Processed

Hanford's B Reactor, as it stood in 1945



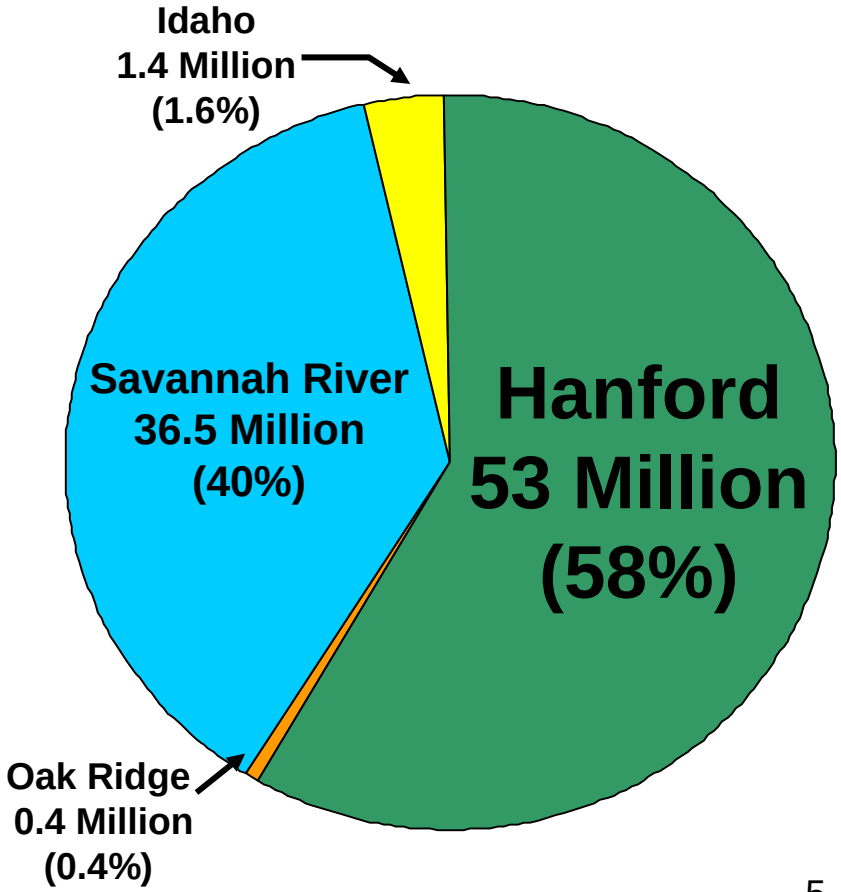
Hanford Tank Waste Cleanup Challenge



Hanford has:

- 63% of DOE tanks; 80% of DOE single-shell tanks
- 58% of DOE total tank waste
- ~194 million curies of radioactivity
- ~190,000 tons of chemicals

Total Number of Gallons in Waste Tanks at DOE Sites:



Single Shell Tanks (SSTs) under Construction

149 SSTs
Capacity up to 1 Mgal

Double-Shell Tanks (DSTs) under Construction

28 DSTs
Capacity 1 Mgal
Diameter 80 ft
Height 49 ft

Waste Treatment Plant (WTP)

Hanford's WTP will be the world's largest radioactive waste treatment plant to treat Hanford's underground tank waste

