Department of Energy
Office of River Protection

Hanford Mixing & Sampling Demonstration Program

Mixing and Sampling Update

November 7, 2012

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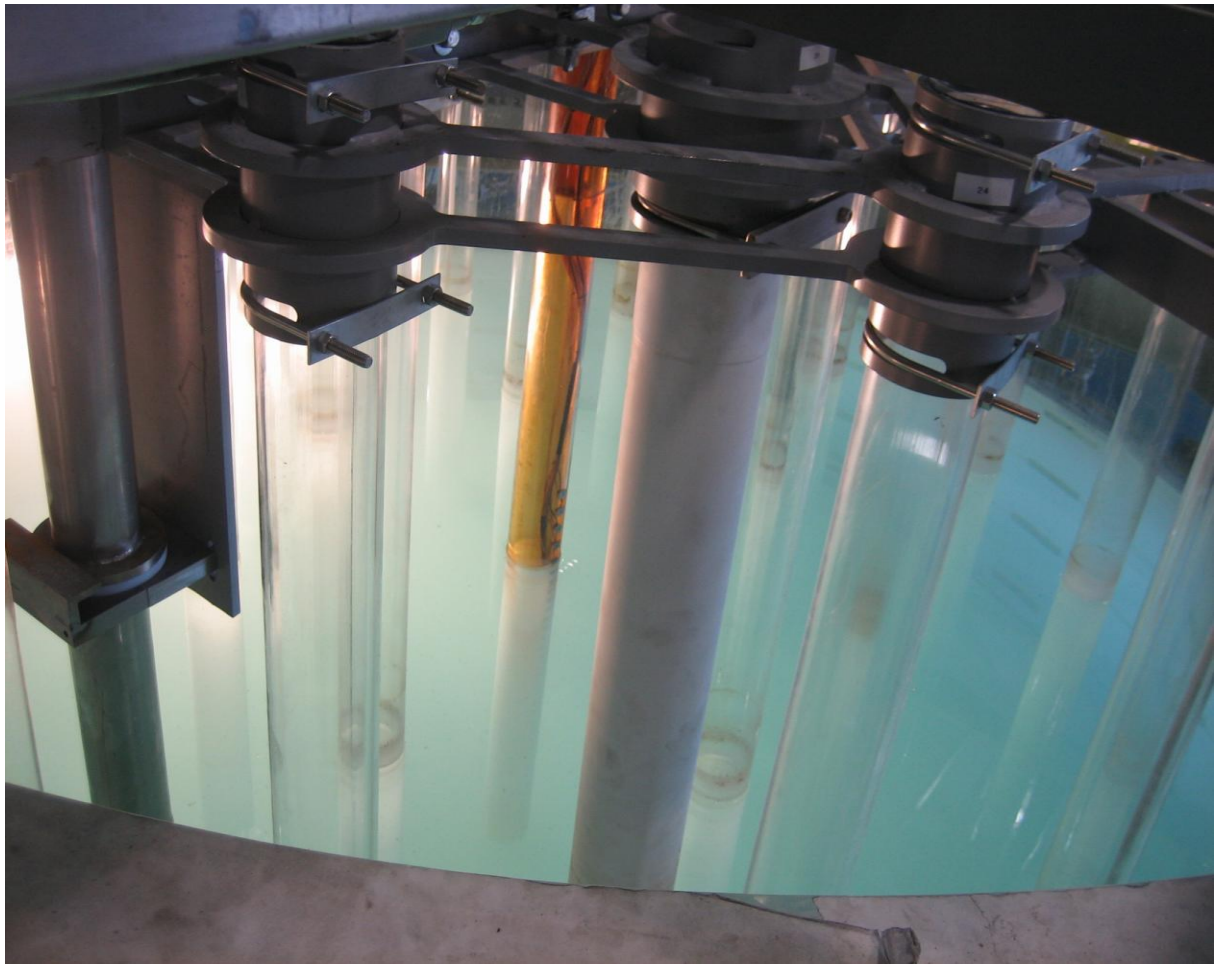
Office of River Protection
Federal Project Director

