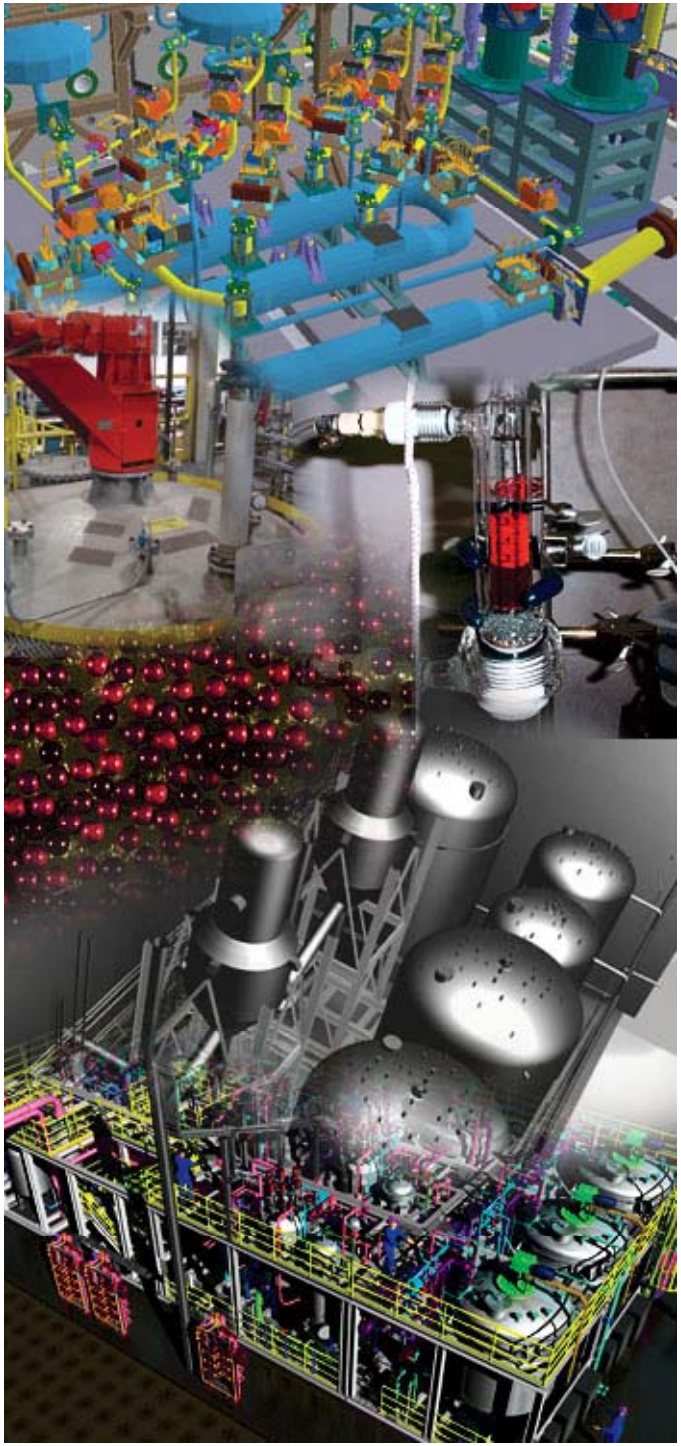


Waste Treatment Plant Project

TECHNICAL ACCOMPLISHMENTS, NEEDS, AND CHALLENGES

"The World's Largest Nuclear Chemical Processing Plant"

for the
National Academies Committee
October 31, 2007

Dr. Walter L. Tamosaitis. P.E.
Research and Technology Manager
Deputy Chief Process Engineer

Office of River Protection

Bechtel National, Inc.

