

# Results of Salt Batch Qualification Testing

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## This presentation.....

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- **Describes the Integrated Salt Disposition Project (ISDP), the newest operating facilities at the Savannah River Site for treating stored radioactive waste.**
- **Reviews the past campaigns of salt disposition (Macrobatch 1 and 2).**
- **Reviews current operations (Macrobatch 3)**
- **Outlines the next qualification (Macrobatch 4)**
- **Discusses the limiters in operations.**

# Introduction

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**In 2001, the Department of Energy (DOE) identified Caustic-Side Solvent Extraction as the preferred processing option for removing cesium from SRS wastes. Similarly, the preferred method for removing alpha-emitting actinides and strontium is by sorption on monosodium titanate (MST).**

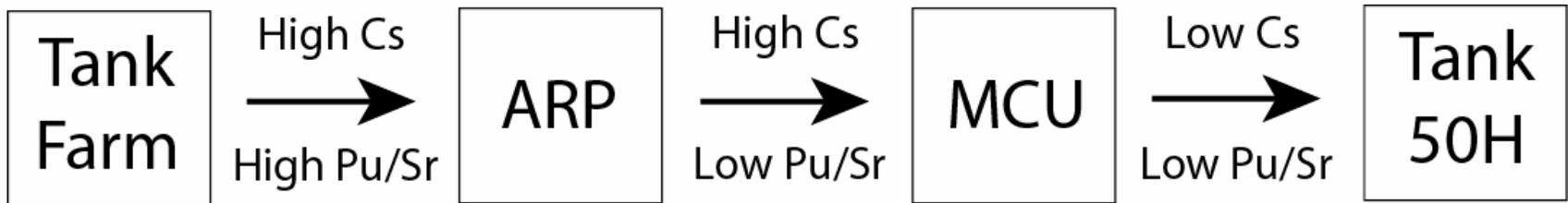
**February 2004, DOE commissioned construction and operation of a pilot version (i.e., 11-34 L/min processing rate for salt solution) of these processes until construction of the full-scale Salt Waste Processing Facility (SWPF). The effort is known as the Integrated Salt Disposition Project.**

**The combined facilities began radioactive operations in April of 2008.**

# What is ISDP ?

$$\text{ISDP} = \text{ARP} + \text{MCU}$$

- ARP = Actinide Removal Process (ARP)
- MCU = Modular Caustic Side Solvent Extraction (CSSX) Unit
- Two different processes fed in sequence from the Tank Farm

