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SRS Tank 12H Residual Radionuclide Release Testing Status

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Savannah River NUCLEAR SOLUTIONS℠

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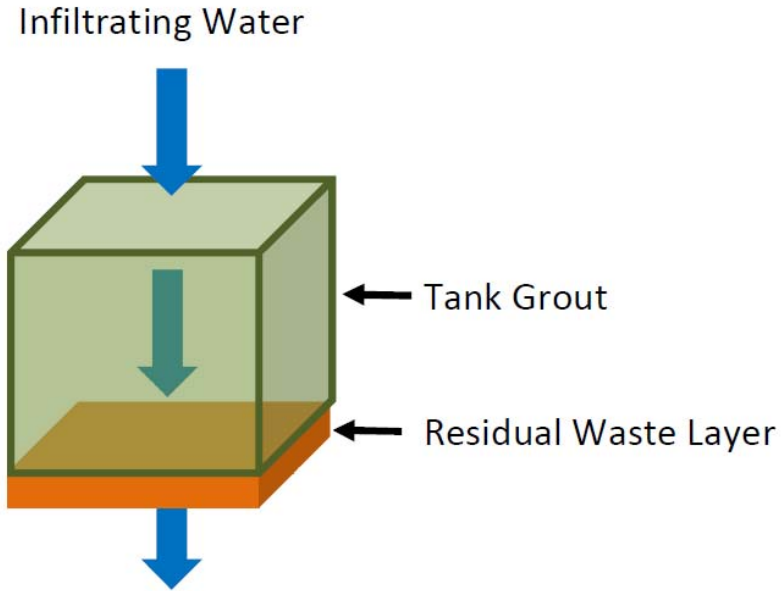
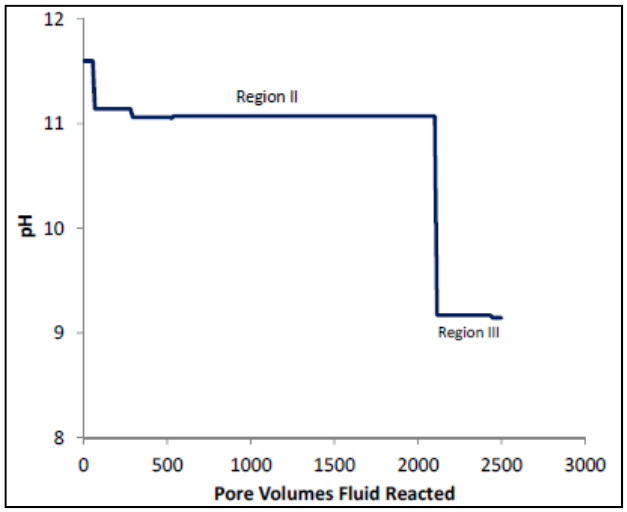
Project Objective and Authorization

- Objective: Provide additional information regarding the residual waste solubility assumptions used in the F-Area and H-Area Tank Farm Performance Assessments' waste release models by developing methods to test the solubility of Tc, I, U, Np, and Pu under various simulated waste tank chemistry conditions using actual Tank 12H waste residual solids to supplement previous Tank 18F testing.
- Using Tank 12H for testing provides data from an H-Area tank exposed to extensive mechanical waste retrieval operations, caustic aluminum dissolution, and oxalic acid cleaning (in contrast, Tank 18F is an F-Area tank that did not undergo acid cleaning).
- Technical Task and Quality Assurance Plan (TT&QAP): SRNL-RP-2017-00411, Rev. 0 (approved 8/2017), *Task Technical and Quality Assurance Plan for Tank 12 Waste Residual Radionuclide Release Testing.*

