Low Activity Waste Pretreatment System

Hanford Advisory Board
Tank Waste Committee
Project Highlights

- Critical Decision (CD)-1 approved: May 2015
  - Initiated Preliminary Design phase: May 2017
  - Full use of fiscal year (FY) 2015 capital funds allotted: $23M
  - Advancement of design to 90% at CD-2/3

- CD-3A will allow procurement of long lead items

- Integrated engineered-scale test prior to CD-2/3
  - Full scale column test, 1/9th scale integrated test
  - Request for Proposals issued in July 2015
Cross-Flow Filtration was selected for technical maturity, cost, and maintenance considerations.

Spherical Resorcinol Formaldehyde (sRF) resin was chosen over other non-elutable IX media for cost and media disposal considerations.

Both selections also provide operations and maintenance experience relevant to future Waste Treatment and Immobilization Plant (WTP) Pretreatment Facility operations.
Project Scope

- **Hazard Category 2, Seismic Design Category 3, Performance Category 3**
- Site footprint is approximately 4 acres
- Process facility footprint is approximately 20,000 square feet (ft.)
- Process cells cover an area – 68 ft. x 76 ft., with depth of cells varying from 23-48 ft.
- Lag storage tank vault covers an area 112 ft. x 42 ft., 48 ft. deep
- Main process tanks:
  - Filter Feed Tank – 4,000 gallons
  - Treated Waste Transfer Tank – 1,560 gallons
  - Cesium Product Tank – 35,000 gallons
  - Lag Storage Tanks (3) – 75,000 gallons each
- Reagent tanks:
  - Sodium Hydroxide (NaOH) tanks: 19 million (M) – 3,700 gallons, 1M – 3,100 gallons, 0.1M – 2,200 gallons
  - Dilute Nitric Acid (HNO₃) tanks (2): 12,000 gallons each
  - Assured Elution System tanks (2) (dilute HNO₃): 4,500 gallons each
- Piping – permanent underground pipe-in-pipe design:
  - Between AP Tank Farm and Low Activity Waste Pretreatment System (LAWPS) – Three 2-inch diameter lines, ~1,700 ft. long
  - Between LAWPS and the WTP interface point – Two 3-inch diameter lines, ~1,000 ft. long
- **Note: Utilities provided up to LAWPS site separately from the LAWPS Project under the Direct Feed Low Activity Waste (DFLAW) program scope**
Process Description

- Double-shell tank (DST) AP-107 will send liquids to LAWPS – roughly 90 gallons per minute – to the LAWPS filter feed tank.

- The filter feed tank will return roughly 80 gallons per minute to DST AP-107.

- The filter feed tank pump will send the tank waste liquids through the cross-flow filter tubes (408 porous sintered metal tubes) at a rate of 900 gallons per minute.

- Filtrate (free of suspended solids) will flow from the cross-flow filters to the ion exchange columns – 10 gallons per minute.

- The IX columns (lead and lag) will undergo an elution cycle every 7 days – cesium is stripped from the columns weekly with dilute HNO₃.

- The cesium and other miscellaneous small liquid waste streams (such as flushes) will be chemically adjusted and returned to the tank farm DSTs.

- Low Activity Waste (LAW) feed is collected in one of three lag storage tanks, each with a capacity of 75,000 gallons. At any given time, one tank will be filling with LAW feed, one will be undergoing confirmatory lab analysis (within a week), and one will be sending feed to the WTP LAW Facility.

- Each lag storage tank can hold roughly 7-10 days feed to the WTP LAW Facility – feeding both melters at full capacity to produce 30 metric tons (MT) of glass per day, which is 5 of the Immobilized Low Activity Waste containers (7.5 ft. tall, 4.5 ft. in diameter).
Key Performance Parameters

- **Facility Throughput** – Support WTP LAW vitrification operations to produce 30 MT per day of glass. Translates into processing 1,600 MT sodium/year, 20 wt% waste loading in glass

- **WTP LAW Vitrification Facility Waste Acceptance Criteria (WAC)** – Produce LAW feed in compliance with WAC and Interface Control Document 30

