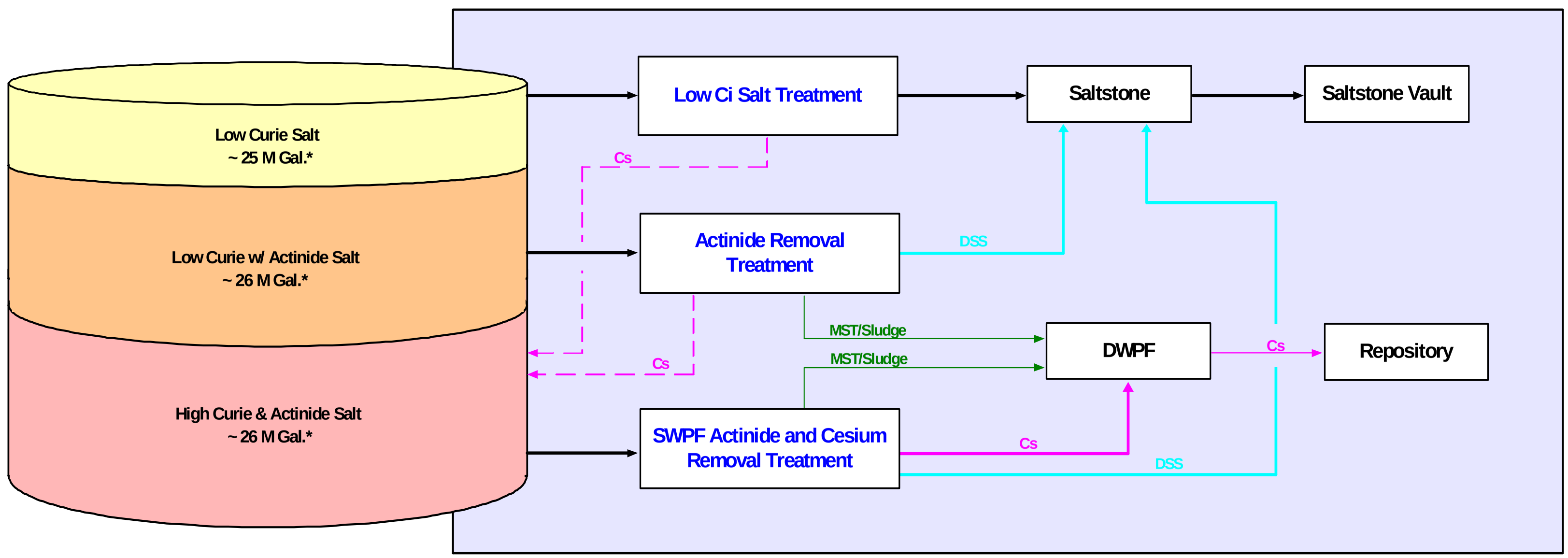
Model for Waste Transfer Line System of Salt Processing Program

Washington Savannah River Corp.
Systems Engineering
Bob Chang

Tailored Salt Treatment Approach



*Salt wastes must be segregated to enable multiple treatment paths

Salt Processing Technology of Choice

- **Actinide Removal Process (ARP):**
  - Use monosodium titanate (MST) strike to absorb the strontium and actinides then following filtration to remove the MST and sludge solids. Filtrate to CSSX or Saltstone.
  - To treat "low in cesium but contains actinides" waste and "high curie with actinide salt" waste.

CSSX Technology

- Caustic Side Solvent Extraction (CSSX)
  - Three stages
    - Extraction Stage,
    - Scrub Stage,
    - Strip Stage.
- Clean raffinate stream to Saltstone for disposal.
- Cs-Strip effluent in aqueous phase to DWPF for vitrification.