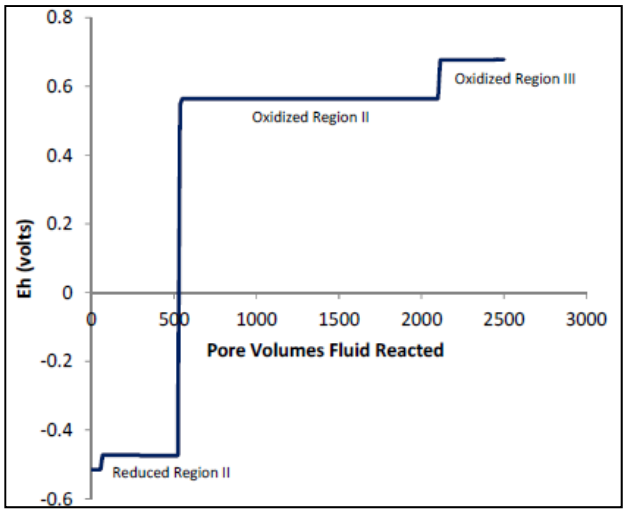
Tank Waste Release Model



Radionuclide-Bearing Pore Fluid



environment less basic, increasingly oxidizing with time



Target Conditions

Condition	E_h (mV)	pH
Reduced Region II (RR2)	-470	11.1
Oxidized Region II (OR2)	+560	11.1
Oxidized Region III (OR3)	+680	9.2

SRR-CWDA-2010-00128, Rev. 1 (ML13045A499)

Test Sample Components

test methodology developed in previous testing

1. Infiltrating Water (as prepared)

Component	Concentration (mg/L)
Na^+	1.39
Cl^-	5.51
Ca^{2+}	1.00
Mg^{2+}	0.66
K^+	0.21
SO_4^{2-}	0.73

2. Tank Grout Solids (CFS) or Grout–Representative Solids ($CaCO_3$, CaOH, FeS)

3-Component Slurry Samples

3. Archived Tank 12H Waste Heel Residual Solids

Component	Comp 1 Measured Conc. (wt %)	Comp 2 Measured Conc. (wt %)	Comp 3 Measured Conc. (wt %)
Al	5.9	9.5	5.9
Fe	32	22	36
Hg	19	12	16
Na	0.5	0.7	0.4
Mn	1.2	1.6	1.3
Si	0.1	0.2	0.2
Th	3.4	8.2	3.3
U	0.04	0.15	0.074
F:M ratio	5.6:1	1.9:1	4.4:1

bulk characterization data for composite samples similar to the composite test sample with varying floor:mass (F:M) ratios

trace radionuclide constituents include: Tc-99, I-129, Np-237, and Pu-238

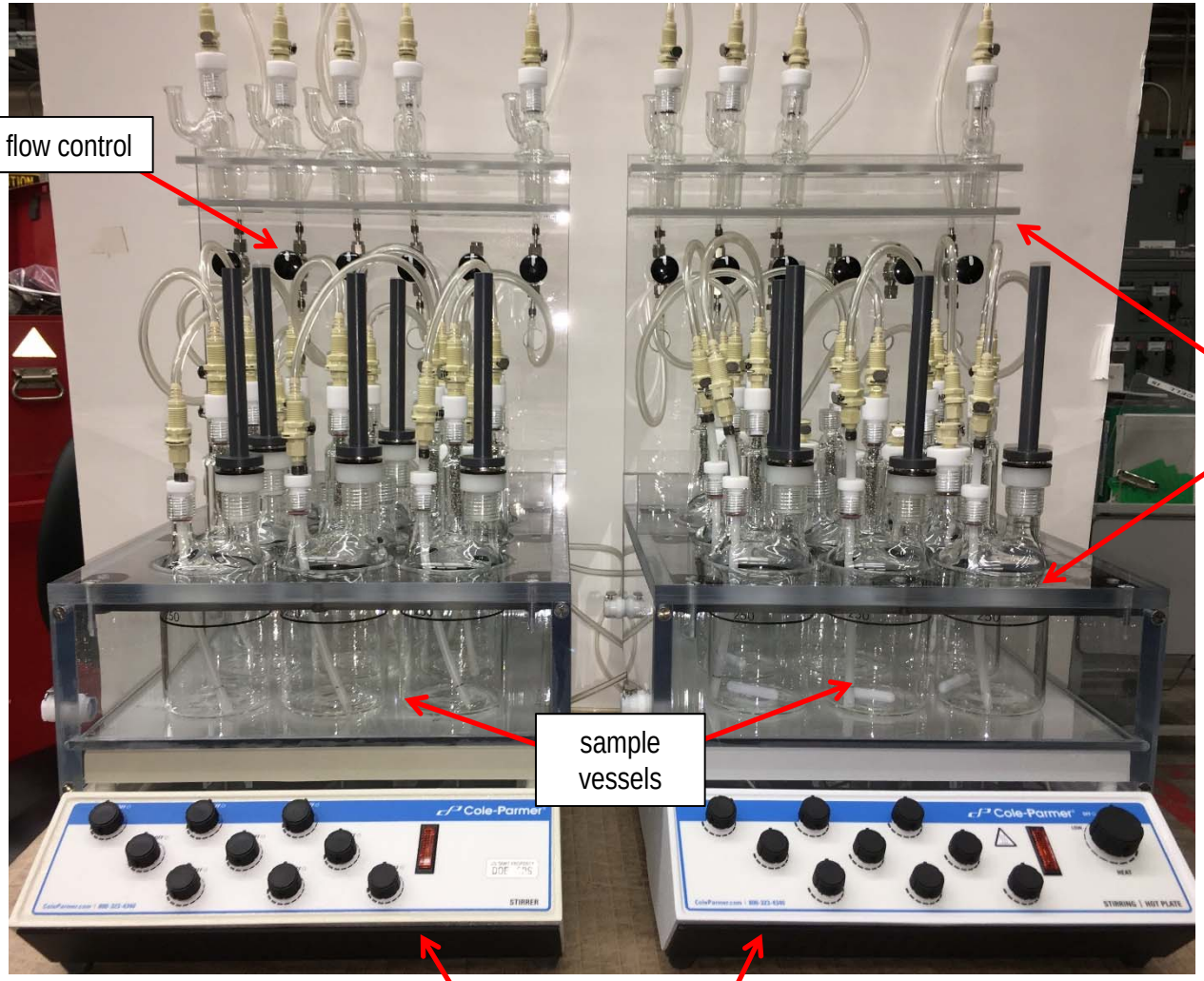
SRNL-STI-2014-00456, Rev. 0 (ML15147A543); SRNL-STI-2015-00446, Rev. 0, (ML15324A143), SRNL-STI-2015-00241, Rev. 0.