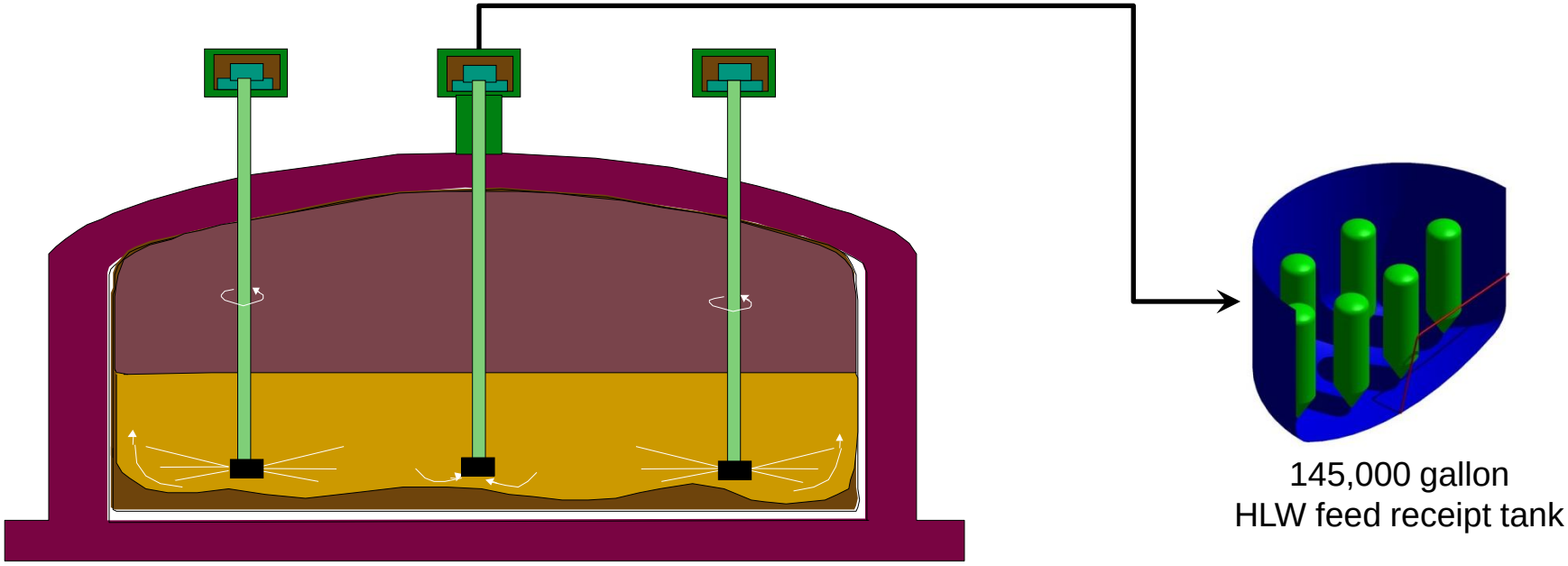


DNFSB 2010-2 Overview

- DNFSB Recommendation 2010-2 identifies the following safety concerns related to the ability of the WTP systems to adequately mix, sample, and transfer fast settling solids:
  - Accumulation of fissile material at the bottom of [WTP] vessels leading to potential criticality.
  - Generation and accumulation of hydrogen resulting from the accumulation of solids.
  - The possibility that accumulating solids will interfere with the vessel-level detection system leading to loss of pulse jet mixer (PJM) control and overblows (discharge of air from the PJM).
- DOE issued an Implementation Plan to address the 2010-2 concerns that includes multiple WTP, TOC, and ORP activities and commitments related to seven sub-recommendations
  - WTP owned sub-recommendations include: large scale testing, waste simulants, model verification, vessel sampling, tank heel management, and technical and safety risks
  - WRPS owned sub-recommendation is related to representative sampling from double-shell feed tanks and the potential to transfer particles that cannot be accommodated by WTP systems

Feed Delivery Challenge

- Sufficiently mix and sample HLW sludge batches to provide accurate characterization allowing WTP feed waste acceptance and consistent HLW batch delivery



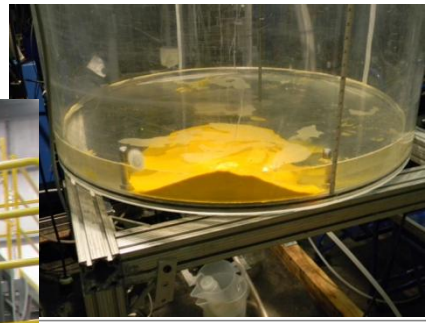
1,000,000 gallon double shell feed staging tank