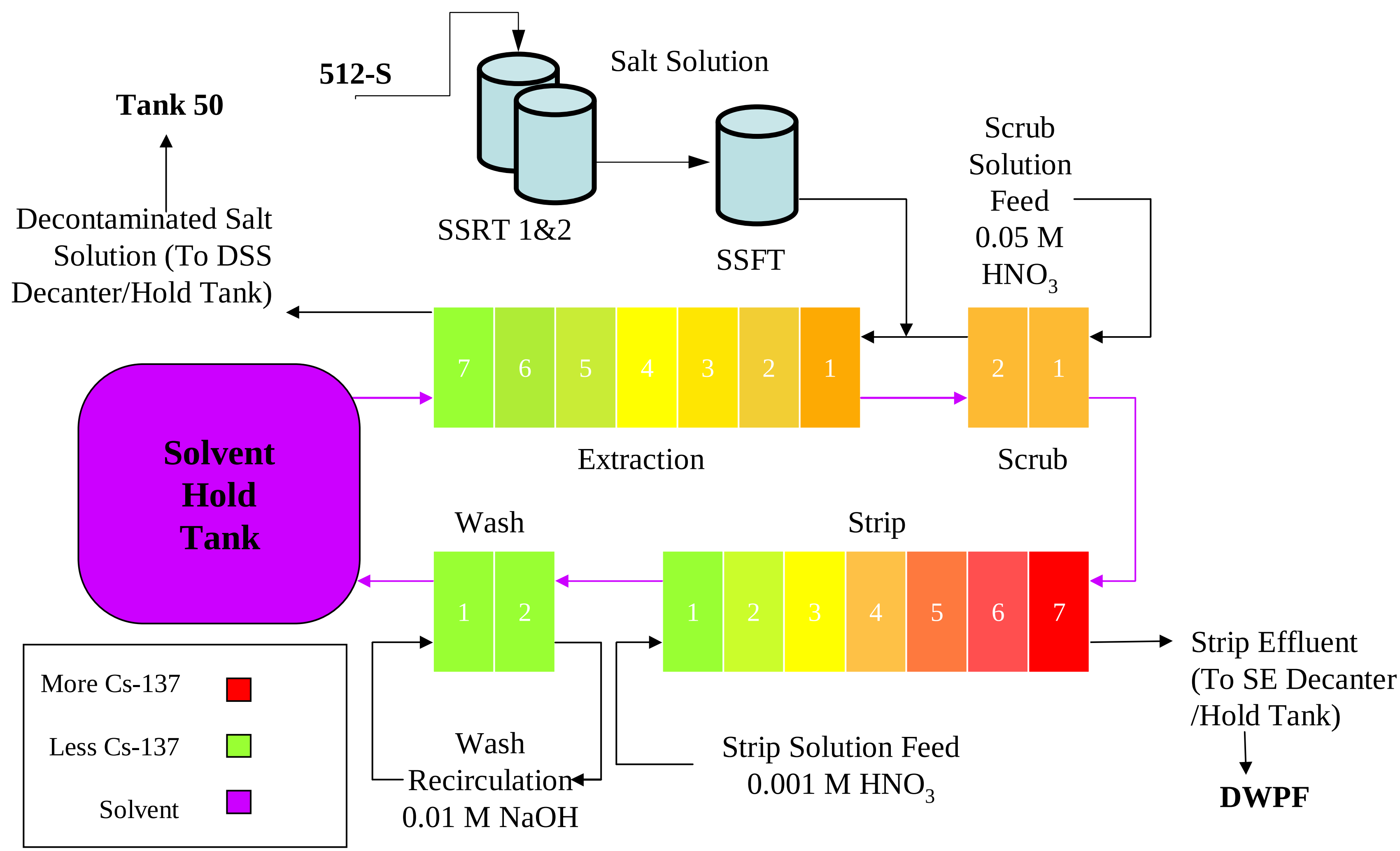
CSSX Technology

– Scrub Stage: Following cesium extraction, the solvent is scrubbed with dilute nitric acid to remove other soluble salts from the solvent stream to aqueous phase.