Tank 12H Residual Radionuclide Release Test Conditions

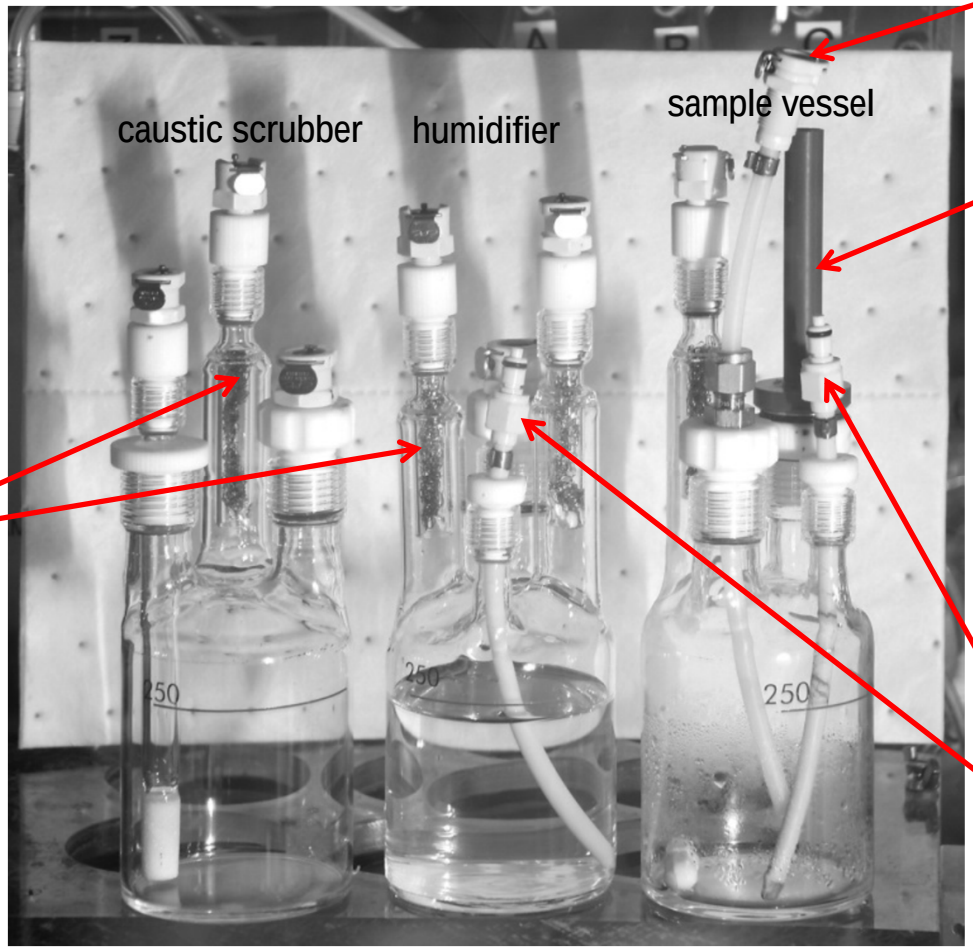
- Reducing condition RRII (representative of recently closed tank)
  - $Ca(OH)_2$ addition for pH adjustment
  - FeS and either $CaCO_3$ or CFS (cement, fly-ash, slag) grout solids ($CaCO_3$ represents solid phase believed to be controlling pH and E_h at equilibrium conditions)
  - Continuous N_2 purge to minimize oxygen
  - Unwashed and washed samples evaluated to represent different aging periods
- Intermediate oxidizing condition ORII
  - $Ca(OH)_2$ addition for pH adjustment
  - $CaCO_3$ addition
  - Continuous CO_2-stripped air purge
  - Washed samples tested
- Aged tank oxidizing condition ORIII
  - $Ca(OH)_2$ addition for pH adjustment
  - $CaCO_3$ addition
  - Continuous CO_2-stripped air purge, occasional direct air purge for pH adjustment
  - Washed and highly washed samples tested