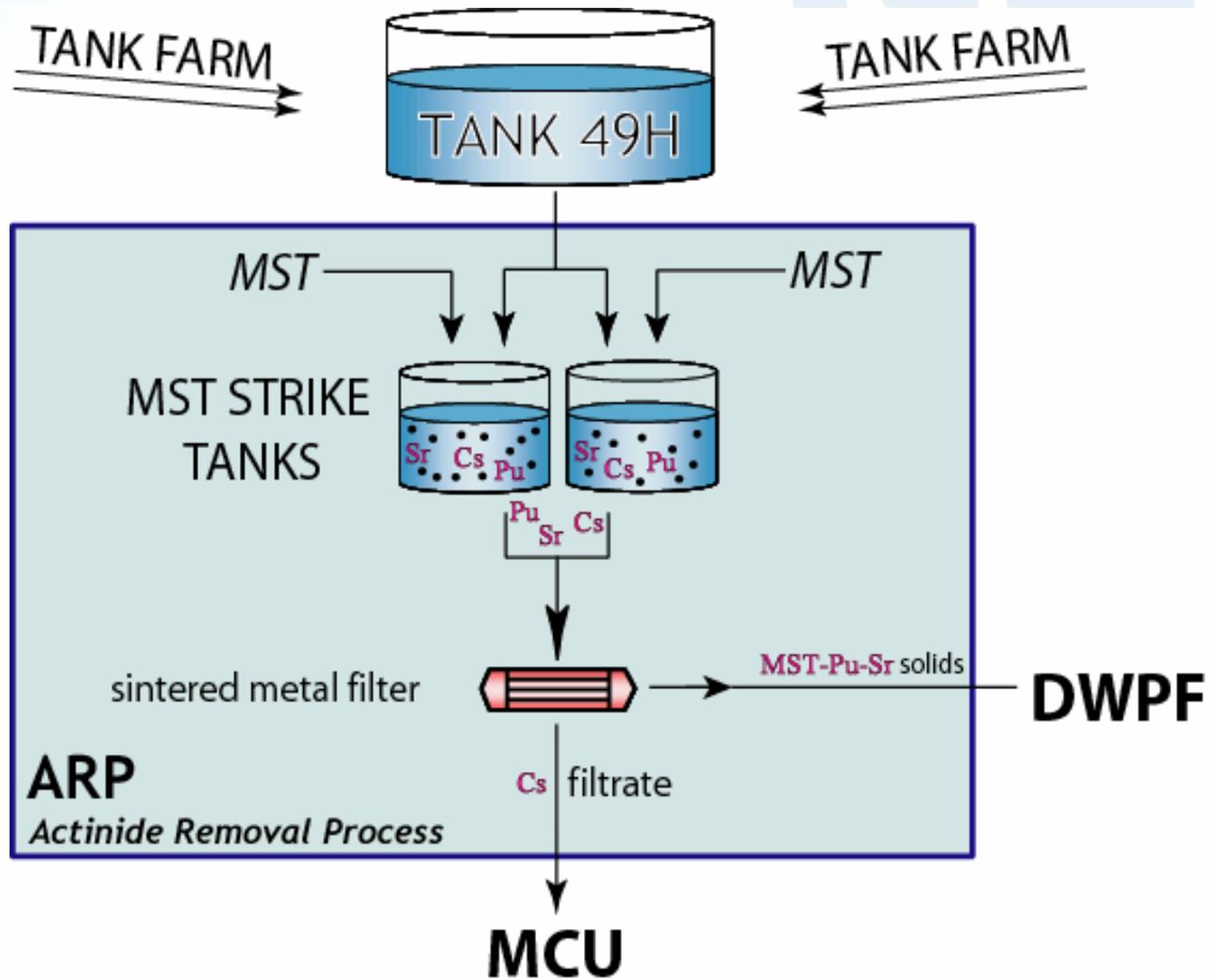


## Actinide Removal Process - ARP

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- **Two 20,100-L working volume sorption tanks**
- **0.4 g/L MST added to each tank**
- **Contact time = originally 24 hours, now 12 hours**
- **MST removed by cross-flow filtration (sintered metal 0.1 micron filter); typically ~6-7 gpm**
- **Solids are collected, washed and sent to the Defense Waste Processing Facility (DWPF)**
- **Supernate is sent to MCU**

