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# Tank 12 Residuals Sampling

**Sampling and Analysis Approach for Characterizing the Tank 12 Residual Materials**

June 25, 2014

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Presentation to the South Carolina Department of Health and Environmental Control and the US Environmental Protection Agency

SRR-CWDA-2014-00065

# Presentation Outline

- Meeting Purpose
- Tank 12 Background Information
  - Operational history
  - Waste removal history
  - Residuals for sampling
- Sampling Approach
  - Sampling Option Evaluation
- Current Status

# Meeting Purpose



Meeting Purpose:

Present an overview of the Tank 12 operational history as it relates to residual material distribution and volumes.

Describe the planned sampling approach and factors evaluated in the sample location selection decision.

# Tank 12 Background



- Tank 12 is one of four Type I tanks in the H-Area Tank Farm (HTF) at the Savannah River Site (SRS).
- All Type I tanks have an annulus between the primary tank liner and the secondary containment pan/vault wall.
- The bottom of the Tank 12 containment vault is approximately 35.5 feet below the mean elevation of the water table.
- Additional details on the HTF Type I tanks can be found in the HTF Performance Assessment. [SRR-CWDA-2010-00128]

# Tank 12 Profile

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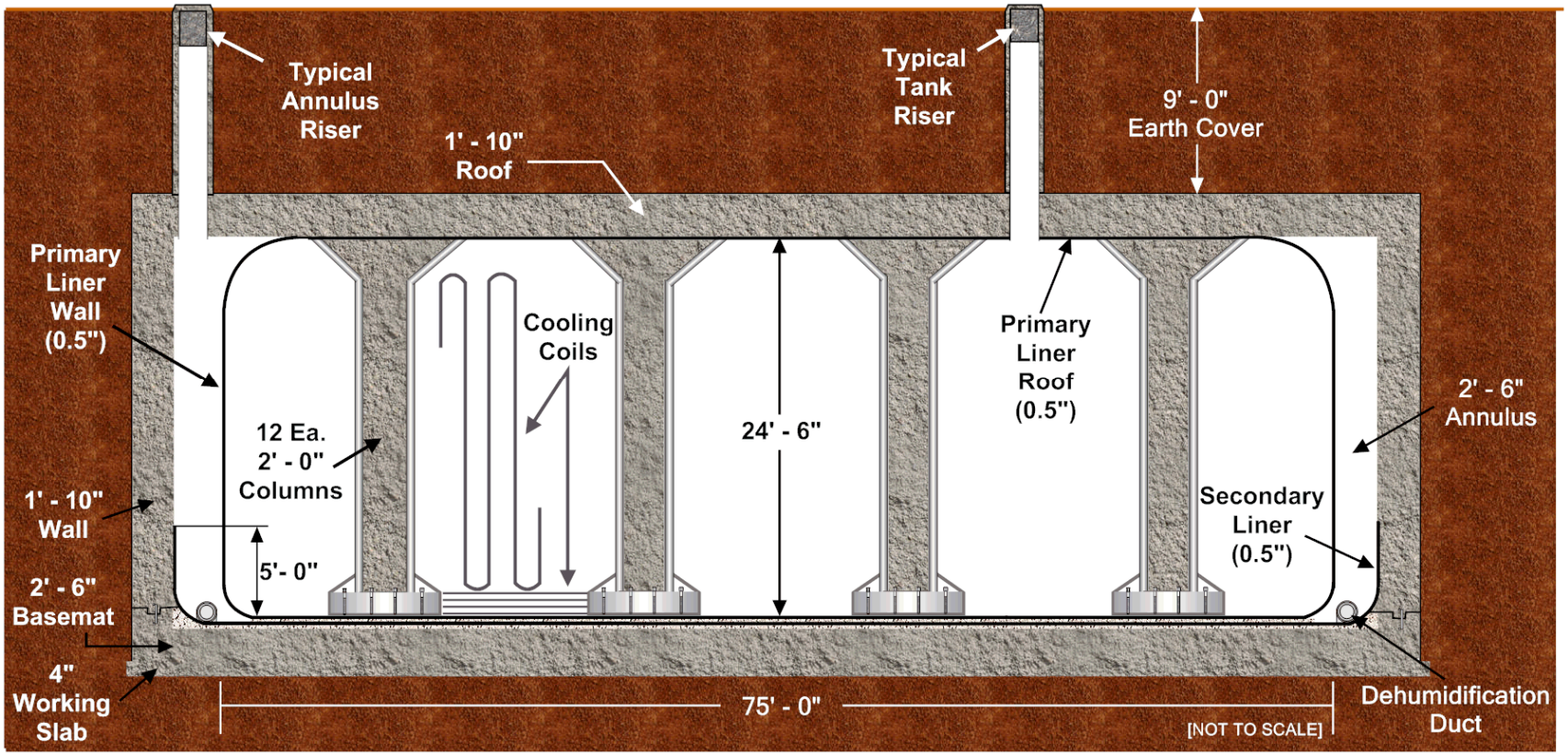