CSSX Technology

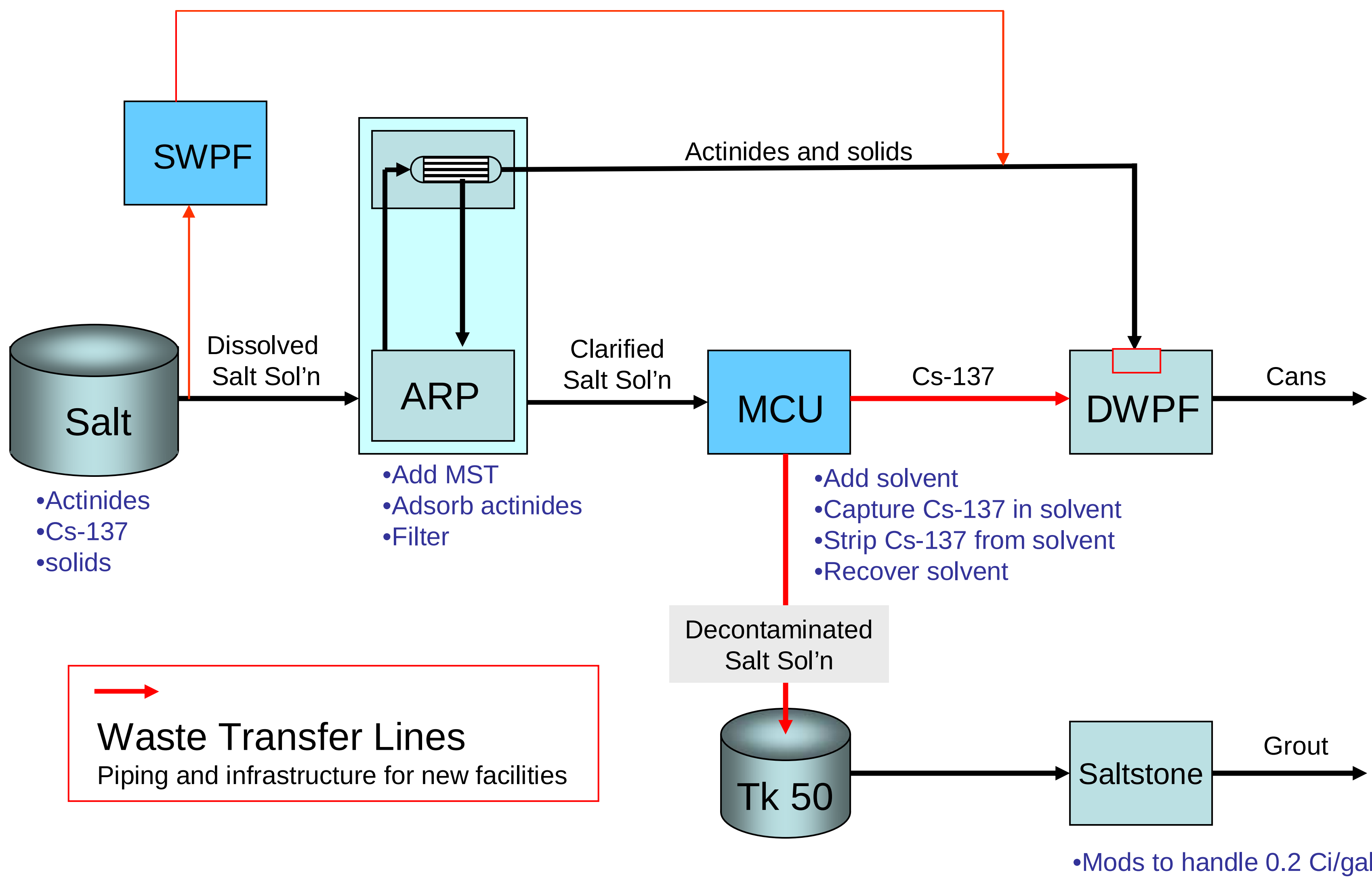
- Strip Stage: Solvent contacted with a very dilute nitric acid stream containing a small quantity of cold cesium to transfer the cesium to the acid stream.
- Solvent recycled.