- All samples include a 3.5:1 mass ratio of Tank 12H floor:mound residuals.
- All samples tested for multiple weeks to confirm equilibrium
- Conditions based on Tank 18F waste testing; SRNL-STI-2016-00432, Rev. 0 (ML 17059D500)

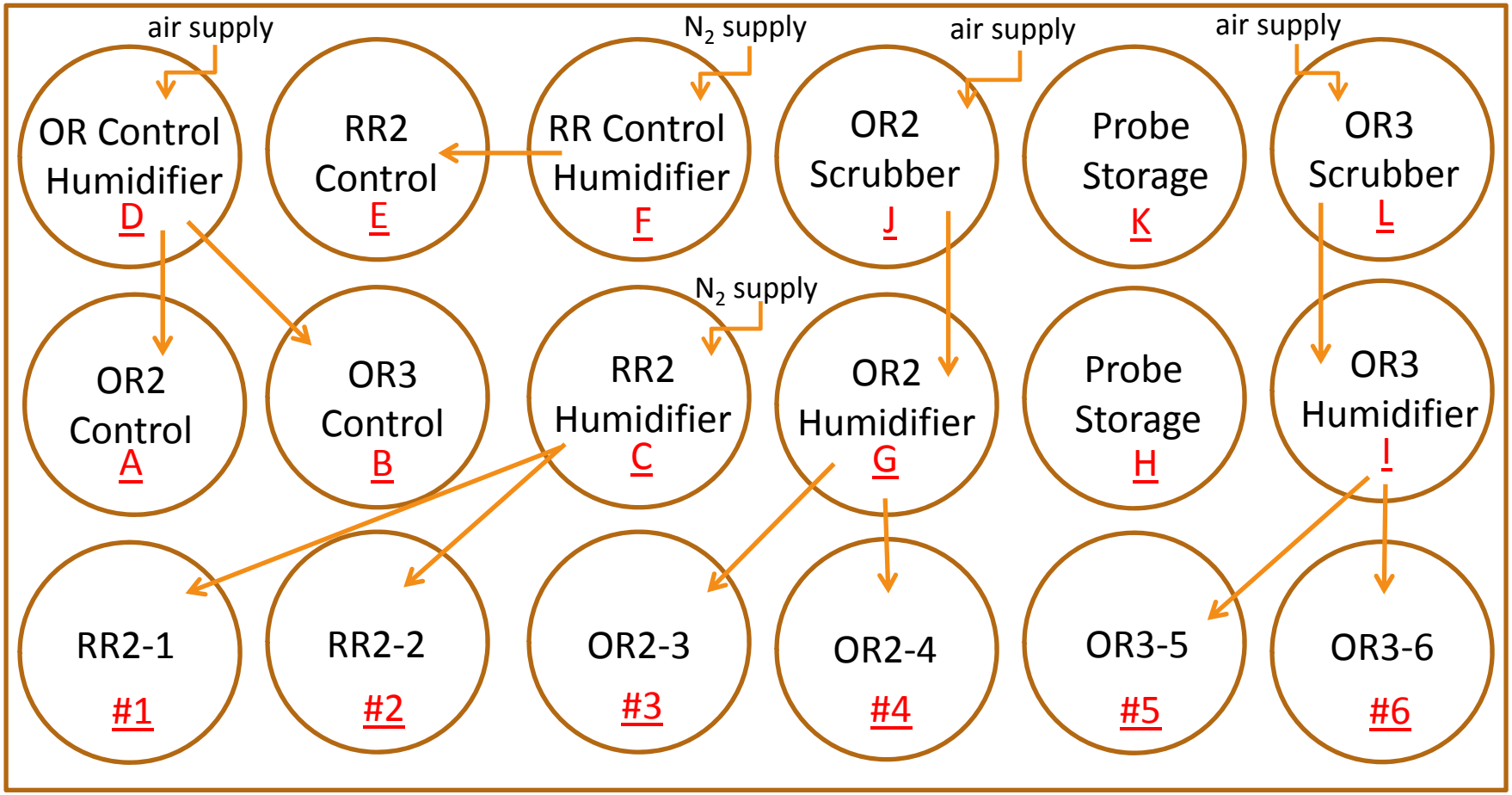
Tank 12H Residual Leach Testing Equipment