# Tank 12 Operational History



- Tank 12 was placed into service in September 1956 to receive high heat waste (HHW) from H-Canyon operations. The tank was filled by October 1957 and the waste was allowed to cool and decay radioactively.
- Supernate transfers out and additional receipts were made until May 1973.
- A leak into annulus discovered in May 1974.
- 1976-1978: Series of supernate transfers performed to lower liquid level

# Tank 12 Operational History



- 1978-2004: Tank was dormant. Supernate was allowed to evaporate and the solids layer shrank from 95 to 75 inches (203,000 gallons).
- The tank was rewet between November 2004 and January 2005 in preparation for Bulk Waste Removal Efforts (BWRE).
- At the start of BWRE in August 2008, the tank liquid level was approximately 110 inches.

# Tank 12 Leaksite History



- Leak into annulus discovered in May 1974. (Salt nodule on wall near North riser at 105-inch level)
- 1974 – 2008: Five more leaksites discovered during limited (25%) annulus inspections.
- 2012: 100% annulus inspection discovered nine more leaksites.
- A total of 25 gallons of dried waste is estimated to be present on the annulus floor and as nodules on the primary tank wall.

# Tank 12 Waste Removal

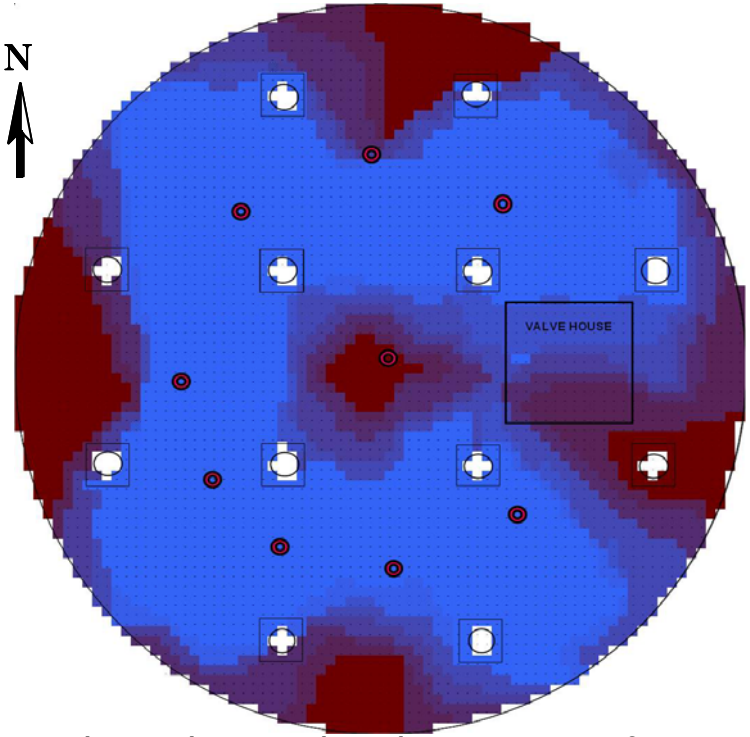


- Tank 12 underwent extensive waste removal campaigns between 2008 and 2013 including separate chemical cleaning campaigns using low-temperature aluminum dissolution (LTAD) and bulk oxalic acid cleaning (BOAC).
  - More detail was presented in the : "*Proposal to Cease Waste Removal Activities in Tank 16 and Enter Sampling and Analysis Phase*" recently presented to the agencies. [SRR-CWDA-2013-00041, Rev. 1]
- The following residuals thickness maps are intended to show how the movement and mixing of the residuals during waste removal campaigns influences the planned sampling.