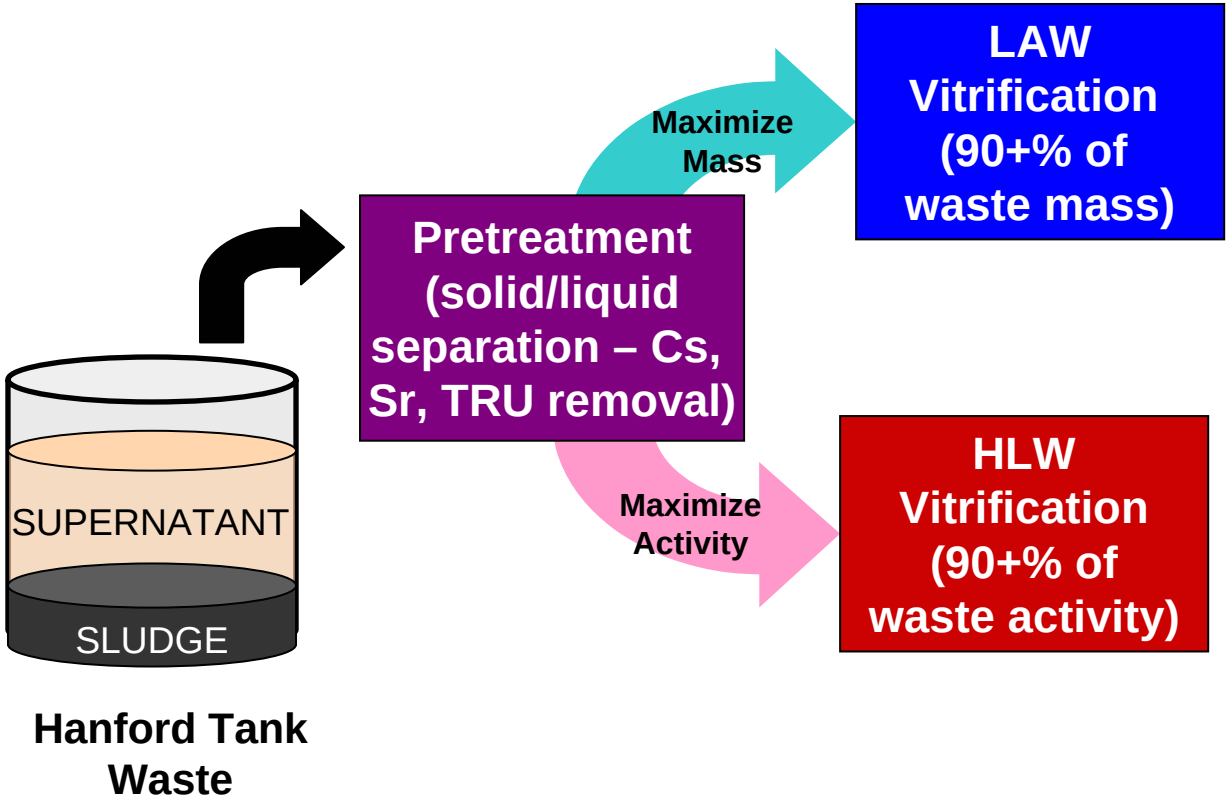
Major Facilities

1. Pretreatment (PT) Facility
2. Low Activity Waste (LAW) Vitrification Facility
3. High Level Waste (HLW) Vitrification Facility
4. Analytical Laboratory
5. Balance of Facilities

Commodities

Concrete	90,000 CY
Structural Steel	10,000 Ton
Pipe	160,000 ft
HVAC	1,200 Ton
Cable Tray	40,000 ft
Conduit	220,000 ft

WTP Flow Sheet – Key Process Flows



How is the Vitrified Waste Dispositioned?

High Level Waste Canisters

- 2’ x 14.5’
- 6,600 pounds of glass
- 600 canisters to be produced/year
- Temporarily stored in Hanford’s Canister Storage Building until National Repository opened

Low Activity Waste Containers

- 4’ x 7.5’
- 13,000 pounds of glass
- 1,300 containers to be produced/year
- Disposed on Hanford Site

Aerial View of the Waste Treatment Plant
$12.2 B 2019 Completion

Project 38% complete ~2650 staff

Pretreatment Facility - July 2007

Pretreatment Facility
Design 70% Complete
Construction 25% Complete

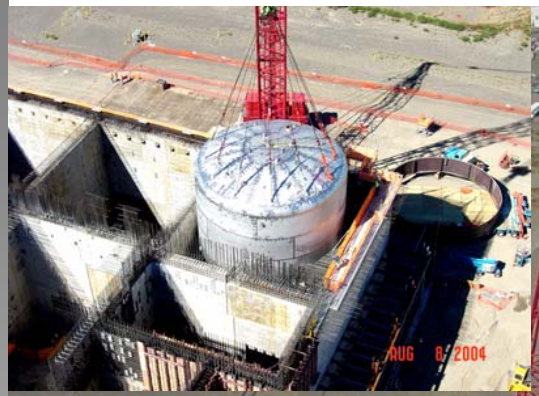
5 Stories (0', 28', 56', 77', 98')
250' Wide x 558' Long + 28' wide loading bay/dock
119' Tall (Top of Basemat at Grade to Roof)

