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Tank 12 Radiological and Chemical Screening

Analyte Screening Approach for the Tank 12 Residual Materials

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Screening Overview

The radiological and chemical analyte screening process for Tank 12 is similar to the process that was used for other tanks

Due to the variability of the wastes received and stored in the individual SRS tanks over their years of service, the selection of analytes to characterize waste tank residuals is tailored to:

- the unique tank waste receipt history,
- the impacts of the waste cleaning techniques, and
- the characteristics of the residuals remaining in the tank.

Tank 12 History

- Tank 12 is a Type I waste tank that was placed into service in 1956 and actively received H-Canyon high heat waste (HHW) until the early 1970's.
- Tank 12 was removed from active service in late 1974 after confirmation of a leaksite.
  - The majority of the supernate was removed over time,
  - The remaining supernate evaporated leaving the tank in a "dry" condition.
- Tank 12 was rewet starting in 2004 in preparation for bulk waste removal efforts.
- Tank 12 underwent extensive waste removal campaigns between 2008 and 2013 including separate chemical cleaning campaigns using low-temperature aluminum dissolution (LTAD) and bulk oxalic acid cleaning (BOAC).

Tank 12 Processing History

- Tank 12 received HHW associated with three distinct H-Canyon separations processes:
  - Early receipts were associated with recovery of weapons grade plutonium from natural and depleted uranium targets via the Plutonium Uranium Extraction (PUREX) process [Similar to typical FTF waste],
  - The bulk of the receipts were associated with recovery of highly enriched uranium from irradiated enriched uranium fuel via the H-Modified process [Typical HTF waste], and
  - A series of the waste receipts were from specialty campaigns designed to recover U-233 from thorium targets (i.e., the Thorium Extraction (THOREX) campaigns) [unique waste stream present in a few HTF tanks].

Tank 12 Waste Storage History

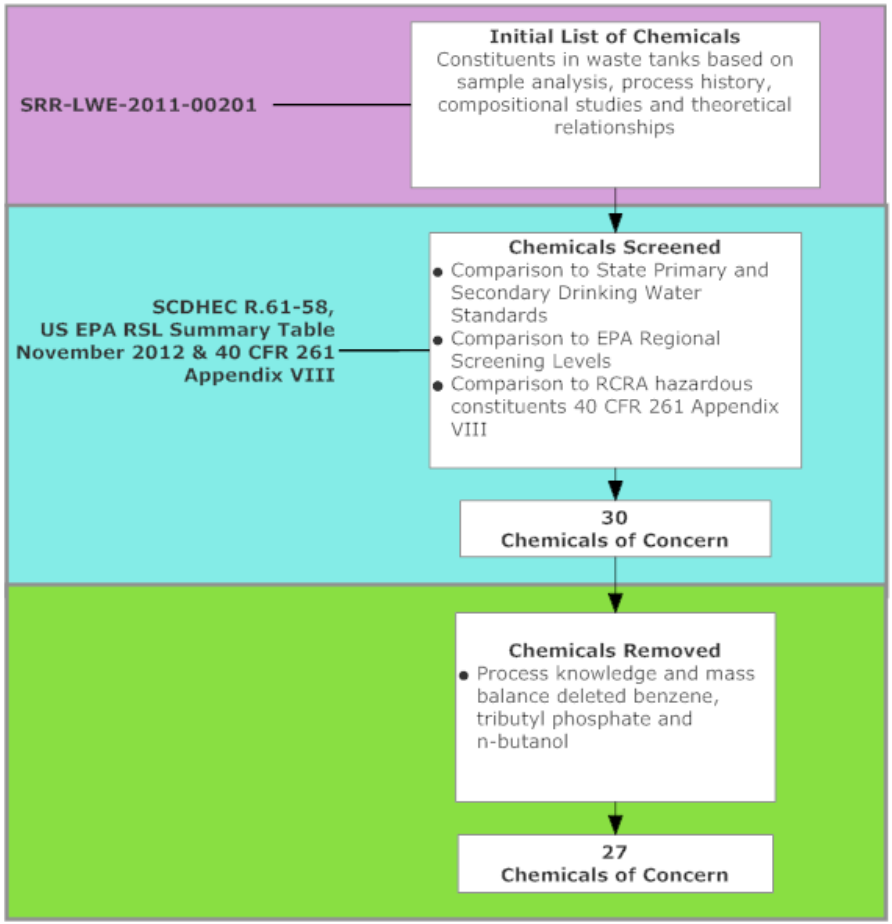
Tank 12 Waste Storage History

Fill#	Waste Type	Fill Start	Fill End	Decant
1	HHW (PUREX)	9/56	10/57	8/63 (to Tank 13)
2	HHW (HM, THOREX)	10/63	9/64	12/66 (to Tank 13)
3	HHW (HM)	12/66	7/67	2/69 (to Tanks 13, 14)
4	HHW (HM)	2/69	10/69	2/70 (to Tank 15)
5	HHW (HM)	2/70	10/70	10/72 (to Tank 13)
6	HHW (HM)	11/72	6/73	3/66, 4/76, 9/78 (to Tank 13)