# MSR-I Campaigns 1 – 4 Result



Sludge mounded in center of tank and along wall in all four quadrants.
Solids volume reduced from 203,000 to 77,400 gallons.
Mounds were greater than 70 inches high.




Darker colors (red) indicate areas of greater material thickness

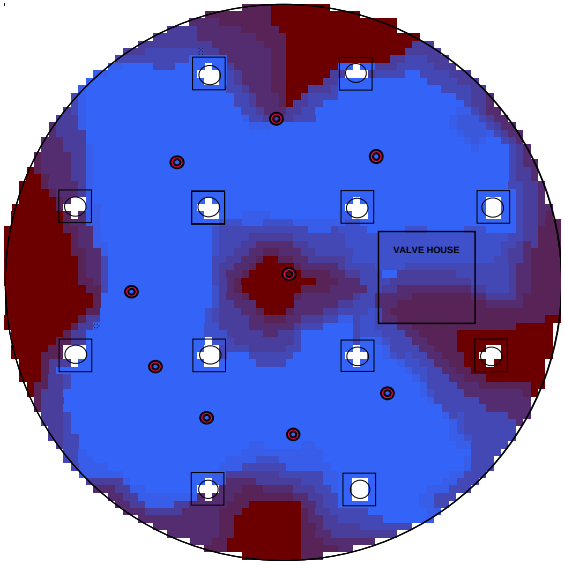
Riser 4 – View East Toward Tank Center

# Waste Movement and Mixing

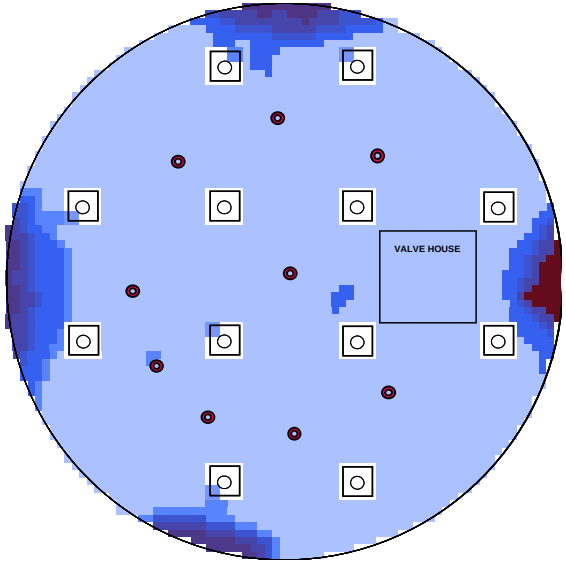


Start Waste Removal

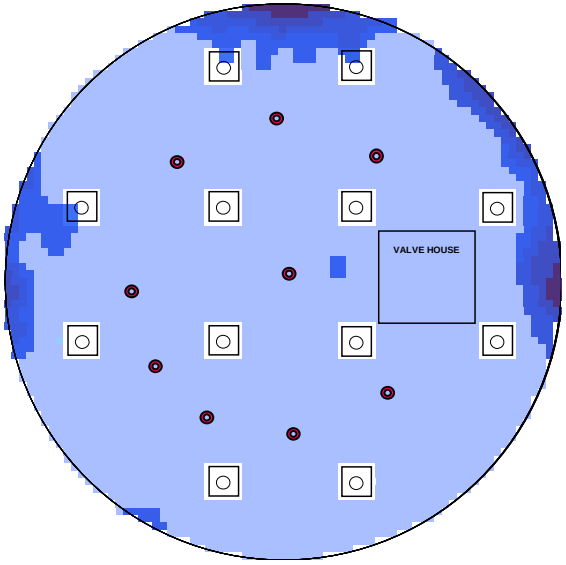
**Before MSR-1 Campaign 5**
**77,400 gals**




