



OFFICE OF  
**RIVER PROTECTION**  
United States Department of Energy

# WTP Technical Issue Resolution Update

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Hanford Advisory Board Tank Waste Committee

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Presented by: Waste Treatment and Immobilization Plant

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# WTP Mission: Immobilize the Waste in Glass

**Vitrification is the selected technology for immobilizing Hanford's high-level radioactive waste for safer long-term storage**

## ➤ **Sturdy Waste Form**

- Impervious to the environment, allowing radioactivity to safely dissipate over hundreds to thousands of years

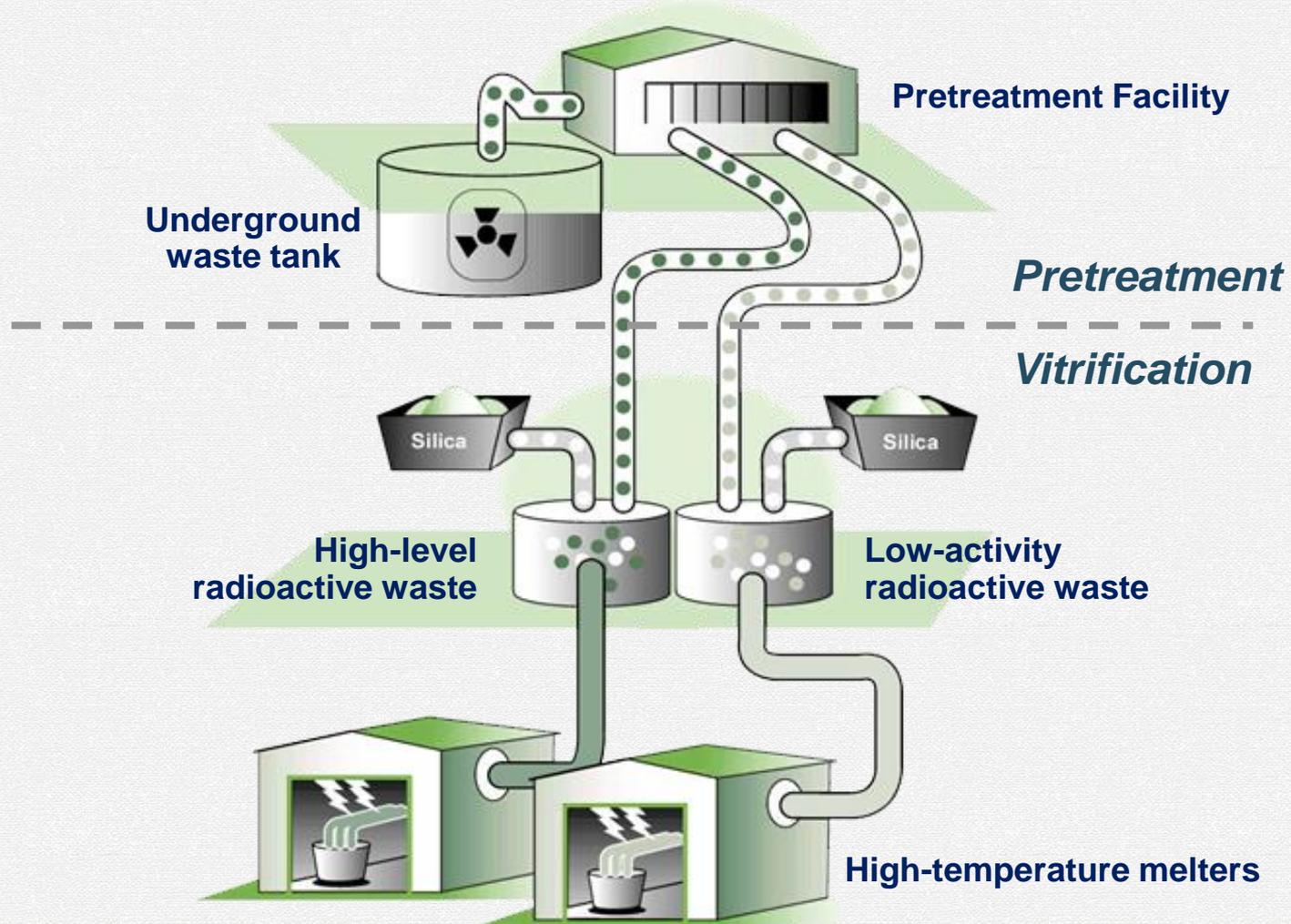
## ➤ **Proven Technology**

- Vitrification is used overseas and at other U.S. Department of Energy (DOE) sites