# Actinide Removal Process - ARP

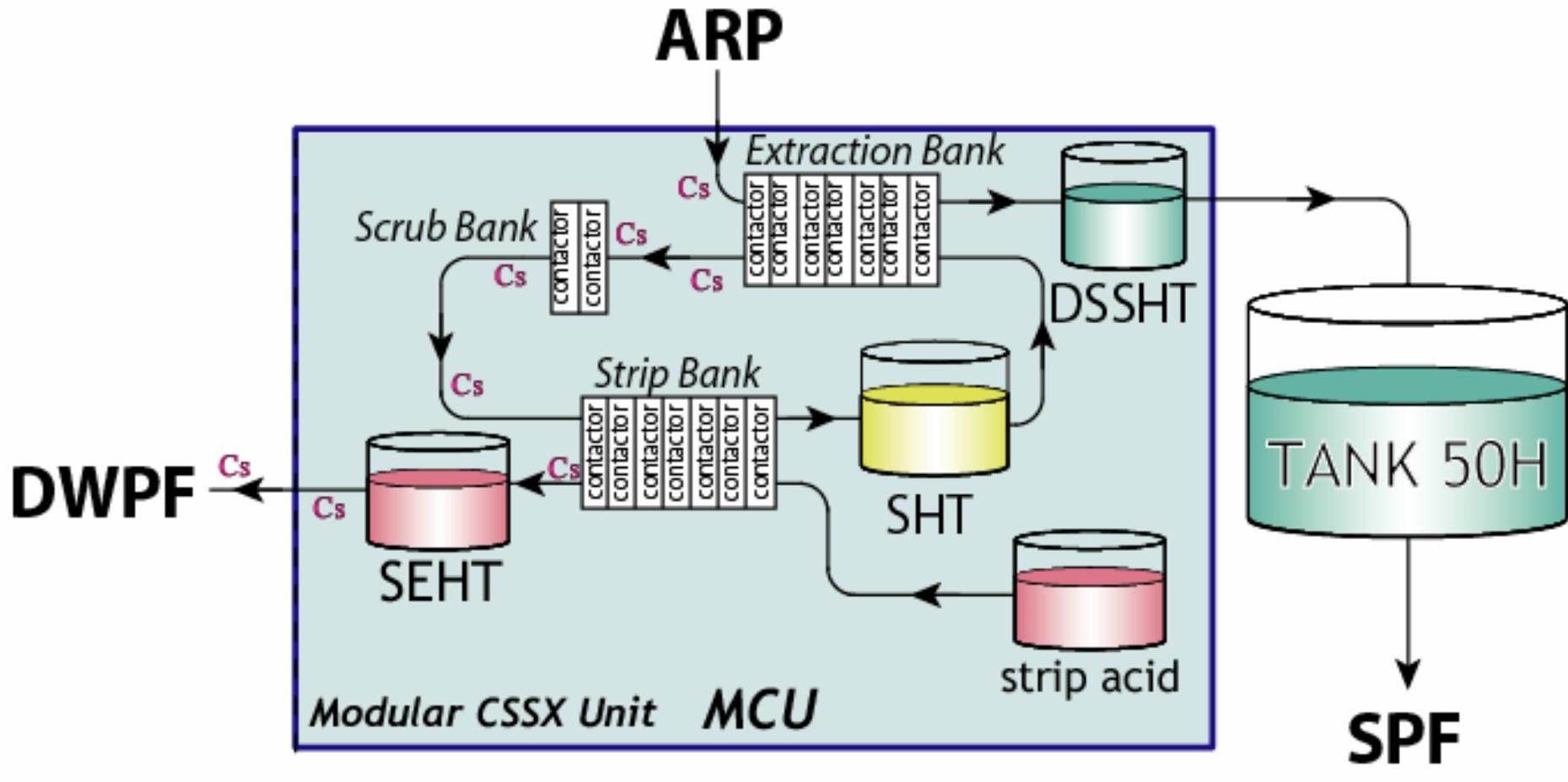


## Modular CSSX Unit - MCU

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- **Material received from ARP**
- **Two 20,100-L working volume tanks**
- **Material processed through contactors at 11-34 L/m**
- **Cesium-depleted material is sent to the Decontaminated Salt Solution Hold Tank (DSSHT)**
- **Cesium-concentrated acid stream is sent to the Strip Effluent Hold Tank (SEHT)**

# Modular CSSX Unit - MCU

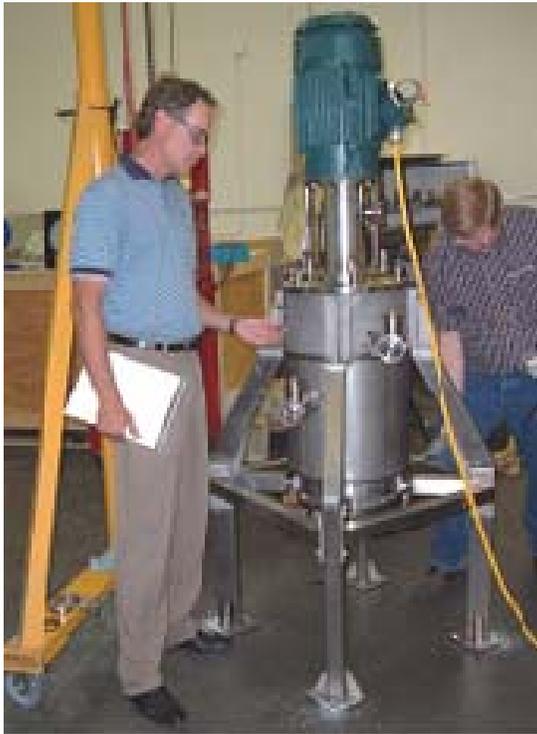


# Modular CSSX Unit - MCU



# Modular CSSX Unit - MCU

A single test contactor



Inside MCU –contactor banks

## Typical Salt Solution in Each Macrobatches

- Each of the salt solutions that we process have the same approximate bulk chemical characteristics:
  - Na = 5.5 – 7 M
  - Density = 1.2 to 1.3 g/mL
  - K = < 500 mg/L
  - Free hydroxide = 0.7-2.76 M
    - increased in later batches due to solids formation
  - $^{137}\text{Cs}$  =  $\sim 1.2 \times 10^8$  dpm/mL ( $\sim 0.2$  Ci/gal)
  - $^{238}\text{Pu}$  =  $3 \times 10^4$  to  $9 \times 10^4$  dpm/mL
  - $^{90}\text{Sr}$  =  $3 \times 10^5$  to  $9 \times 10^5$  dpm/mL

## Qualification of Macrobatches



- **Each of the Macrobatches salt solutions qualified in a laboratory setting before material is moved through the tank farm:**
- **Extensive radionuclide analysis (Pu, Sr, Cs, etc)**
- **Extensive non-rad analysis (ICPES, IC, etc)**
- **density**
- **ARP test (MST strike)**
- **Extraction-Scrub-Strip (ESS) test**
- **Only after all these analyses and test can a Macrobatches be qualified**