Leach Test Vessels



Sample and Gas Pretreatment Vessel Layout



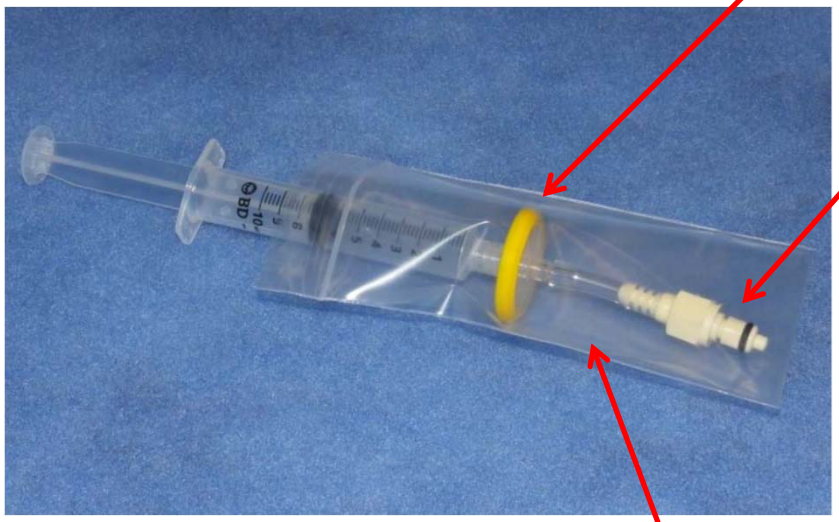
- Caustic scrubber vessels to remove CO_2 from air supply
- Humidifier vessels on all gas lines
- Vapor demisters on all vessels
- Bubblers on downstream end of all gas lines

SRNL Shielded Cells Testing Facility

Installed Equipment for Tank 12H Testing

- Remote sample handling with manipulators
- Gases and probe connections introduced through front wall penetrations
- Variable ambient temperature

Sub-sampling System



- Disposable sampling system with modified bottle caps to minimize contamination.
- Sub-samples collected manually and placed into 10 mL syringes prior to direct filtration into closed bottles.
- Blank samples used to monitor sample contamination levels from cell environment.

Equipment Improvements and Lessons Learned

- Sampling system simplified.
- Bubbler system modified to eliminate liquid back flow into sample vessels (occurred with one sample during Tank 18F testing).
- Check valves added between vessels to eliminate liquid back flow into tubing due to vessel pressure differences.
- Filter added to recirculator loop to protect gear pump from debris.

Status and Schedule

- Tank 12H testing completed.
  - Tank 12H slurry samples could not be agitated by stir plate; manual agitation utilized (other agitation methods may be considered in future testing).
  - Achieving a stable pH was difficult with most Tank 12H samples due to base consumption by samples (required frequent reagent addition).
  - Achieving target reducing potentials was difficult for Tank 12H residuals.
  - One vessel broke during testing (may re-evaluate square vessel bottom in future testing).
- Tank 12H sample analysis is ongoing.
- Preparation of a Tank 12H Waste Release Testing Report is in progress (scheduled to be issued September 30).