Washington Group International

Today's Objective

Provide WTP Input Regarding Your Focus Areas of:

- **Science and Technology Areas for Pursuit and Leverage.**
- **National Laboratory Core Capabilities and Needs**

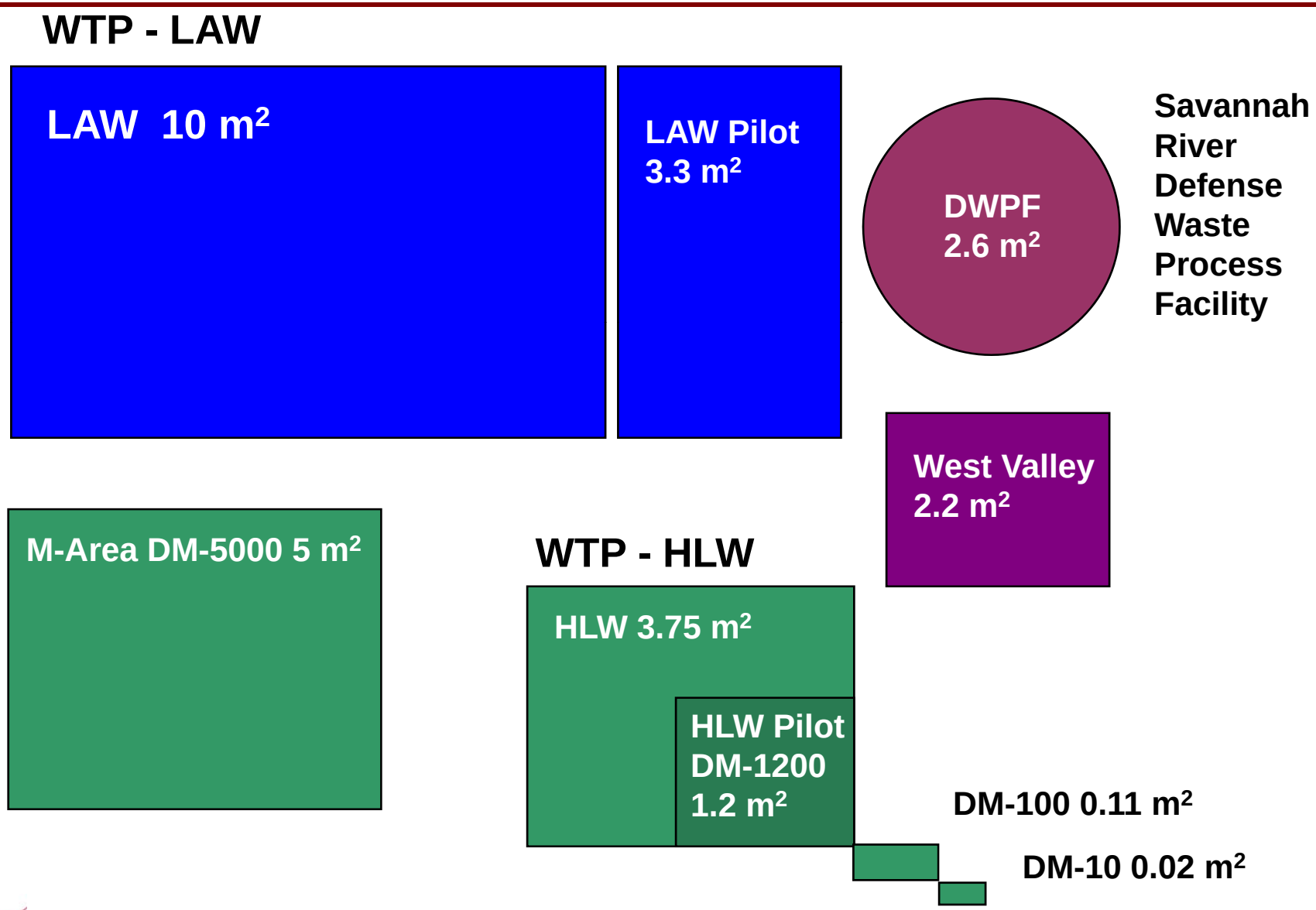
Today's Agenda

- What is WTP
- What Makes it Unique
- The Flow Sheet
- Challenges, Accomplishments, Examples
- Where are We Today
- Technology: Path Forward and Future Needs

WTP: What Is It?