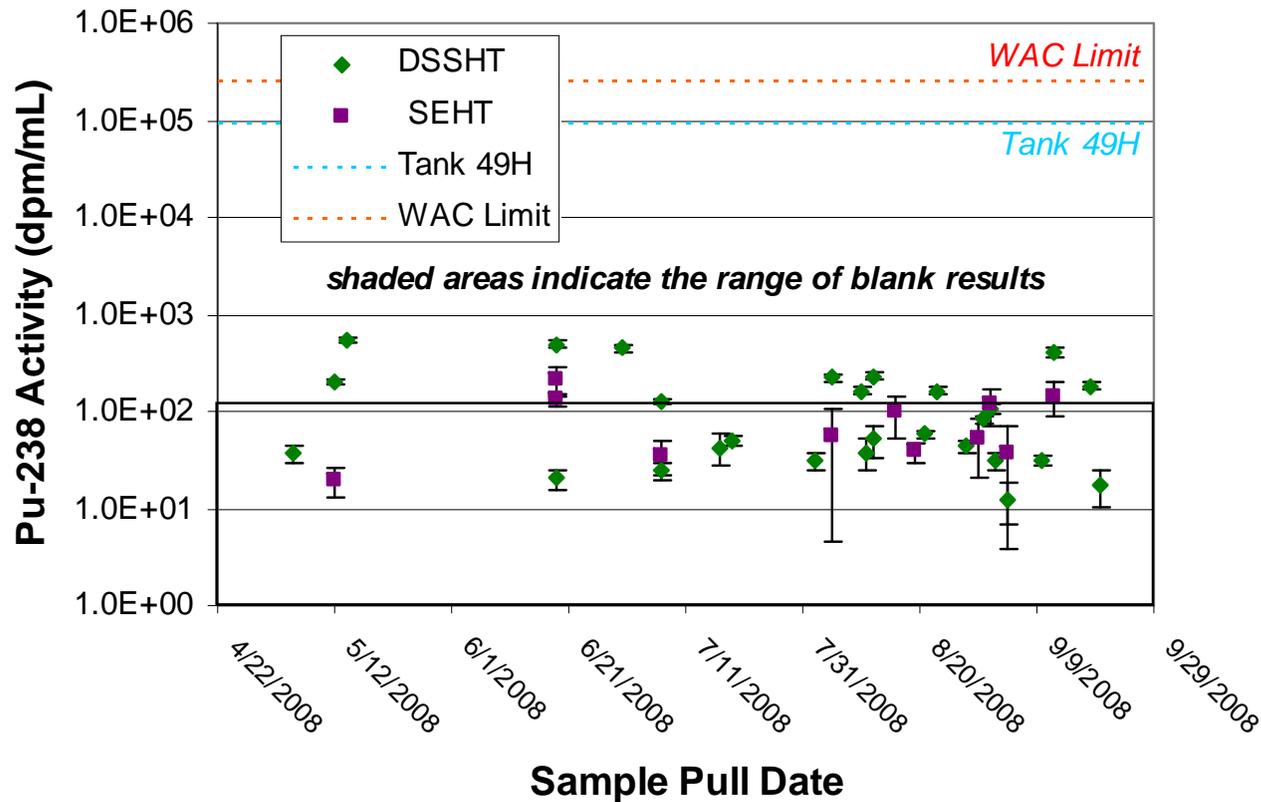
# Macrobatch 1

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- **Macrobatch 1 came solely from Tank 49H**
- **Macrobatch 1 processed a total volume of 140,000 gallons from April to September 2008**
- **Discoveries: DSS coalescer subject to aluminosilicate solids fouling – need to increase free hydroxide**

# Macrobatch 1 Pu Results

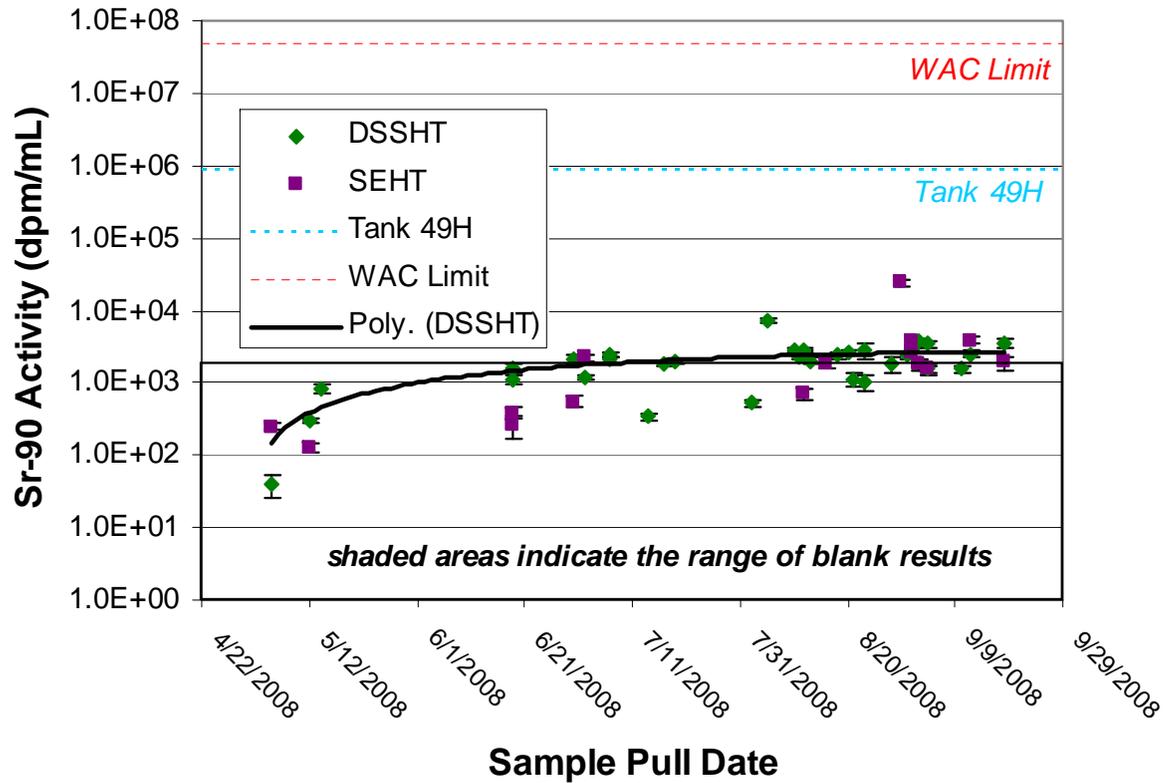
Track  $^{238}\text{Pu}$  removal performance over time