Process Flow Sheet Summary

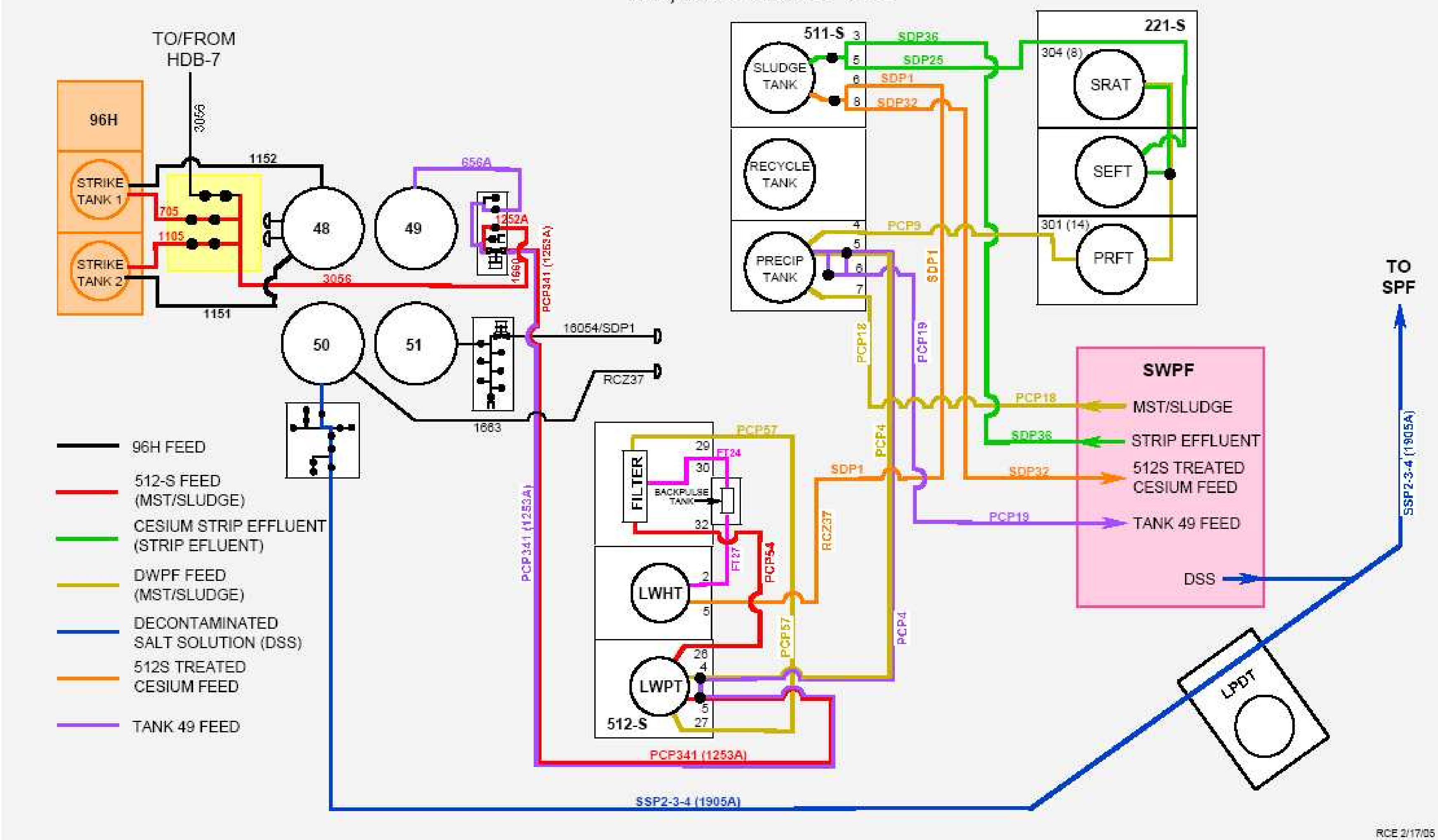


Project Overview

LWD Salt Processing



96H, 512-S & SWPF OPS



Problem Statement

- A recent program risk assessment identified several waste transfer lines as potential process bottlenecks. Two areas of risk were identified: (1) Bi-directional flow in a transfer line and (2) Multi-process mutual use of a transfer line. Both the transfer line “bi-directional flow” and “mutual use” scenarios can create usage conflicts, thereby limiting the ability of the various waste transfer systems to make transfers between processes.