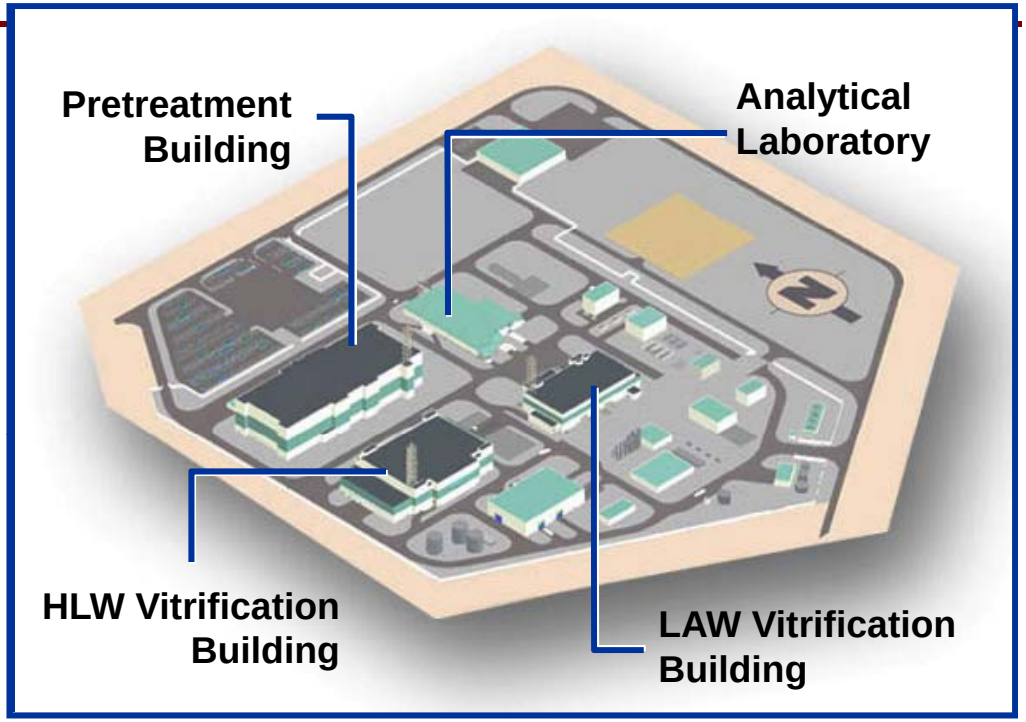
- World's Largest Nuclear Waste Processing and Vitrification Plant
- Two Major Contractors
  - Bechtel National Inc. (BNI - prime)
  - Washington Group International (WGI - prime sub)
  - Estimated Cost: $12B
- Full Operation 2018
- Vitrify ~ 54M Gallons of Waste
- 5 Main Plant Areas

Vitrification Size and Testing Comparisons



WTP: The Cornerstone of Hanford Cleanup

Hanford's Waste Treatment Plant will be the world's largest chemical-radioactive plant



Five Main Areas

- Pretreatment (PT) Facility
- Low-Activity Waste (LAW) Vitrification Facility
- High-Level Waste (HLW) Vitrification Facility
- Analytical Laboratory
- Balance of Facilities (BOF)