**Excellent  $^{238}\text{Pu}$  removal – well under WAC limits**

# Macrobatch 1 Sr Results

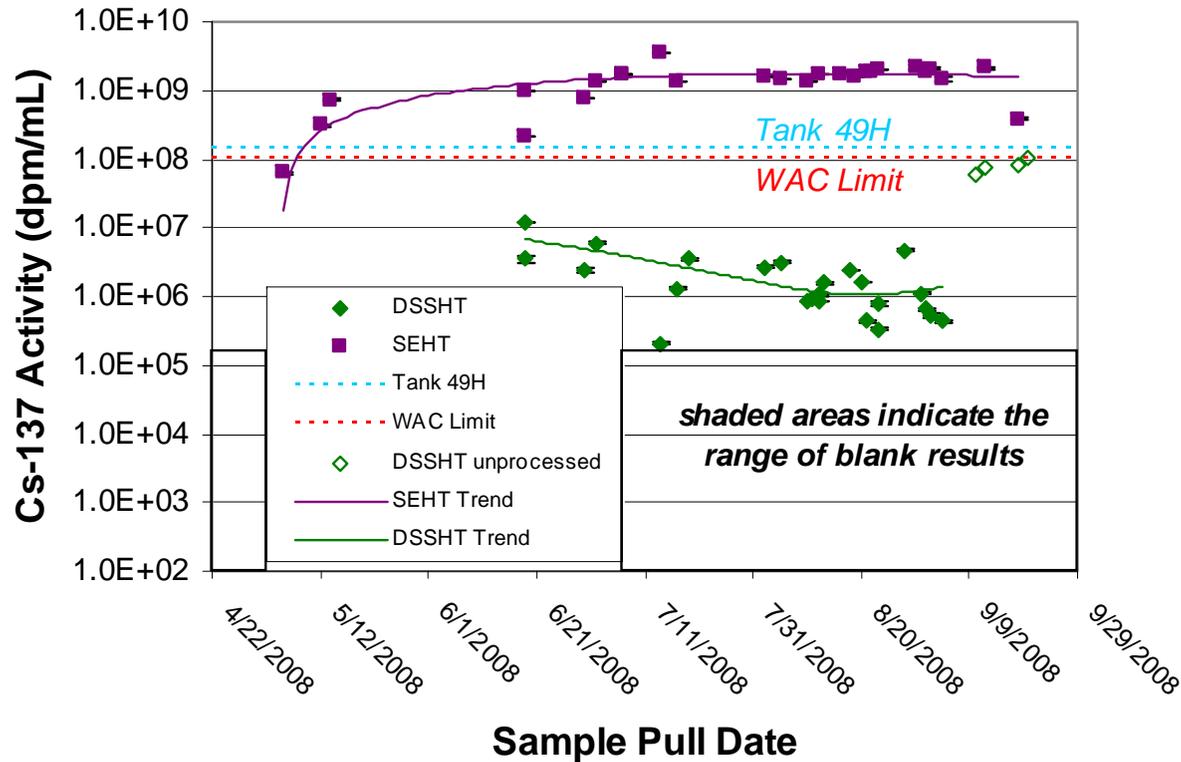
Track  $^{90}\text{Sr}$  removal performance over time