# WTP Vitrification Process





# Waste Treatment and Immobilization Plant



Analytical  
Laboratory

Pretreatment  
Facility

Low-Activity  
Waste Facility

High-Level  
Waste Facility

Balance of Facilities  
(20 support buildings)

July 2014





# Pretreatment Facility Function



- Tank waste is pumped to the Pretreatment (PT) Facility's interior waste feed receipt vessels
- Pretreatment separates the low-activity radioactive waste from the high-level radioactive waste
- During pretreatment, waste is concentrated by removing water in an evaporator
- Solids filtered out for inclusion in high-level waste stream; remaining soluble, highly radioactive isotopes removed with ion-exchange process





# Pretreatment Facility Technical Issue Resolution Impacts



- In late 2012, the DOE Office of River Protection (ORP) limited project activities at the PT Facility
- Restrictions were imposed on the remaining engineering, procurement, and construction work due to:
  - Unresolved technical, management, and quality issues
  - Need for design and nuclear safety basis alignment





## T1 Hydrogen Gas Events in Vessels

- Risk of combustion in the vessel headspace due to hydrogen accumulation
- Develop safety basis strategy to prevent/mitigate hydrogen event

## T2 Criticality in Pulse-Jet Mixer (PJM) Vessels

- 16 tanks may contain plutonium particles of size and density prone to settling
- Resolve criticality issues in high solids vessels through analysis and testing

## T3 Hydrogen in Piping and Ancillary Vessels

- Concern over a deflagration event occurring in piping and ancillary vessels
- Develop piping design guide to mitigate and complete conceptual design for vessels based on quantitative risk assessment process

## T4 PJM Vessel Mixing and Control

- Concern with adequacy of PJM mixing and control system
- Complete testing of standard high solids vessel prototype

## T5 Erosion/Corrosion in Piping and Vessels

- Uncertainties exist in waste feed characteristics and ability to meet 40-year service life
- Confirm erosion/corrosion design basis, including margin, through testing and analysis

## T6 Design Redundancy/ In Service Inspection

- Perform failure modes, effects, and criticality analysis
- Complete conceptual design of Planning Areas 2, 3, and 4

## T7 Black Cell Vessel/ Equipment Structural Integrity

- Seismic ground motion criteria for Waste Treatment and Immobilization Plant changed around 2005
- Complete structural analysis of standard vessel and strategy for structural upgrades to installed vessels

## T8 Facility Ventilation/Process Off-Gas Treatment

- Multiple technical challenges associated with ventilation system, including HEPA filters
- Complete engineering/nuclear safety assessments to ensure ventilation meets requirements



# Pretreatment Facility Technical Issues

## T-1 Hydrogen Gas Events in Vessels

- Risk of combustion in the vessel headspace due to hydrogen accumulation
- Develop safety basis strategy to prevent/mitigate hydrogen event

Technical Issue	Status of Resolution
T-1 Hydrogen Gas Events in Vessels	<ul style="list-style-type: none"> <li>• ORP is currently reviewing the Waste Treatment and Immobilization Plant (WTP) Contractor Engineering Study supporting revised control strategy. Expect resolution in fourth quarter calendar year (CY) 2016.</li> </ul>





# Pretreatment Facility Technical Issues (Cont.)

## T-2 Criticality in Pulse-Jet Mixer (PJM) Vessels

- 16 tanks may contain plutonium particles of size and density prone to settling
- Resolve criticality issues in high-solids vessels through analysis and testing

Technical Issue	Status of Resolution
T-2 Criticality in PJM Vessels	<ul style="list-style-type: none"> <li>• ORP has reviewed and accepted an updated WTP Criticality Safety Evaluation Report and Engineering Study evaluating heavy plutonium particulate treatment in the PT Facility. Expect resolution in fourth quarter CY 2016.</li> </ul>