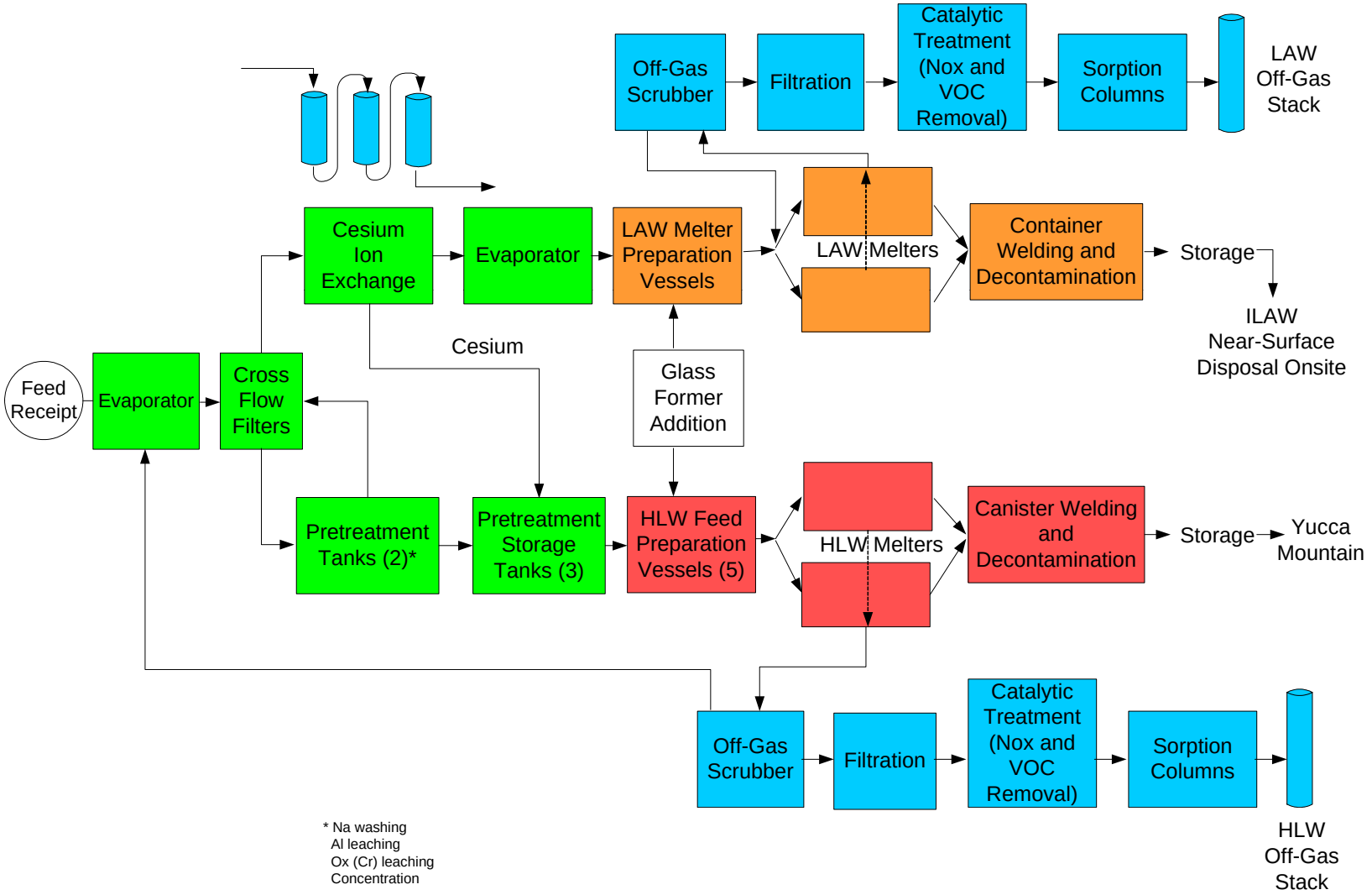
The WTP January 2002

The WTP Today!

What Makes WTP Unique

- **WTP:**
  - **Size and Complexity**
    - **Filtration, Number and Type Melters, IX Resin**
  - **Feed Stock Varies (~10 Different Feeds)**
  - **Internal Recycles (vs. return to tankfarm)**
  - **Caustic Melter Flow Sheet (vs. acid)**
  - **Blackcells (Chemical Ops w/no Moving Parts)**
  - **Many First-of-a-Kind Technologies or First-of-a-Kind Application of Technology**
  - **Time Table**

WTP Process Flow Sheet



Some Technology Challenges and Accomplishments

- Caustic Melter Flow Sheet
- Multiple Melters and LAW Melters
- Blackcells
- RF Bead Resin
- Pulsejet Mixing System for non-Newtonian Fluids
- Pulsejet Mixing for Newtonian Fluids
- Laser Ablation for Glass Composition Analysis
- Ultrafiltration Design
- Glass Canisters Development
- Largest Simulator for Operator Training
- Chromium Leaching Process
- Sparged Melters
- Glass Compositions
- Antifoam

How is WTP Developmental Work Done?