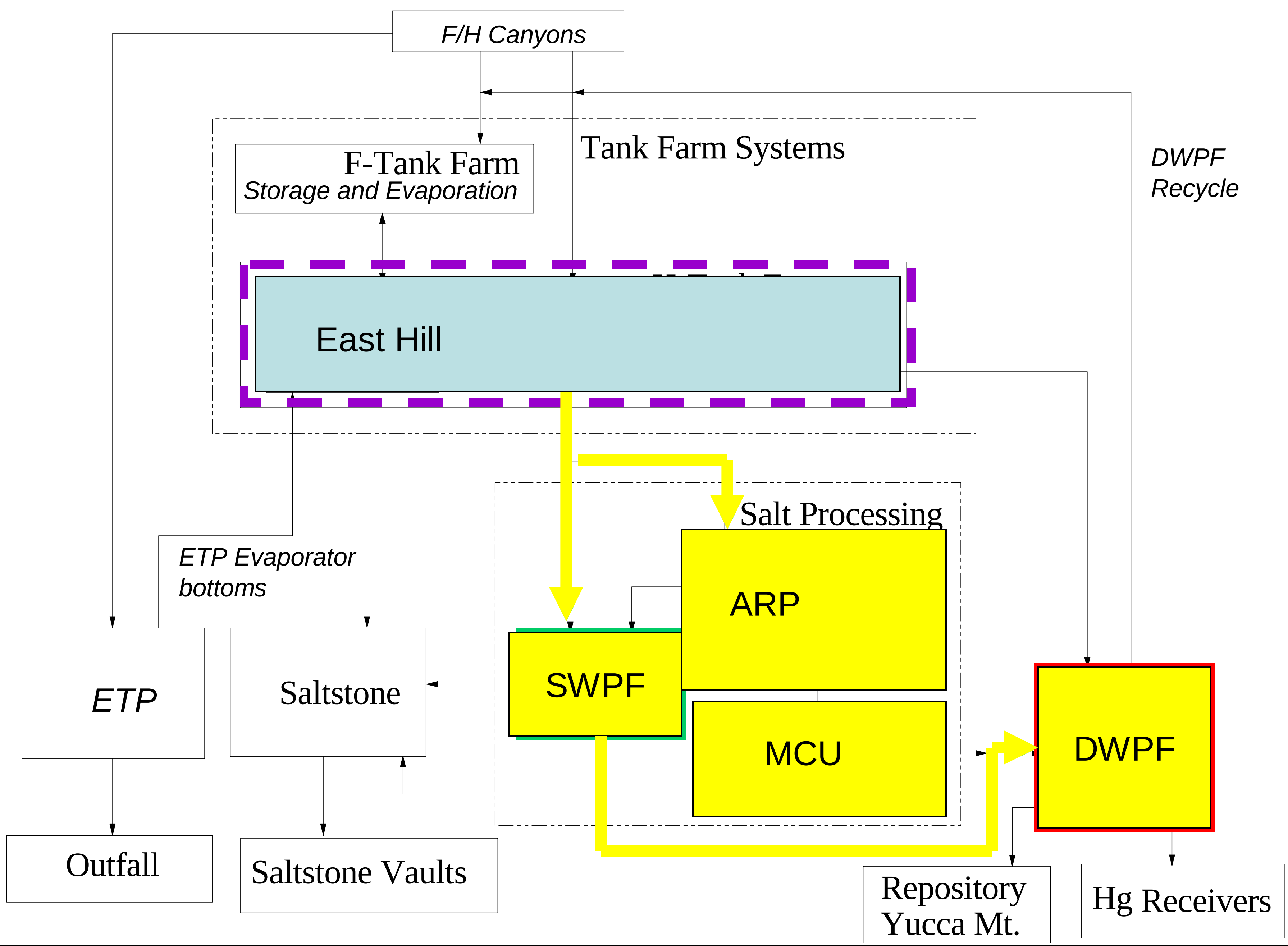
Objectives of Model

- **Objective**
  - **Evaluate the risk of using Bi-Directional Flow Transfer Lines and Mutual Use Transfer Lines by studying the impact of utilizing these transfer lines on processing rates and attainments for Actinide Removal Process (ARP), Modular CSSX Unit (MCU), Salt Waste Processing Facility (SWPF), and Defense Waste Processing Facility (DWPF).**

Project Requirements

- **Target**
  - ARP + SWPF
    - ARP = 1 Mgal/yr
    - SWPF = 6 Mgal/yr
  - SWPF (no ARP)
    - 7 Mgal/yr
- **Minimum Throughput Requirement**
  - SWPF process > 3.0 Mgal/yr fresh waste