## Pretreatment Facility Technical Issues (Cont.)

### T-3 Hydrogen in Piping and Ancillary Vessels

- Concern over a deflagration event occurring in piping and ancillary vessels
- Develop piping design guide to mitigate and complete conceptual design for vessels based on quantitative risk assessment process

Technical Issue	Status of Resolution
T-3 Hydrogen in Piping and Ancillary Vessels	<ul style="list-style-type: none"> <li>• ORP is currently evaluating a preliminary documented safety analysis change package, consequence calculation, and proposed update to the WTP design basis to resolve the hydrogen in piping and ancillary vessel issue. Expect resolution in fourth quarter CY 2016.</li> </ul>





# Pretreatment Facility Technical Issues (Cont.)

## T-4 PJM Vessel Mixing and Control

- Concern with adequacy of PJM mixing and control system
- Complete testing of standard high-solids vessel (SHSV) prototype

Technical Issue	Status of Resolution
T-4 Vessel Mixing and Control	<ul style="list-style-type: none"> <li>• Phases 1 and 2 of PJM control system testing complete.</li> <li>• SHSV prototype fabricated and delivered to Richland Test Facility on July 14.</li> <li>• Test plan for PJM control and mixing tests for SHSV in final development. Expect plan in fourth quarter CY 2016.</li> </ul>





## Pretreatment Facility Technical Issues (Cont.)

### T-5 Erosion/ Corrosion in Piping and Vessels

- Uncertainties exist in waste feed characteristics and ability to meet 40-year service life
- Confirm erosion/corrosion design basis, including margin, through testing and analysis

Technical Issue	Status of Resolution
T-5 Erosion/Corrosion in Piping and Vessels	<ul style="list-style-type: none"> <li>• Pipe loop to evaluate wear in piping complete; test plan in final development.</li> <li>• Corrosion testing underway.</li> <li>• Preparation of jet impingement test equipment in progress.</li> </ul>





## Pretreatment Facility Technical Issues (Cont.)

### T-6 Design Redundancy/ In-Service Inspection

- Perform failure modes, effects, and criticality analysis
- Complete conceptual design of Planning Areas 2, 3, and 4

Technical Issue	Status of Resolution
T-6 Design Redundancy/ In-Service Inspection	<ul style="list-style-type: none"><li>• Conceptual design study underway to provide basis for implementing SHSV into pretreatment.</li></ul>





## Pretreatment Facility Technical Issues (Cont.)

### T-7 Black Cell Vessel/ Equipment Structural Integrity

- Seismic ground motion criteria for WTP changed around 2005
- Complete structural analysis of standard vessel and strategy for structural upgrades to installed vessels

Technical Issue	Status of Resolution
T-7 Black Cell Vessel/ Equipment Structural Integrity	<ul style="list-style-type: none"><li>• Structural design of SHSV-test vessel complete</li><li>• Structural design of SHSV-plant vessel nearing completion</li><li>• Fitness for service approach for evaluation of vessels installed in PT Facility in progress</li></ul>





## Pretreatment Facility Technical Issues (Cont.)

### T-8 Facility Ventilation/ Process Off-Gas Treatment

- Multiple technical challenges associated with ventilation system, including HEPA filters
- Complete engineering/nuclear safety assessments to ensure ventilation meets requirements

Technical Issue	Status of Resolution
T-8 Facility Ventilation/ Process Off-Gas Treatment	<ul style="list-style-type: none"> <li>• PJM vessel off-gas treatment system design under review (will be included in the T-6 Conceptual Design Study).</li> <li>• Facility ventilation system design review plan in progress.</li> </ul>





# Full-Scale Test Vessel Fabrication Progress



**Main SHSV Design Vessel PJM Installation Complete**



**Head Welding Complete**





## Full-Scale Test Vessel Arrival



The SHSV design test vessel was transported via barge from Vancouver, Wash., to the Port of Benton. Greenberry Industrial, Inc. is the design test vessel manufacturer.



The SHSV design test vessel was then loaded onto a trailer for transport to the test facility in Richland. The design test vessel is 35 feet tall, 16 feet in diameter with a total capacity of 22,000 gallons.



# Full-Scale Test Vessel Installed at Atkins Engineering Laboratory



SHSV design test vessel lifted into Atkins Engineering Laboratory Facility





# Safety Always Comes First!

The Hanford Reach  
White Bluffs Overlooking the Columbia River