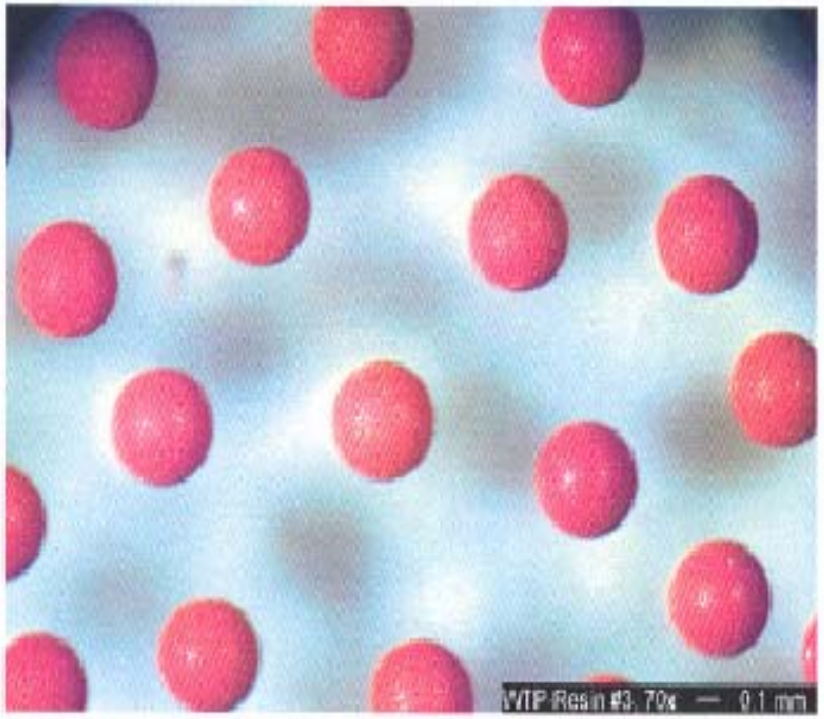
- Engineering Identifies Need or Risk
- R&T Writes the Test Specification
- The Supplier Writes Test Plan
- All Work Executed Under NQA-1 Requirements
- Main Suppliers -
  - 2 National Labs
  - Duratek/VSL
  - Dominion Engineering
  - Energy Solutions
  - Many Consultants Worldwide

Ion Exchange

- Removes Cesium
- Carousel 4 Column Operation
- Original: SuperLig® 644
  - Shard Form
  - Prone to Oxygen Degradation
- Developed: RF (Resorcinol Formaldehyde) Bead Resin
  - Uniform 400μ Spheres
  - Increased Resin Life and Plant Throughput
  - Lifetime Savings > $300M