Screening Process

- The chemical analyte list began with 50 chemical constituents taken from the *Information on the Radiological and Chemical Characterization of the Savannah River Site Tank Waste as of July 5, 2011*, SRR-LWE-2011-00201.
- The radionuclide analyte list started with the 54 radionuclides identified as “of concern” in the HTF PA Inventory Document, SRR-CWDA-2010-00023.
- Flowsheets (Slide 7 for chemicals and Slide 10 for radionuclides) show screening process for radionuclides and chemicals.

Chemical Screening Flowsheet



Tank 12 Chemical Analytes

- Chemical – 27 Analytes
  - Same list as Tank 16

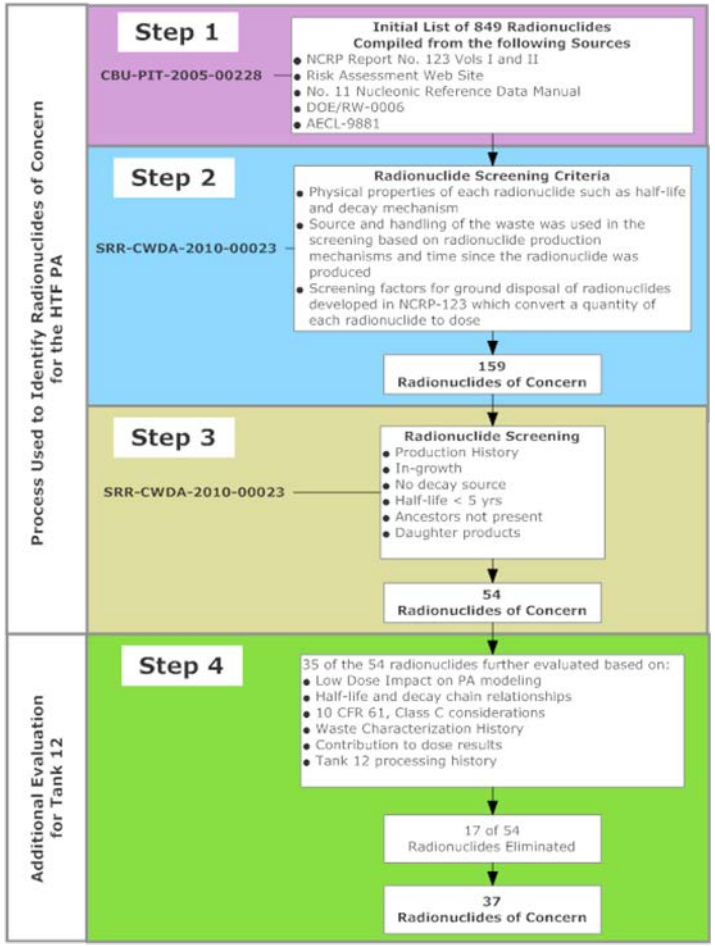
Ag	Al	As	B	Ba	Cd	Cl
Co	Cr	Cu	F	Fe	Hg	I
Mn	Mo	Ni	NO_2	NO_3	Pb	PO_4
Sb	Se	SO_4	Sr	U	Zn	

Chemicals not Analyzed

Chemicals on screening list not to be analyzed in Tank 12 samples (same as previous tanks):

- Benzene – Not present by process knowledge, no In-Tank Precipitation solutions in Tank 12
- Tributyl phosphate – Not present by process knowledge, would have degraded quickly to butanol in high caustic environment
- Butanol - Not present by process knowledge, would have evaporated or been washed out of the tanks during waste removal activities

Radionuclide Screening Flowsheet



Tank 12 Radionuclides

- Radiological –37 Analytes (See Table)
  - Started with HTF PA list (54 radionuclides)
  - Of these 54 radionuclides, 35 were further evaluated for elimination based on insignificant impact to modeling dose results (i.e., less than 1.0E-02 mrem/yr PA dose estimate).
  - The processing history in Tank 12 and comparisons between the actual inventories in Tanks 5, 6, 18, and 19 and the values assigned in the FTF PA were major factors in the evaluation.