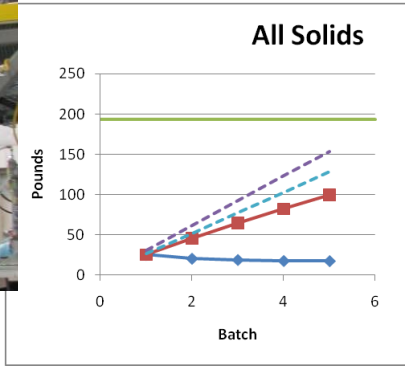
145,000 gallon
HLW feed receipt tank

Mixing & Sampling Demonstration Program

Tank Mixing Concept

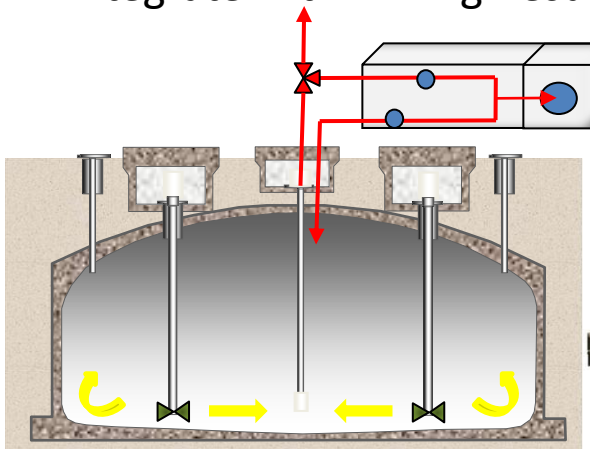
- Small Scale Demonstrations
  - SRNL 42” qualitative data
  - ES 43” & 120” quantitative data
- Equivalent Mixing Behavior
- Sampling and Batch Transfer
- Confirmation Test in First Feed Tank

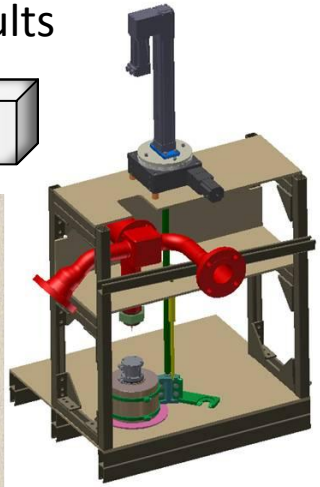




Tank Sampling Concept

- Remote Sampler Loop Concept
  - Sample slurry directly from transfer pump
  - Measure critical velocity in-line
- Critical Velocity Instrument Demo
- Sampling System Demonstration
- Integrate with Mixing Results



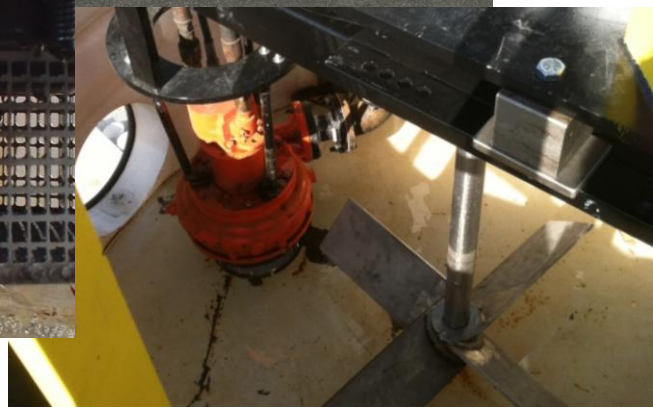


Scouting Studies Test Platform

- SRNL Scouting Studies
  - Visual and qualitative information
  - Explore boundaries of performance
  - Explore solids accumulation
- Learned
  - DST mixing is not homogeneous
  - Consistent transfers even with poor mixing
  - Mixer Jet velocity is most dominant variable
  - 90 percent of fast settling solids are transferred out of the tank
  - Solids accumulation reaches a plateau after three to five cycles