Resin Comparison

SuperLig Ion Exchange Resin Shards



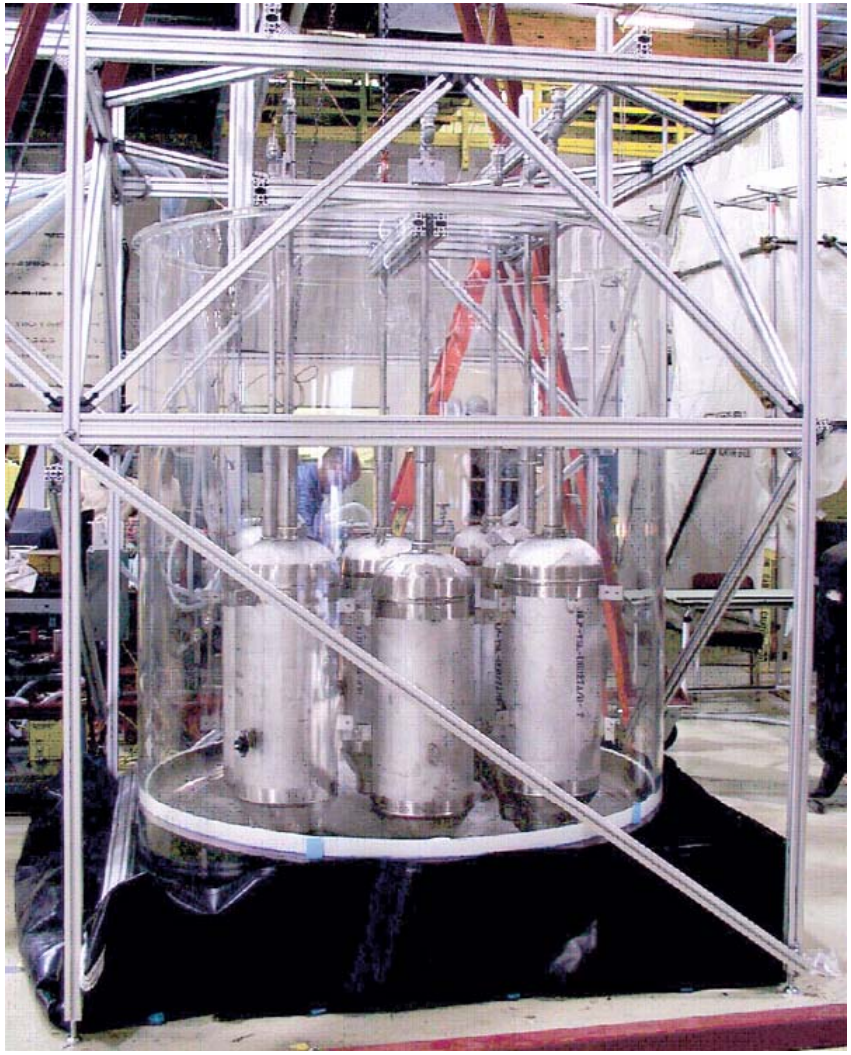
RF Ion Exchange Resin Beads

Pulse Jet Mixers (PJMs)

- Hydraulic Mixers for non-Newtonian Slurries
  - Designed for 30 Pascal
  - Tested up to 600 Pascal
- Sparger Supplemented
- Tested at Multiple Scales
- Operate in a “Blackcell” (No Moving Parts)

Quarter Scale PJM Test Tanks

Ultrafiltration Process Tank



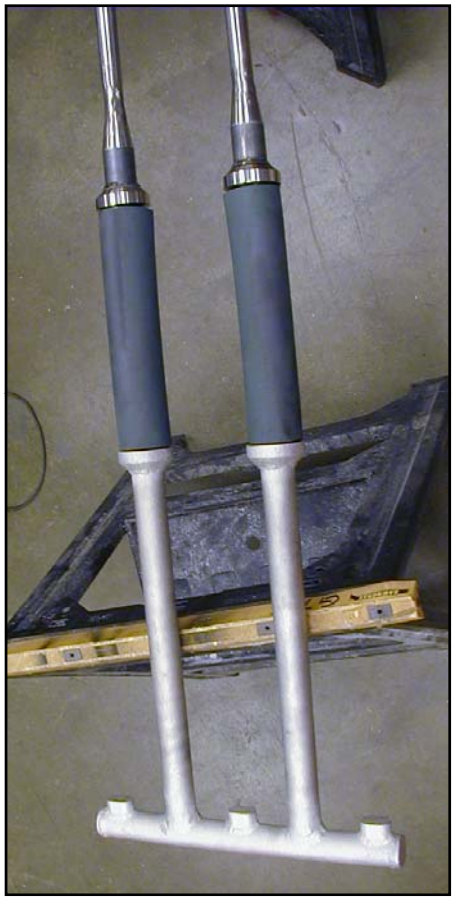
Lag Storage / Blend Vessels

Half Scale Pulse Jets

WTP Glass Development

- Melters: 2 LAW (Low Level); 2 HLW (High Level)
- Bubbled Melters for Increased Throughput
- Bubbler Tubes Required Extensive Testing for Highly Corrosive Conditions
- Large Scale and Full Scale Testing
- Tested Glass Formulations through Canister Drop Test
- Compositions Vary by Batch (500+ Batches)
- Composition Determined Prior to Feeding to Melter Using Laser Ablation Techniques