Tank 12 Radionuclide Analyte List

Am-241	Am-242m	Am-243	Ba-137m	C-14	Cl-36
Cm-243	Cm-244	Cm-245	Cs-135	Cs-137	I-129
K-40	Nb-94	Ni-59	Ni-63	Np-237	Pa-231
Pu-238	Pu-239	Pu-240	Pu-241	Ra-226	Ra-228
Sn-126	Sr-90	Tc-99	Th-229	Th-230	Th-232
U-232	U-233	U-234	U-235	U-238	Y-90
Zr-93					

Breakdown of Excluded Radionuclides

- The following radionuclides were screened out for both Tank 12 and Tank 16:
  - Ac-227, Al-26, Eu-152, Eu-154, H-3, Pd-107, Pt-193, Se-79, Sm-151, U-236.
- The following radionuclides are excluded from Tank 12 but not for Tank 16:
  - Cf-249, Cf-251, Cm-247, Cm-248, C-60, Pu-242, Pu-244.
- The following radionuclides are excluded from Tank 16 but not for Tank 12:
  - Ra-228, Sn-126, Th-229, Th-232, U-232.

Radionuclides Excluded from Tank 16 but not Tank 12

- Ra-228, Th-229, Th-232, and U-232 are included in the Tank 12 analyte list based primarily on the fact that Tank 12 received H-Canyon waste streams produced during U-233 campaigns and therefore these radionuclides may have been transferred to Tank 12 in non-negligible quantities.
- Sn-126 is included in the Tank 12 analyte list based primarily on the fact there is greater than desired uncertainty surrounding the final Sn-126 inventory, based on the actual Sn-126 inventories in Tank 5 and Tank 6.

Radionuclides Excluded from Tank 12 but not Tank 16

- Cf-249, Cf-251, Cm-247, Cm-248, C-60, Pu-242, Pu-244 were excluded from the Tank 12 analyte list because:
  - The HTF PA demonstrates that they have a negligible contribution to the radiological results for MOP dose and airborne dose at the assigned inventory values, and
  - An evaluation of the factors impacting inventory significance (e.g., daughter products, decay times, characterization history) did not identify a reason for including them on the Tank 12 analyte list.

Summary

- Used similar screening process as performed previously.
- Result:
  - 27 chemicals – no change from Tank 16.
  - 37 radionuclides – slight reduction from Tank 16.

Current Status

- Tank 12 Radiological and Chemical Screening document approved and issued (SRR-CWDA-2014-00052).
- Analyte lists will feed into the Tank 12 Technical Task Request (TTR) to SRNL for sample analysis – currently under development.
- SRNL will issue Task Technical Quality Assurance Plan (TTQAP) – to be completed after TTR received.

References

- CBU-PIT-2005-00228, Hamm, B.A., *Savannah River Site High-Level Waste Tank Farm Closure Radionuclide Screening Process (First-Level) Development and Application,* Savannah River Site, Aiken, SC, Rev. 0, November 7, 2006.
- SRR-CWDA-2010-00023, *H-Tank Farm Closure Inventory for Use in Performance Assessment Modeling*, Savannah River Site, Aiken, SC, Rev. 3, May 10, 2012.
- SRR-CWDA-2010-00128, *Performance Assessment for the H-Area Tank Farm at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 1, November 14, 2012.
- SRR-LWE-2011-00201, Pasala, N.R., *Information on the Radiological and Chemical Characterization of the Savannah River Site Tank Waste as of July 5, 2011*, Savannah River Site, Aiken, SC, Rev.0, September 26, 2011.
- SRR-CWDA-2014-00052, *Recommended Radionuclide and Chemical Analyte List for Tank 12*, Savannah River Site, Aiken, SC, Rev. 0, May, 2014.

Backup Slides

THOREX Campaigns

- THOREX campaigns involved Th-232 targets being irradiated for U-233 production
  - U-233 is formed when Th-232 captures a neutron to become Th-233. This normally emits an electron and an anti-neutrino by ß-decay to become Pa-233. This then emits another electron and anti-neutrino by a second ß−decay to become U-233.
  - U-232 is also formed (as a contaminant) in the U-233 production process (via (n,2n) reactions between fast neutrons and U-233, Pa-233, and Th-232). As a contaminant, the U-232 was produced in very small quantities in terms of mass, but because of its short half-life (68.9 years) a small mass of U-232 may still have a non-negligible activity contribution.
  - Th-229 is produced by the decay of U-233 and Ra-228 is produced by decay of Th-232.