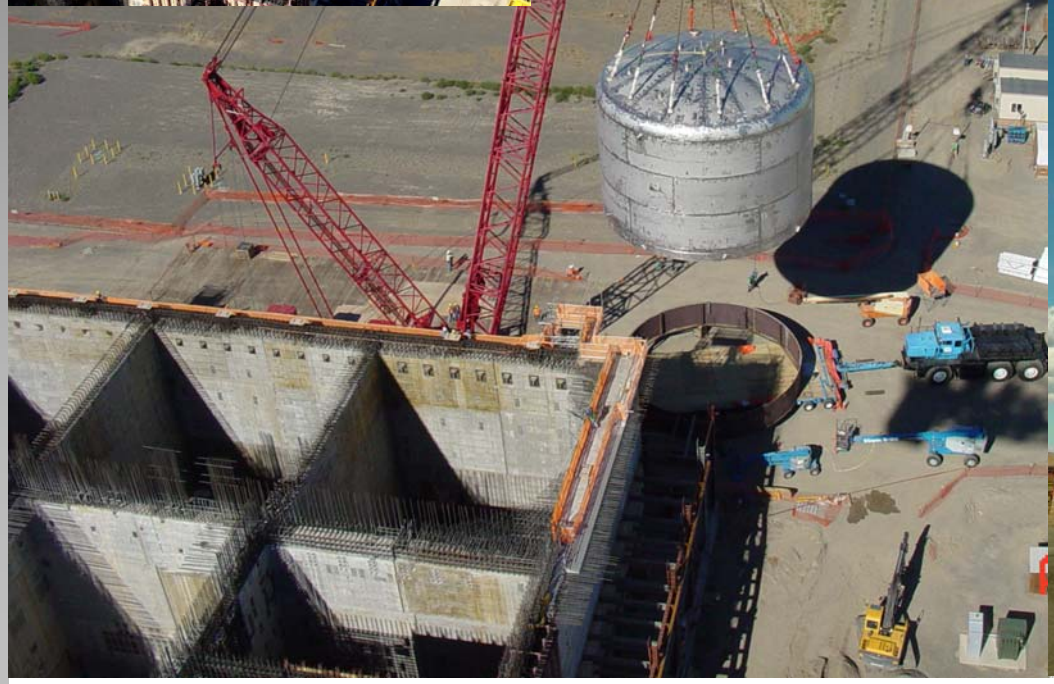
Feed Receipt Vessels in Fabrication-2004

Feed Receipt Vessels (4)

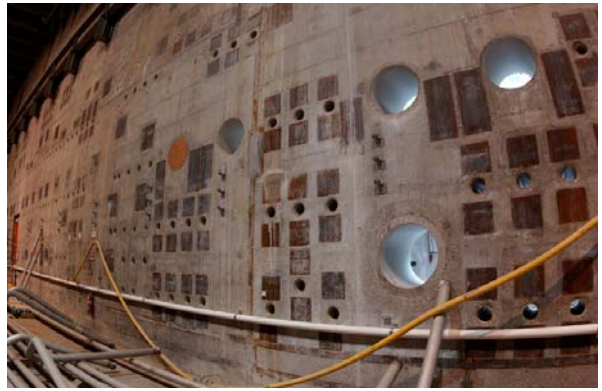
- Largest Vessels in Pretreatment
- Batch Volume 375,000 gal
- Diameter 47 ft, Height 43 feet