**Excellent  $^{90}\text{Sr}$  removal – well under WAC limits**

# Macrobatch 1 Cs Results

Track  $^{137}\text{Cs}$  removal performance over time



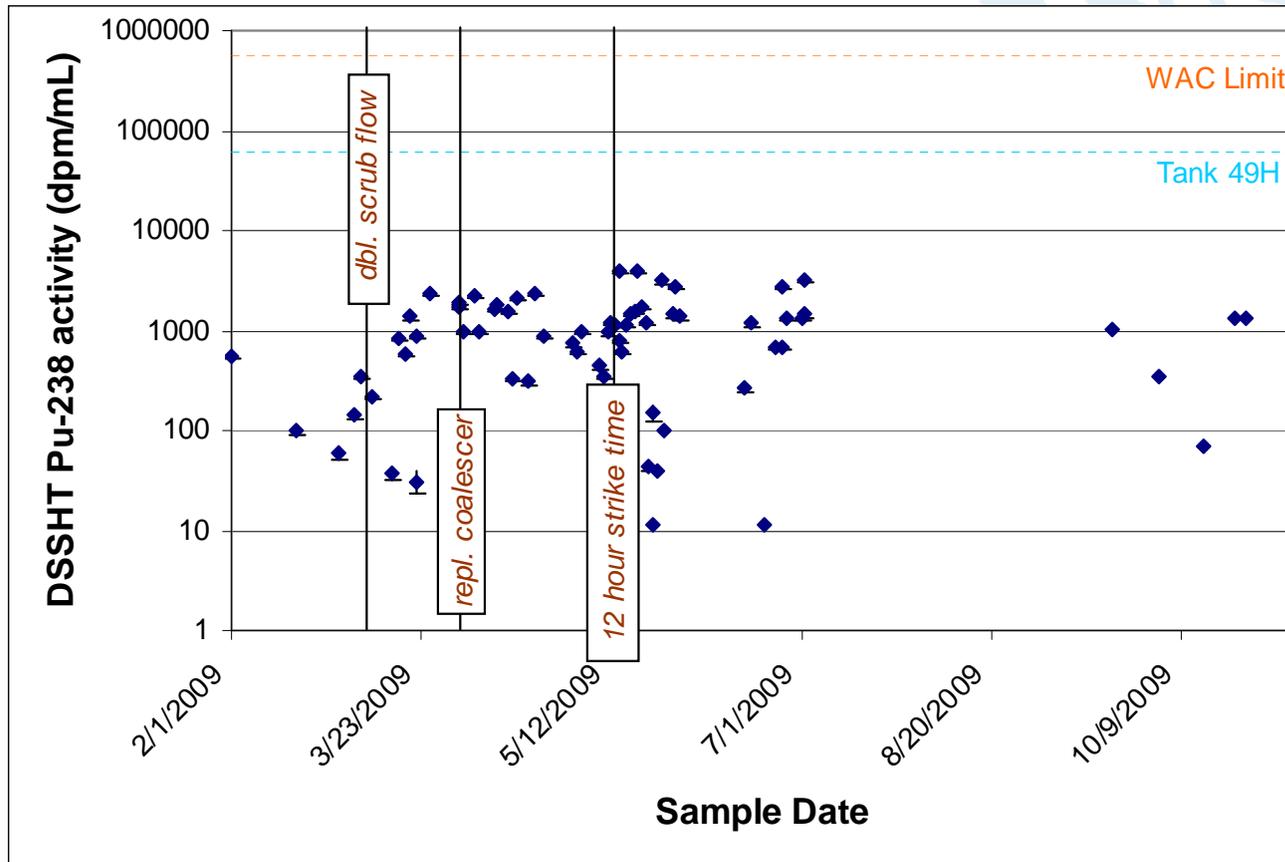
Excellent  $^{137}\text{Cs}$  removal – well under WAC limits

## Macrobatch 2

- **Macrobatch 2 derived from Tank 22H, Tank 41H, Tank 49H, and added NaOH**
- **Macrobatch 2 processed a total volume of 730,000 gallons from February 2009 to May 2010**
- **Discoveries:**
  - Excessive Isopar<sup>®</sup> L evaporation can lead to a problematic dense solvent and poor hydraulics in contactors producing emulsions.
  - Reducing MST strike times to 12 hours does not significantly reduce the actinide and strontium removal.
  - System changes (increase scrub acid flow and change SE coalescer) did not affect the bulk chemistry behavior but did not solve SE coalescer issues
- **Long outages for pump and contactor replacement and Isopar in SE issues**