Nuclear Waste Management System in SRS



Parameters for Different Cases

Case		1	2	3	4	5	6	7	8	9	10
CSSX Rate (SWPF)		17 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm
Tank 50 Available		Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Tank 49 Feed and Bleed		No	No	Yes	No	No	No	No	No	Yes	Yes
New Tank in Saltstone for DSS		No	No	No	Yes 0.12 Mgal	No	No	No	No	No	No
Each SRAT batch fills x canisters		6	6	6	6	5.5	6	5.5	6	6	5.5
Canister pour time		26 hr	26 hr	26 hr	26 hr	26 hr	26 hr	22 hr	26 hr	26 hr	26 hr
Strike Time	ARP	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	N/A	N/A	N/A
	SWPF	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr
ARP Running		Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
SWPF Throughput		**3.17**	**2.97**	**4.08**	**3.7**	**4.03**	**3.79**	**4.10**	**4.68**	**5.28**	**5.15**
ARP Throughput		**0.79**	**0.78**	**0.75**	**0.7**	**0.72**	**0.7**	**0.74**	**0**	**0**	**0**
ARP + SWPF		**3.96**	**3.75**	**4.8**	**4.4**	**4.7**	**4.5**	**4.84**	**4.68**	**5.28**	**5.15**

Parameters for Different Cases

Case		1	2	3	4	5	6	7	8	9	10
CSSX Rate (SWPF)		17 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm
Tank 50 Available		Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Tank 49 Feed and Bleed		No	No	Yes	No	No	No	No	No	Yes	Yes
New Tank in Saltstone for DSS		No	No	No	Yes 0.12 Mgal	No	No	No	No	No	No
Each SRAT batch fills x canisters		6	6	6	6	5.5	6	5.5	6	6	5.5
Canister pour time		26 hr	26 hr	26 hr	26 hr	26 hr	26 hr	22 hr	26 hr	26 hr	26 hr
Strike Time	ARP	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	N/A	N/A	N/A
	SWPF	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr
ARP Running		Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
SWPF Throughput		**3.17**	**2.97**	**4.08**	**3.7**	**4.03**	**3.79**	**4.10**	**4.68**	**5.28**	**5.15**
ARP Throughput		**0.79**	**0.78**	**0.75**	**0.7**	**0.72**	**0.7**	**0.74**	**0**	**0**	**0**
ARP + SWPF		**3.96**	**3.75**	**4.8**	**4.4**	**4.7**	**4.5**	**4.84**	**4.68**	**5.28**	**5.15**

Parameters for Different Cases

Case		1	2	3	4	5	6	7	8	9	10
CSSX Rate (SWPF)		17 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm	21.29 gpm
Tank 50 Available		Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Tank 49 Feed and Bleed		No	No	Yes	No	No	No	No	No	Yes	Yes
New Tank in Saltstone for DSS		No	No	No	Yes 0.12 Mgal	No	No	No	No	No	No
Each SRAT batch fills x canisters		6	6	6	6	5.5	6	5.5	6	6	5.5
Canister pour time		26 hr	26 hr	26 hr	26 hr	26 hr	26 hr	22 hr	26 hr	26 hr	26 hr
Strike Time	ARP	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	24 hr	N/A	N/A	N/A
	SWPF	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr	12 hr
ARP Running		Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
SWPF Throughput		**3.17**	**2.97**	**4.08**	**3.7**	**4.03**	**3.79**	**4.10**	**4.68**	**5.28**	**5.15**
ARP Throughput		**0.79**	**0.78**	**0.75**	**0.7**	**0.72**	**0.7**	**0.74**	**0**	**0**	**0**
ARP + SWPF		**3.96**	**3.75**	**4.8**	**4.4**	**4.7**	**4.5**	**4.84**	**4.68**	**5.28**	**5.15**