Feed Receipt Vessel being lifted into Shielded cell





Pretreatment Black Cell and Hot Cell



- **Permanent equipment installed in Black Cell**
  - 15 Black Cells
- **Equipment requiring maintenance installed in Hot Cell-maintainable/replaceable area**
- **Design concept allows insertion of new/modified technologies at later date**

HLW Vitrification

HLW Vitrification Facility
Design 79% Complete
Construction 20% Complete

4 Stories (0’, 14’, 37’, 58’)
281’ Wide x 448’ Long
120’ Tall (Bottom of Basemat @ -21’ to Roof)

LAW Vitrification

LAW Vitrification Facility
Design 93% Complete
Construction 48% Complete

Analytical Laboratory

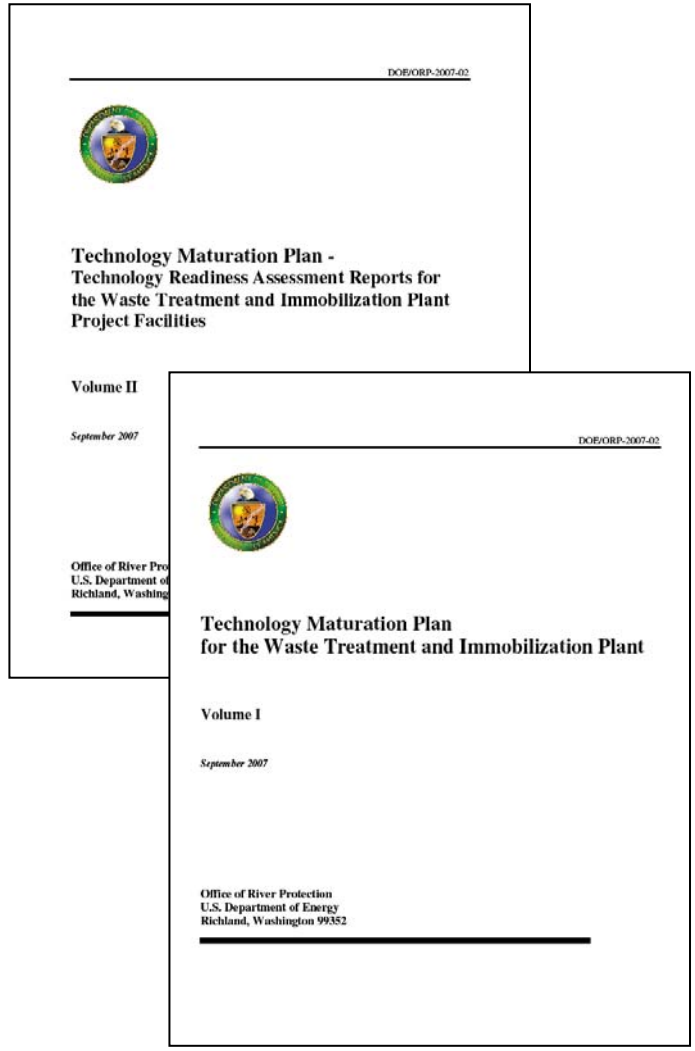
Analytical Laboratory
Design 88% Complete
Construction 35% Complete

WTP TRAs Status

Three TRA's Completed for WTP

- *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) Analytical Laboratory, Balance of Facilities and LAW Waste Vitrification Facilities,* 07-DESIGN-042, U.S. Department of Energy, Richland, Washington
- *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) HLW Waste Vitrification Facility,* 07-DESIGN-046, U.S. Department of Energy, Richland, Washington
- *Technology Readiness Assessment for the Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility,* 07-DESIGN-047, U.S. Department of Energy, Richland, Washington

Technology Maturation Plan Completed


DOE/ORP-2007-02

Technology Maturation Plan -
Technology Readiness Assessment Reports for
the Waste Treatment and Immobilization Plant
Project Facilities