# Macrobatch 2 Pu Results

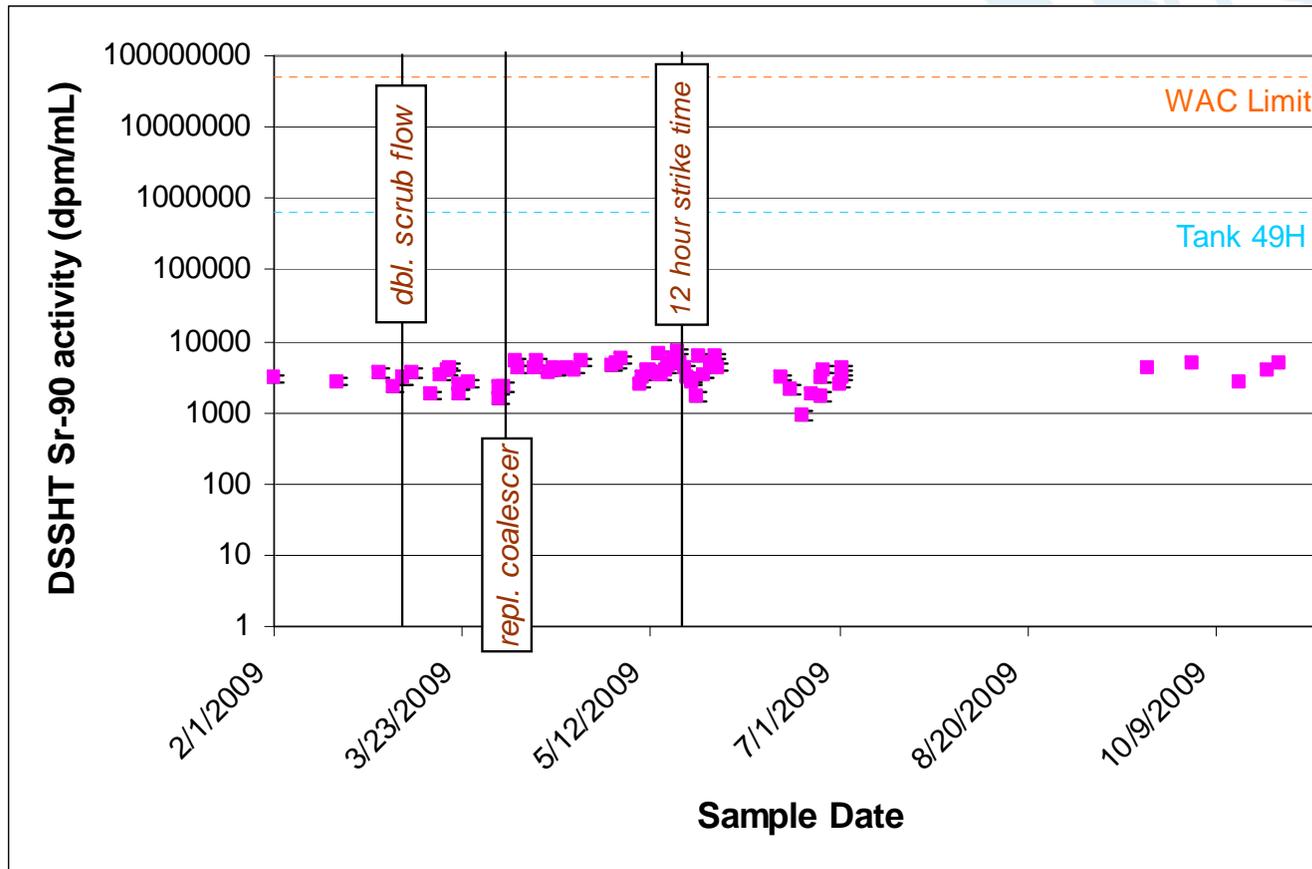
Track  $^{238}\text{Pu}$  removal performance over time



Excellent  $^{238}\text{Pu}$  removal – well under WAC limits

# Macrobatch 2 Sr Results

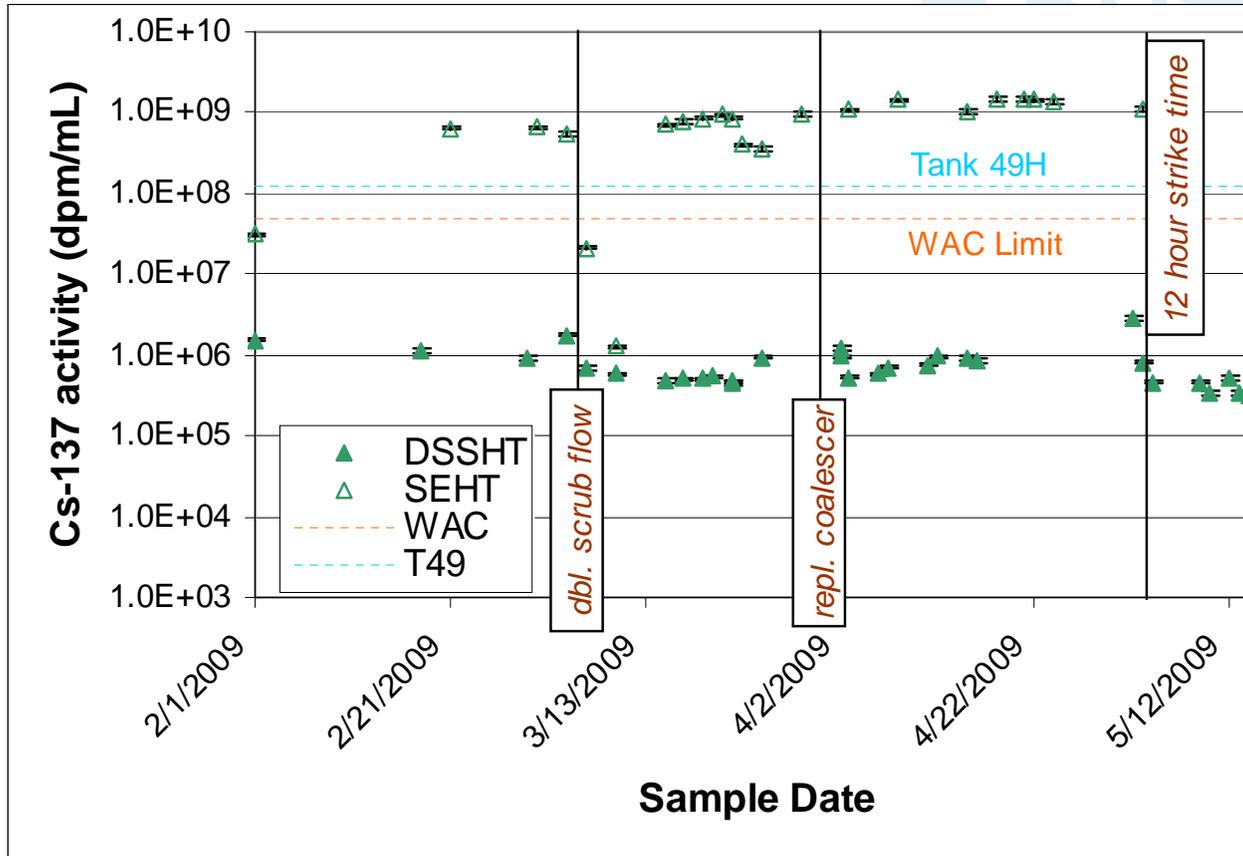
Track  $^{90}\text{Sr}$  removal performance over time