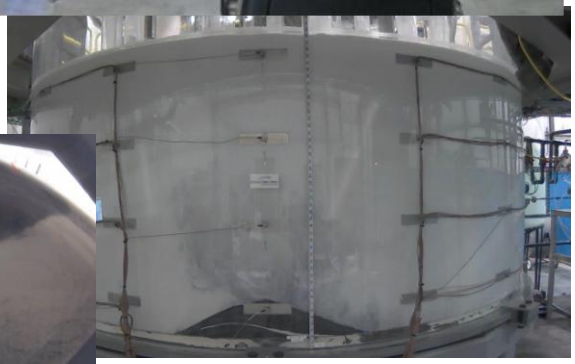
Full Scale Pump Test Platform

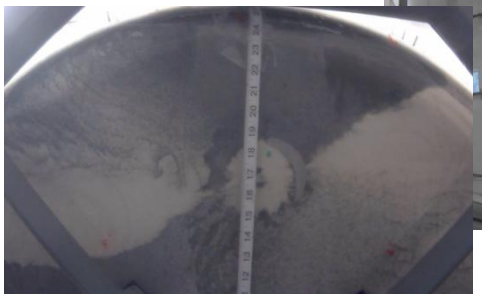
- Full Scale Transfer Pump
  - Hydraulic equivalent to DST transfer pump
  - Prototypic piping elevations out of DST
  - Explore limits of system capabilities
  - Mixing is not prototypic
- Learned
  - Transfer system is capable of moving extreme particles that mixing system can move to the pump
    - up to ¼” glass and 1/8” stainless steel
  - Pump is not effective at sucking extreme particles off of floor



Mixing Test Platform

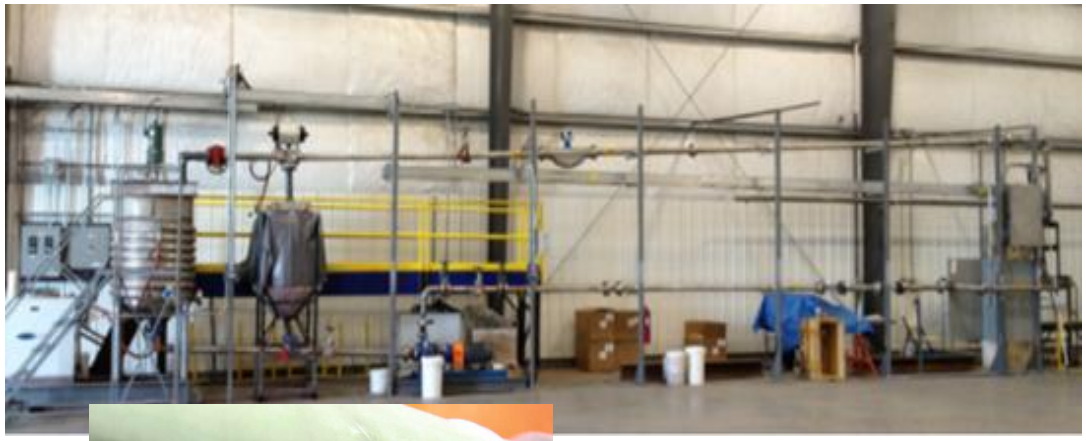
- Mixing (SSMD)
  - Simple to complex simulants
  - Two tank sizes to explore scale-up
    - 1:21 Scale (43” diameter)
    - 1:8 Scale (10’ diameter)
- Learned
  - Demonstrated equivalent performance between tanks
    - Supports scale-up estimates
  - Identified cyclic nature of solids concentration
  - Demonstrated bounding nature of pre-transfer samples
  - Demonstrated reasonably consistent batch transfers
  - Mixing appears to be more limiting factor in extreme particle transfer





Sampling Test Platform

- Sampling (RSD)
  - Full scale full flow system
  - Isolok sampler
  - Remote sample bottle handling
  - Integrated Pulse Echo System
- Learned
  - Sample bias with horizontal Isolok
    - Larger bias with faster settling particles
  - Improved sampling perfromance with vertical configuration
  - Demonstrated mechanical handling system concept
  - Pulse Echo system works well
  - Isolok is prone to plugging when particles exceed 1/8”



Caustic Additions

- Status of Double-Shell Tank chemistry is tracked in the WRPS Chemistry Control Program
  - This program drives the ongoing DST sampling requirements
  - Looks ahead five years to anticipate chemistry control actions
  - Modeling is used to predict the hydroxide depletion rates
- Sample, add caustic, sample again
  - Samples are primarily grab samples of tank waste supernatant, though WRPS is close to restoring core sample capability too.
  - Several ways to add the caustic, depending on the waste and mixing needs
    - Add to a C Farm tank undergoing retrieval
    - Drop on top of the supernatant in a DST
    - Pump into a diffuser to distribute caustic on top or bottom of supernatant
  - In most cases, the caustic is mixed in using natural convective flow
  - Can use an installed DST transfer pump in recirculation mode if necessary to mix in the caustic