Volume II

September 2007

DOE/ORP-2007-02

Technology Maturation Plan
for the Waste Treatment and Immobilization Plant

Volume I

September 2007

Office of River Protection
U.S. Department of Energy
Richland, Washington 99352

Purpose of the WTP TRAs

- Assess the maturity of Critical Technology Elements to:
  - Determine readiness of proceeding/continuing with design and construction
  - Identify immature technologies and components (for tracking of maturity of development)
  - Identify technology development needs for immature technologies
- Apply and refine TRL process for potential use by EM Design/Construct Projects

Methodology for Completion of TRAs

TRAs based upon method described in *Department of Defense, Technology Readiness Assessment (TRA) Handbook*, May 2005

Steps in TRA

1. Identification of Critical Technology Elements (CTEs)
2. Completion of TRL Assessment for each CTE
3. Completion of Technology Maturation Plan for technologies with TRL less than 6

WTP TRA Approach (1)

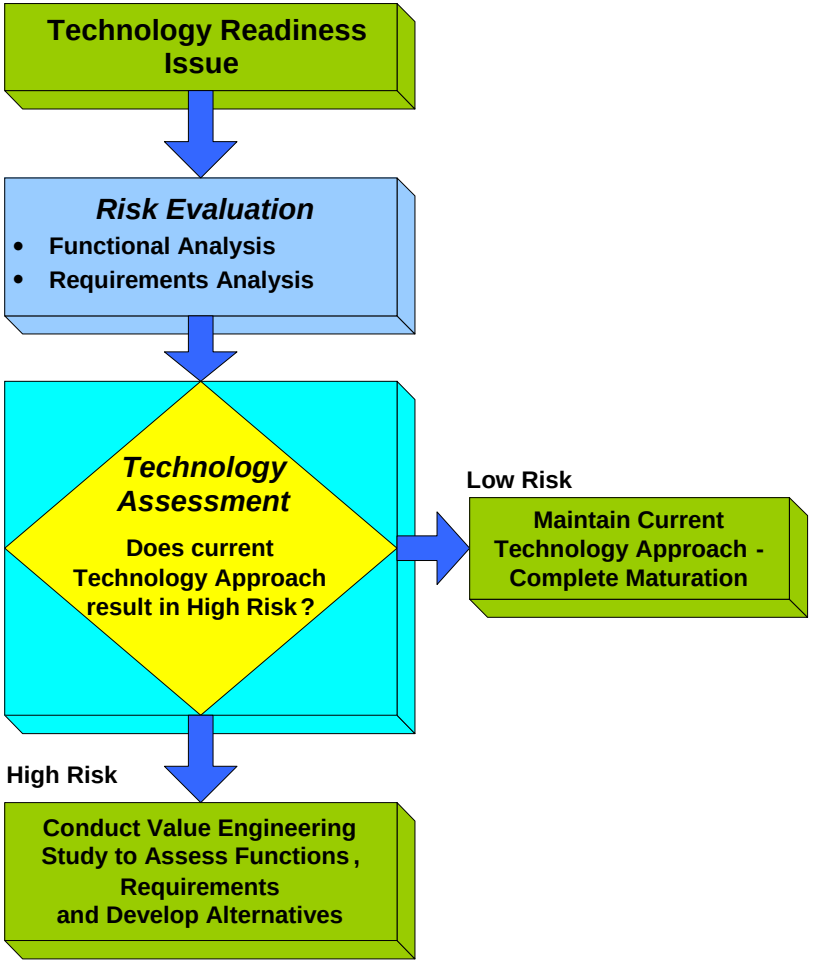
1. Critical Technology Element determination completed in 2 steps
   - Candidate CTE's identified by Assessment Team (DOE/Independent Contractor)
   - Final determination made with WTP Contractor support using DoD criteria
2. Revision of TRL Level definitions for Radiochemical Processing
   - Comparison of NASA, DoD and DOE-EM scale prepared
3. TRLs determined using modified "Nolte" calculator (Level 1-6)
   - All criteria to be met to complete level
   - Software systems not evaluated

WTP TRA Approach (2)