Test Bubblers



Pt-coated with LT-1 Shin Guards

Pt-coated with Cr Shin Guards

First HLW Canister to Be Filled

How is the Vitrified Waste Stored?

High Level Waste Canisters

- 2’ X 14.5’ X .125 inch wall
- 6,600 pounds of glass
- Temporarily stored in Hanford’s Canister Storage Building until national repository built

Low Activity Waste Containers

- 4’ X 7.5’
- 13,000 pounds of glass
- Stored at Hanford’s Central Plateau

WTP: Where are We Today?

- **External Flow Sheet Team Review (10/05-2/06)**
  - 28 Issues
    - No Show Stoppers
    - Response Plans Written to Address Each
    - 70% Complete, 100% by End of 2008
- **Technology Readiness Review**
  - 8 Technology Areas Identified for Further Testing
  - Utilized DOD Evaluation Process (First Time Use within DOE)
  - Response Plans Being Written

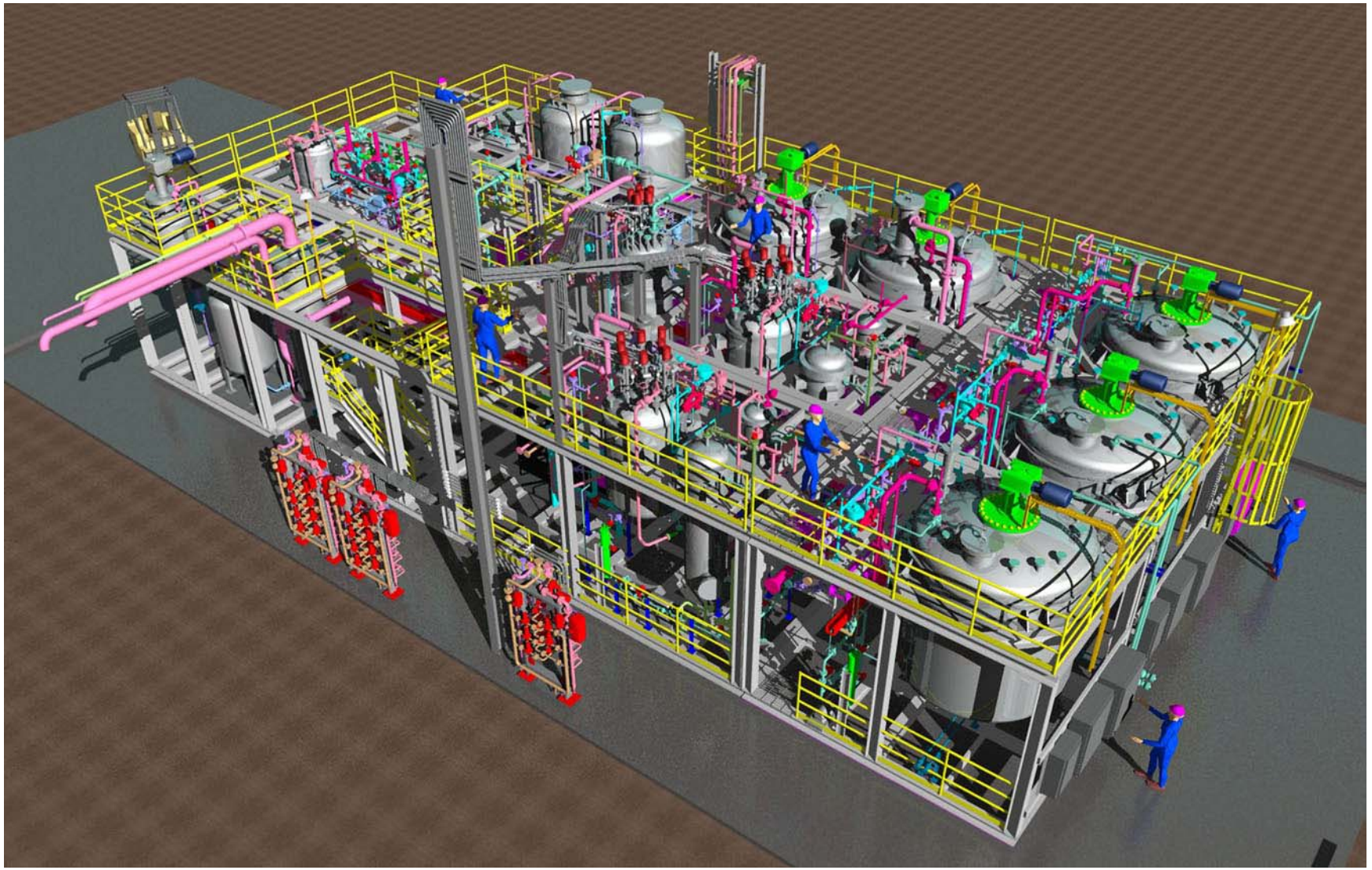
Some Current Technology Activities

- Slurry Transport Demonstration
- Filtration Demonstration
- Solids and Gel Formation Identification
- Erosion Testing
- “Newtonian Solids” Suspension
- Process Operating Range Tests
- Nitric Acid Purification with Cesium Decon
- Pretreatment Engineering Platform (PEP)
- Process Modeling
- Commissioning Simulant Development

WTP Pretreatment Engineering Platform

- $17M (equipment only) integrated demonstration of PT (less Ion Exchange)
- Demonstrates sludge washing, leaching, and concentration.
- Provides Data for Improved Modeling of Throughput and Mission Life
- ¼ scale
- 5000 Sq. ft., 2 floors, self-powered

WTP PEP 3D View



Cross Flow Filtration

- Typically Used in Polishing Applications
