Modular Cesium Removal Technology
Tank Side Cesium Removal (TSCR)

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Tank Side Cesium Removal (TSCR) Objectives

- Demonstrates modular tank-side technology for treating waste supernatant
  - Filter solids using backwashable filter technology
  - Remove Cs-137 and Sr-90 with Crystalline Silicotitanate (CST)

- Early production of feed for WTP LAW-Vitrification commissioning and operation
  - Bypasses WTP Pretreatment Facility
  - Treated product meets WTP feed acceptance criteria

- Builds upon AVANTech’s commercial Cs removal experience at Fukushima

*TSCR Provides Early Feed to WTP-LAW Vit. Facility*
Direct Feed Low Active Waste (DFLAW)

**TSCR Facts**
- 42 Ft. Long
- 12 Ft. Wide
- 12 Ft. Tall

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**Pretreatment Facility Facts**
- 540 Ft. Long
- 215 Ft. Wide
- 120 Ft. Tall (12 stories)

**DFLAW**

**Effluent Treatment Facility (ETF)**

**Bypasses Pretreatment Facility**

**WTP PRETREATMENT (Work Halted 2012)**

**Storage of Separated Cesium For Future Disposition**

**WASTE TREATMENT PLANT**

**TANK-SIDE CESIUM REMOVAL**

**LOW-ACTIVITY WASTE FACILITY**

**SUPPLEMENTAL LAW**
- Onsite Grout
- Offsite Grout

**INTEGRATED DISPOSAL FACILITY**

**Onsite Disposal**

**Liquid Effluent Retention Facility**

**Effluent MGMT Facility**

**Waste Treatment Byproducts**

**Treated Waste**
Hanford – 200 Area

- TSCR located on edge of 241-AP Tank Farm

- Capable of treated 80% of Hanford tank waste
Modular cesium removal technology within 3 enclosures

- **Process Enclosure**
  - Contains all process and waste wetted components

- **Ancillary Enclosure**
  - Air/ Water/ Reagent

- **Control Enclosure**
  - Operator Workstation
    - All operations take place remotely

All operations take place remotely.
**Technical Evolution of Cesium/Strontium Ion Exchange Columns (IXC-150)**

<table>
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<tr>
<th>Description</th>
<th>SCIX</th>
<th>SARRY</th>
<th>HERO</th>
<th>TSCR</th>
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<tr>
<td><strong>Cooling Features</strong></td>
<td>Active Water Cooling</td>
<td>Convective air flow in annulus between shield and IX Vessel</td>
<td>Convective air cooling through cooling core and conductive cooling through IXC sidewall</td>
<td>Convective air cooling thru cooling core and improved conductive cooling thru IXC sidewall</td>
</tr>
<tr>
<td><strong>Shielding</strong></td>
<td>Inside tank, so tank structure provided shielded</td>
<td>Lead shot filled compartment around IX Vessel</td>
<td>Poured lead in removable annular cylinder around IXC</td>
<td>Poured lead in cavity formed by the IXC wall and outer shell</td>
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<tr>
<td><strong>Handling Method</strong></td>
<td>Placed in tank w/ crane. CST transferred to tank bottom for transfer to DWPF</td>
<td>Overhead crane. Spent IXCs with spent media placed in interim storage</td>
<td>Forklift Handling. Spent IXCs with spent media placed in interim storage</td>
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</tr>
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Ion Exchange

- Design for Crystalline Silicotitanate (CST) media
- High Cs-137 Capacity
  - 141,600 Ci
- Robust Structural Design
  - Design Pressure: 400 psig (ASME Section VIII)
  - Survives 36” vertical drop
- IX Column Internals
  - Support effective flow distribution as well as bulk dewatering/drying
  - Good CST compatibility\(^1\)
- Quickly replaceable

- Integral Self-Shielding
  - Reduces dose rates to < 5 mrem/hr
- Cooling Core
  - Aids in heat dissipation
  - Mitigates IXC boiling under liquid filled static conditions - (580 W Decay Heat)
- Simplified Contact Handling
  - Compatible with forklift or overhead hoist
- Passively Safe Storage
  - > 50-yr interim storage

(\(^1\) AVANTech and UOP have partnered for more than 7 years to deploy over 200,000 kilograms (53,000-gal) of UOP CST adsorbents in systems designed and manufactured by AVANTech.)
TSCR Process Enclosure

- **NQA-1 safety significant features:**
  - Spray leak knockdown
  - Containment of media & waste from H₂ detonation
  - Protects safety-significant components within enclosure during NPH
  - Enclosure has guides & restraints that protect it from forklift damage
  - Lockable to prevent inadvertent entry

- **Seismic Category 2**

*Enclosure is Anchored to Concrete Pad*
IXC Handling and Storage

- TSCR Forklift Used for:
  - Unloading of freshly loaded Ion Exchange Columns (IXC-150’s)
  - Insertion and removal of Filters and IXC-150’s
  - Movement of IXC-150’s to Interim Storage Pad

- Features
  - Mast Height Restrictor
    - Maintains IXC-150 height within 36-in of ground level
  - Wet Chemical fire suppression system

- Mimics handling at Fukushima
  - Eliminates need for cranes and onsite use of transport trailers

Forklift & Yoke for TSCR Filter & IXC-150
IXC-150 Handling

- **Transporter:** Delivers new IXC-150 loaded with CST
  - CST washed, loaded and rinsed by AVANTech *(at Richland facility)*
- **Forklift:** All onsite IXC handling and movement

- **IXC-150**
- **Forklift with Yoke**
- **Truck with Transporter**
Factory Acceptance Testing (FAT) – Richland, WA

- Verify/ Validate
  - System operation
    - Control logic
    - Pressures, flows, etc.
    - IXC carousel rotation
    - Filter backwashing
  - Transient Recovery
  - CST Recovery

- Train operators
  - Procedure refinement

- Train craftsmen
  - IXC replacement
  - Forklift operations

TSCR Arrangement for FAT at AVANTech’s Richland Facility
Results from Lab, Pilot and Factory Testing

- CST will effectively remove Cs from Hanford Tank Waste.
- TSCR filter technology will enable uninterrupted/ continuous operation (24/7).
- H₂ is effectively managed by sweep air, IXC vent assemblies and specific administrative controls (SAC).
- The TSCR forklift & yoke has proven to be an effective method of filter and IXC handling.  
  (Same technique as used by AVANTech at Fukushima)
  ✓ Eliminates rigging
  ✓ Maintains IXC-150’s close to the ground
  ✓ Forklift used for all handling/ movement operations, thus eliminating need for separate crane, trailer, etc.
- FAT has shown that a modular treatment system is an operationally viable method of tank waste treatment.
TSCR Mobilization and Delivery

- Pre-Ship Inspection by Sec. Brouillette
- Mobilization from AVANTech
- Process Enclosure Offload at AP Farm
- TSCR Delivery to AP Farm
Technology to Meet Nuclear Challenges!

✓ Engineering Excellence
✓ Process Innovation
✓ Advanced Manufacturing
✓ NQA-1 Quality
✓ Qualified Personnel

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