4. Process involved due-diligence prior to, during, and following TRL scoring
   - Treated criteria scoring as a “finding of fact”
   - WTP Contractor involving in initial scoring
   - Final scoring done following additional due diligence by Assessment Team
5. TRA Report provided to WTP Contractor for factual accuracy review.
6. Technology Maturation Plan prepared for CTEs < 6

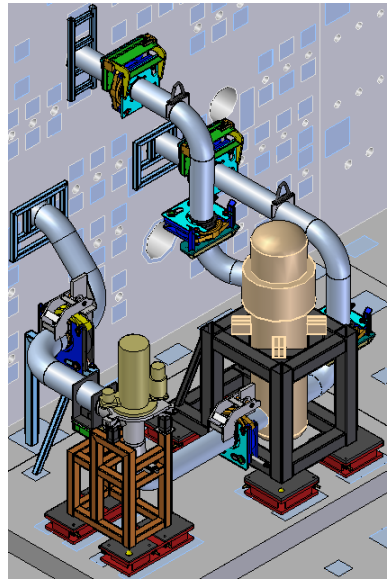
Development of Technology Maturation Plan

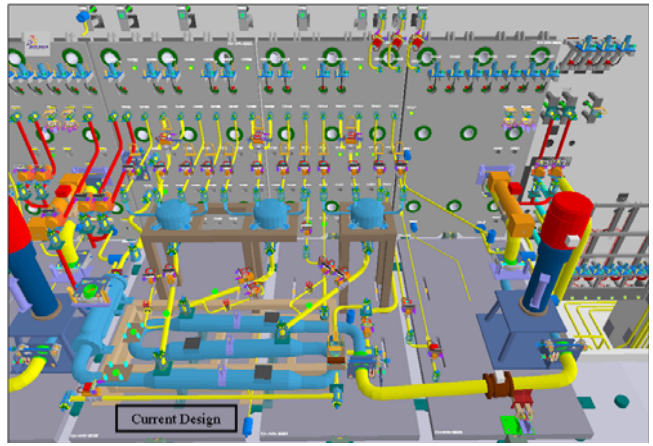
- CTE's < 6 were subjected to risk assessment to determine impact if not matured
- CTEs with significant consequence required technology maturation plans
- CTE < 4 required identification of alternative technology
- Principles of Systems Engineering and Value Engineering used in Development of Maturation Plan
  - Reassessment of Requirements
  - Reassessment of Functions



WTP Systems Requiring Maturation

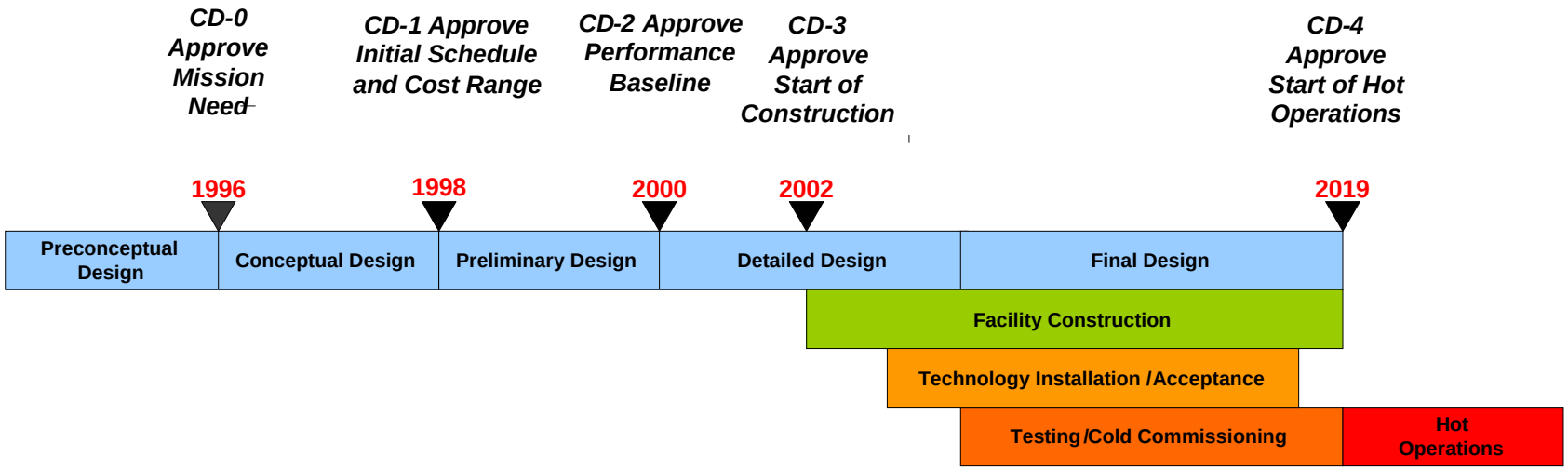
- Pulse Jet Mixing
- Waste Solids Separation
- Radioactive Cesium Removal
- Nitric Acid Recovery and Recycle
- Laser Ablation-Inductivity Coupled Plasma-Atomic Emission Spectrometer
- HLW Melter Offgas Treatment (Electrostatic Precipitator)
- LAW Container Sealing
- LAW Container Decontamination