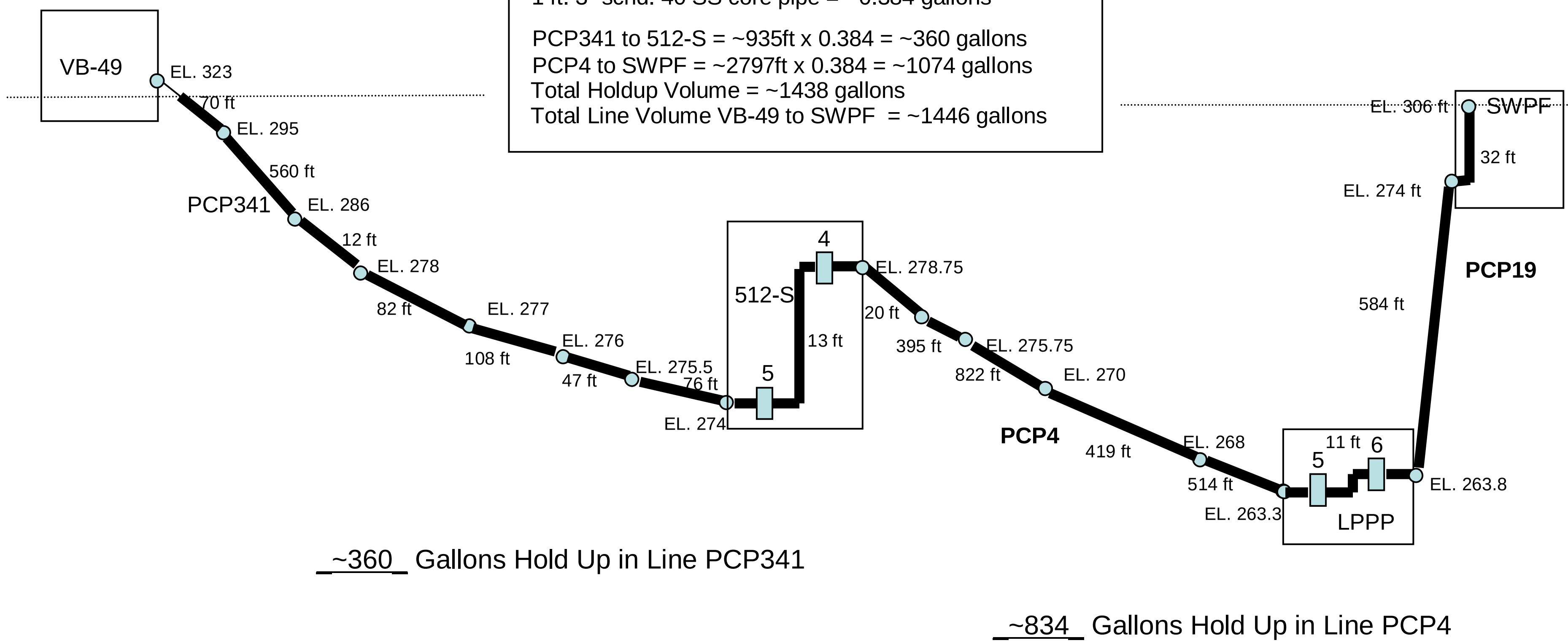
Approximate Transfer Line Holdup Volumes

<u>Approximate Holdup Volume</u>

Trapped Volume in the transfer lines at approx. EL. 306.

1 ft. 3” schd. 40 SS core pipe = ~0.384 gallons

PCP341 to 512-S = ~935ft x 0.384 = ~360 gallons
PCP4 to SWPF = ~2797ft x 0.384 = ~1074 gallons
Total Holdup Volume = ~1438 gallons
Total Line Volume VB-49 to SWPF = ~1446 gallons



Deficiencies Identified

- The model identified deficiencies in existing operational and flushing strategy for the Waste Transfer Line project. Based on the old operational and flushing strategy, two tanks will overflow due to the additions of trapped flushing water in the transfer line into the tanks.

Conclusions

- It is unlikely that the Target Average Annual Rate of 7Mgal/year Can Be Achieved, Due to Close Coupling of SWPF with DWPF and Other Facilities.
- Building Dedicated Transfer Line is Not the Best Use of Resources.
- Provide Inputs to Interim Processing Plan.
- Very little advantage to process ARP after SWPF.
- Based on the modeling results, both WSRC and DOE has made a business decision not to run ARP post SWPF startup.