- **Solids Removal** – Remove undissolved solids from tank farm liquid waste, meeting strontium and transuranic waste concentration limits for LAW feed

- **Cesium Removal** – Remove cesium to meet U.S. Department of Energy (DOE) radioactive waste management limits for near surface disposal

- **Environmental Compliance** – Comply with applicable environmental regulations

- **Facility Flexibility** – Ensure facility layout accommodates expansion – process piping located to serve additional vault cells, vault walls large enough to allow additional penetrations
Low Activity Waste Pretreatment System Facility Concept
LAWPS above-grade structures

Spent Resin Handling Bay
Low Activity Waste Pretreatment System Process Equipment

- Filter Backpulse Tanks: TS-TK-102, TS-TK-101
- IX Lead Column: TS-C-200
- IX LAG Column: TS-C-201
- Treated Waste Tank: TS-TK-300
- Cross Flow Filters: TS-F-100, TS-F-101
- PT-109, TE-111
- FE-136, FCV-13C
- Feed Tank: TS-TK-100
- CS Product Tank: TS-TK-200
The following Technology Readiness Level (TRL) comparison table is derived from DOE G 413.3-4A, *Technology Readiness Assessment Guide*:

<table>
<thead>
<tr>
<th>Relative Level of Technology Development</th>
<th>Technology Readiness Level</th>
<th>TRL Definition</th>
<th>Corresponding Critical Decision</th>
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<tr>
<td>System Operations</td>
<td>TRL 9</td>
<td>Actual system operated over full range of expected mission conditions</td>
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<tr>
<td>System Commissioning</td>
<td>TRL 8</td>
<td>Actual system completed and qualified through test and demonstration (ex. Hot commissioning)</td>
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<td>TRL 7</td>
<td>Full-scale, similar (prototypical) system demonstrated in relevant environment (ex. Cold commissioning)</td>
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<td>Technology Demonstration</td>
<td>TRL 6</td>
<td>Engineering/pilot-scale similar (prototypical) system validation in relevant environment</td>
<td>CD-2, CD-3</td>
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<td>Technology Development</td>
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<td>Laboratory scale, similar system validation in relevant environment</td>
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<td><strong>TRL 4</strong></td>
<td>Component and/or system validation in laboratory environment</td>
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<td>Research to Prove Feasibility</td>
<td>TRL 3</td>
<td>Analytical and experimental critical function and/or characteristic proof of concept</td>
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<td>TRL 2</td>
<td>Technology concept and/or application formulated</td>
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<tr>
<td>Basic Technology Research</td>
<td>TRL 1</td>
<td>Basic principles observed and reported</td>
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Conceptual design for LAWPS resulted in a manageable list of long lead procurement items:

- Cross-Flow Filter Skid
- Ion Exchange Column Skid
- Filter Feed Tank Skid
- Process Building Bridge Crane

Equipment design of the above items during the preliminary design phase will contribute to the integrity of the cost and schedule baseline.
Direct Feed Low Activity Waste Transfer Lines

LAWPS Site

- LAWPS Supernate Feed Line & Solids
- LAWPS Cesium Return Line
- LAWPS DFLAW Feed Line
- WTP Effluent Return Line
- Existing 3”-SN-637, 700, 701 Transfer Lines
- Existing LERF/ETF Influent Transfer Lines

Effluent Management Facility

PTF
LAB
LAW
Scope performed by Tank Operating Contractor and WTP

- **Five pipe-in-pipe bermed or buried transfer lines:**
  - Supernatant from tank farms to LAWPS
  - Filtered solids concentrate return from LAWPS to tank farms
  - Cesium product return to tank farms
  - Treated supernatant feed from LAWPS to WTP
  - Secondary liquid effluent return from WTP to tank farms

Features include secondary containment, leak detection, shielding, flushing, freeze protection, drainage

- **LAWPS Project scope includes transfer lines between LAWPS, tank farms and WTP:**
  - LAWPS transfer lines interface with DST upgrade projects at the tank farm fence line and with WTP at the WTP interface point

- **WTP scope includes transfer lines within WTP site boundary and interfaces with LAWPS transfer lines and connects to/from Effluent Management Facility and LAW Facilities**
Thank you.