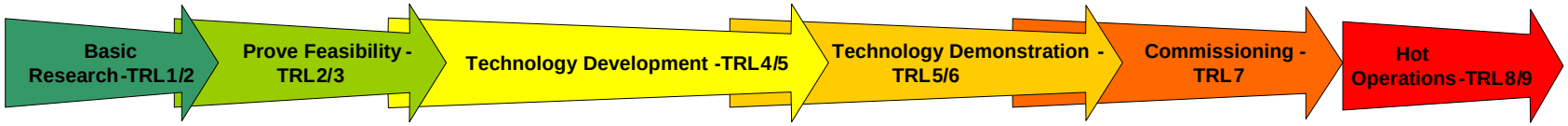


Technology Maturation Sequence and WTP Critical Decisions

DOE's Project Management Process as Applied to WTP



Technology Maturation



WTP Design Build Approach allows Technology Maturation at later stage in Project

Alignment of DOE Critical Decision Milestones with TRLs

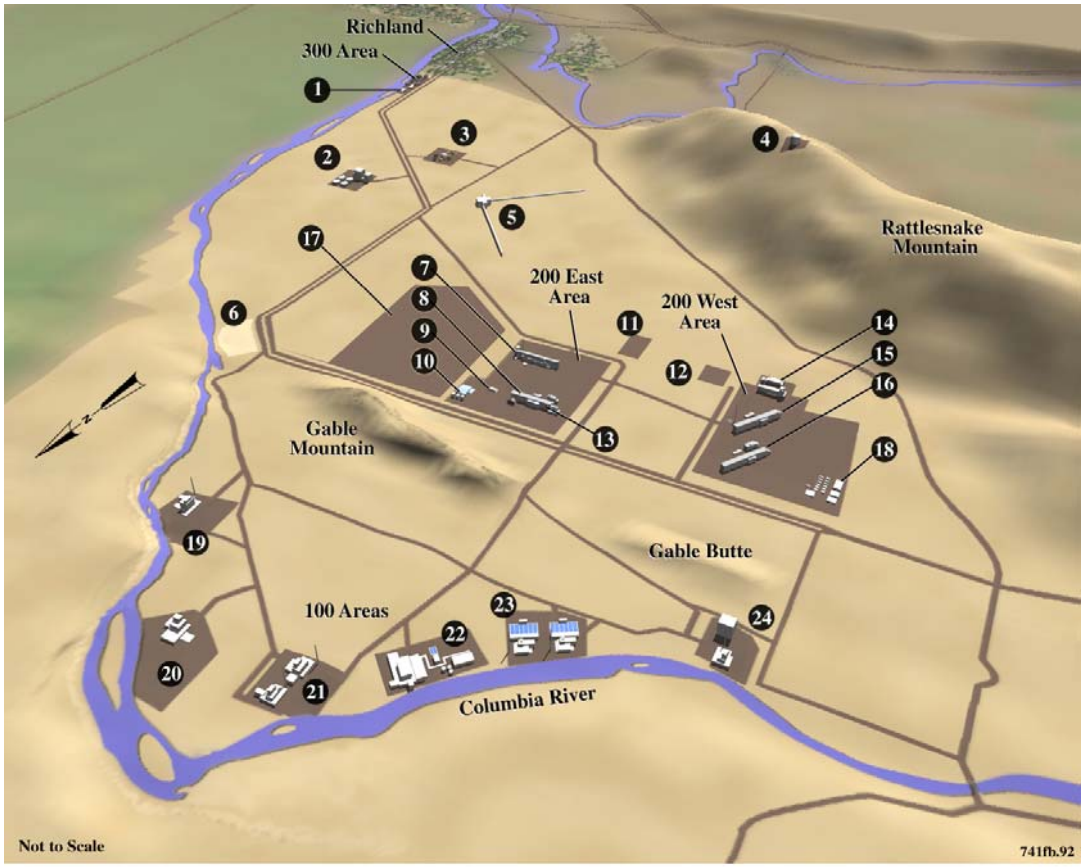
- WTP design concept is flexible and supports technology insertion (new/modified technology) after start of Construction
- Small number of CTEs rated less than TRL 6
- Cost of WTP delay would exceed cost risk of maturation
  - Maturity schedule will be managed within the current construction schedule