**Excellent  $^{90}\text{Sr}$  removal – well under WAC limits**

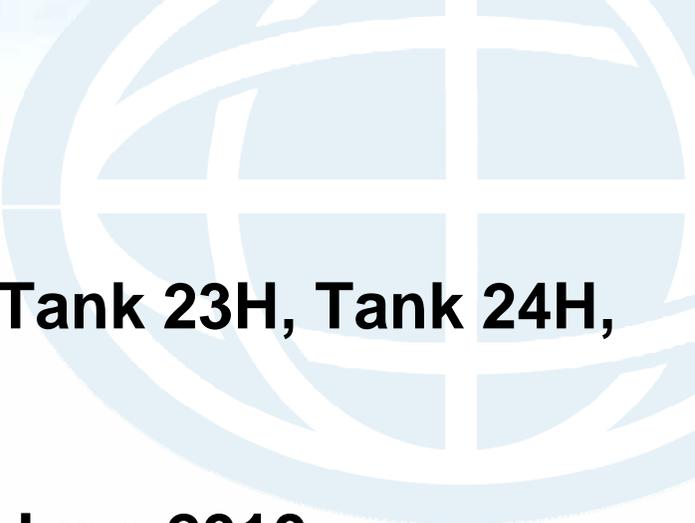
# Macrobatch 2 Cs Results

Track  $^{137}\text{Cs}$  removal performance over time



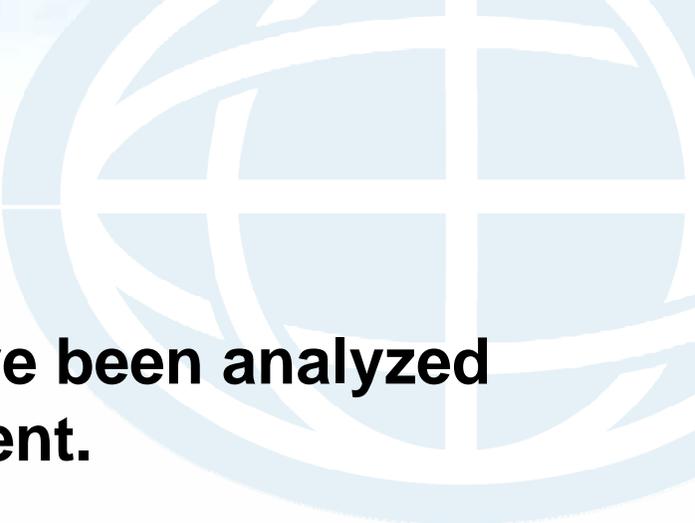
Excellent  $^{137}\text{Cs}$  removal – well under WAC limits

## Macrobatch 3



- **Macrobatch 3 came from Tank 21H, Tank 23H, Tank 24H, Tank 49H and added NaOH.**
- **Macrobatch 3 started processing in June 2010**
- **A total volume of 1,100,00 gallons is scheduled to be processed**
- **Discoveries:**
  - Isopar<sup>®</sup> L content exceeded limits in SEHT due to decanter deinventory procedure.
  - Pump failure led to further outage.
  - SE coalescer replaced due to high differential pressure.
  - Solids – suspected legacy aluminosilicates from non-radioactive commissioning -- found in salt solution receipt tank during pump replacement.

## Macrobatch 3 Results



- **At this time, only a few samples have been analyzed from the batch for Pu and Sr content.**
- **Large number of samples delivered to SRNL for Pu and Sr analysis which is underway.**
- **Removed SE coalescer due to high differential pressure; diagnostic analyses in progress.**

## Macrobatch 4 Qualification



- **Macrobatch 4 will consist of Tank 21H and Tank 49H**
- **Qualification efforts already underway**
- **Estimated start date of June 2011**
- **Mid-way through processing (Nov. 2011), system will be changed to a new, improved solvent system**