- Used in WTP for Concentrating Sludge to 20 Wt%
- 5 Filters, 240 Tubes Each, 10 ft Long, .5 Inch Diameter, .1 Micron
- Dual Filtration Banks
- Pressure Control System: Overall, each Longitudinally, each Radially with Back Pulsing, with Cleaning System.

WTP Technology Path Forward

- Close EFRT and TRA Issues
- PEP Operation
- Flow Sheet Modeling
- Finalize Design
- Address Surfacing Technology Issues

Future Technology Needs

- Waste Forms and Glass Formulations
- Improved Melters
- Waste Throughput Focus
- Process, Unit Ops, and System Modeling
- Precipitation/Gelation Modeling and Prediction
- Non-Newtonian CFD Modeling
- Non-Organic Elutable Ion Exchange Material
- Hydrogen Handling and Mitigation
- On-Line Instrumentation
- Simulant Development

Suggested National Laboratory Needs

- Radiochemistry
- Modeling (all forms)
- Glass/Waste Form Development
- Hot Cells
- Analytical Development and Support
- Pilot Testing Facilities
- Chemical Engineering and Chemistry
- Materials Technology
- Continuity of Technical Knowledge

Special Need

- **Future Supply of Technical Personnel –**
  - **Highlighted by the EFRT (Task M-11)**
  - **Retiring Baby Boomers**
  - **Engineering Graduates Declining**
  - **Commercial Competition**
  - **Extended WTP Schedule**

Summary

- **WTP Progressing Well. Many Technical Challenges Faced and Resolved.**
- **Issues Being Worked and Will Continue to Rise.**
- **Several Technical Areas Have Been Outlined for Future Emphasis.**
- **National Lab Suggestions Made.**
- **Supply of Technologists Seen as Critical Need**