Observations on TRA Process

- DoD TRA provides structured, objective and clearly documented process
  - Helps identify specific actions needed to reduce programmatic risk
  - Complements DOE Design Oversight Process
- TRAs are a “finding of fact”.
  - Specified criteria (e.g. “Nolte Calculator”) essential to ensure consistency in assessments
- TRL Levels usually higher when strong technology program is completed, e.g. “make technology”.
  - Choices to “buy technology” or “engineer technology” without testing have led to lower TRLs.
- “Relevant Environment” and “Prototypic Testing” are critical concepts in TRA.
  - Practical difficulties and limitations of large scale testing with actual wastes with increased cost, complexity and risk may outweigh its value
  - Project design must mature with technology to ensure that testing is relevant.

Backup

Hanford Cleanup Site



1. 300 Area Liquid Effluent Treatment Facility
2. Commercial Operating Nuclear Power Plant
3. Fast Flux Test Facility
4. Observatory
5. Laser Interferometer Gravitational Wave Observatory
6. Old Hanford Town Site
7. Plutonium Uranium Extraction Plant
8. B Plant
9. Prototype Engineered Barrier
10. 200 East Area Effluent Treatment Facility
11. U.S. Ecology Commercial Solid Waste Site
12. Environmental Restoration and Storage Facility
13. Waste Encapsulation and Storage Facility
14. REDOX
15. U Plant
16. T Plant
17. Waste Treatment Plant
18. Waste Receiving and Processing Facility
19. F Reactor
20. H Reactor
21. D and DR Reactors
22. N Reactor
23. KE and KW Reactors
24. B and C Reactors

Balance of Facilities

Determination of Critical Technology Elements (CTEs)

- CTE assessment completed for all WTP Process and Process Support Systems for each facility
- CTEs determined by response to two sets of questions
- Must have positive response to at least one question in each question set for determination as CTE
- CTE's to be evaluated with Technology Readiness Levels

First Question Set

- Does the technology directly impact a functional requirement of the process or facility?
- Do limitations in the understanding of the technology result in a potential schedule risk, i.e., the technology may not be ready for insertion when required?
- Do limitations in the understanding of the technology result in a potential cost risk, i.e., the technology may cause significant cost overuns ?
- Are there uncertainties in the definition of the end state requirements for this technology ?

Second Question Set

- Is the Technology New or Novel?
- Is the Technology modified?
- Has the technology been repackaged so a new relevant environment is realized?
- Is the technology expected to operate in an environment and/or achieve performance beyond its original design intention or demonstrated capability?