**After MSR-1 Campaign 10**
**22,000 gals**




**After MSR-II Campaign 1**
**14,500 gallons**



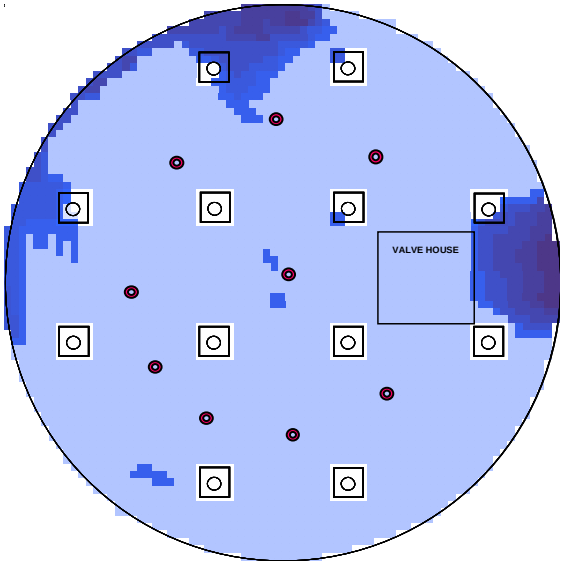

MSR = Mechanical Sludge Removal

# Waste Movement and Mixing

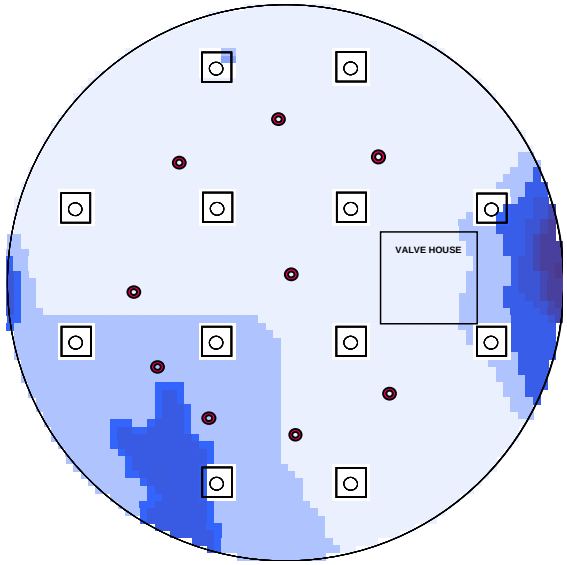


## Waste Removal Continues

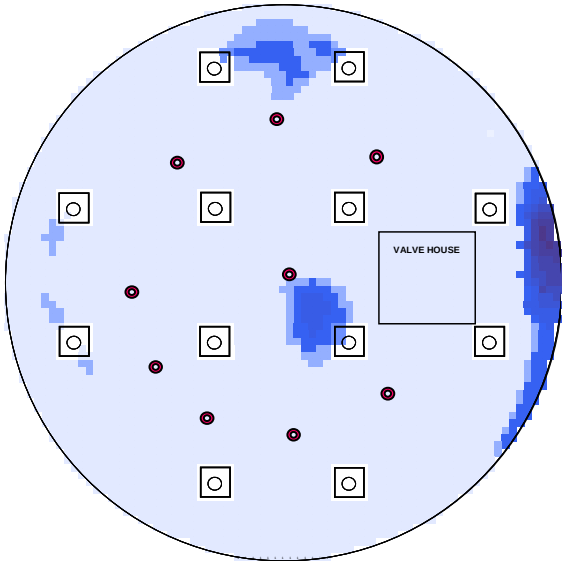
**After MSR-II Campaign 2**
**13,700 gallons**




**After CSR-I**
**7,800 gallons**




**After MSR-III**
**4,400 gallons**

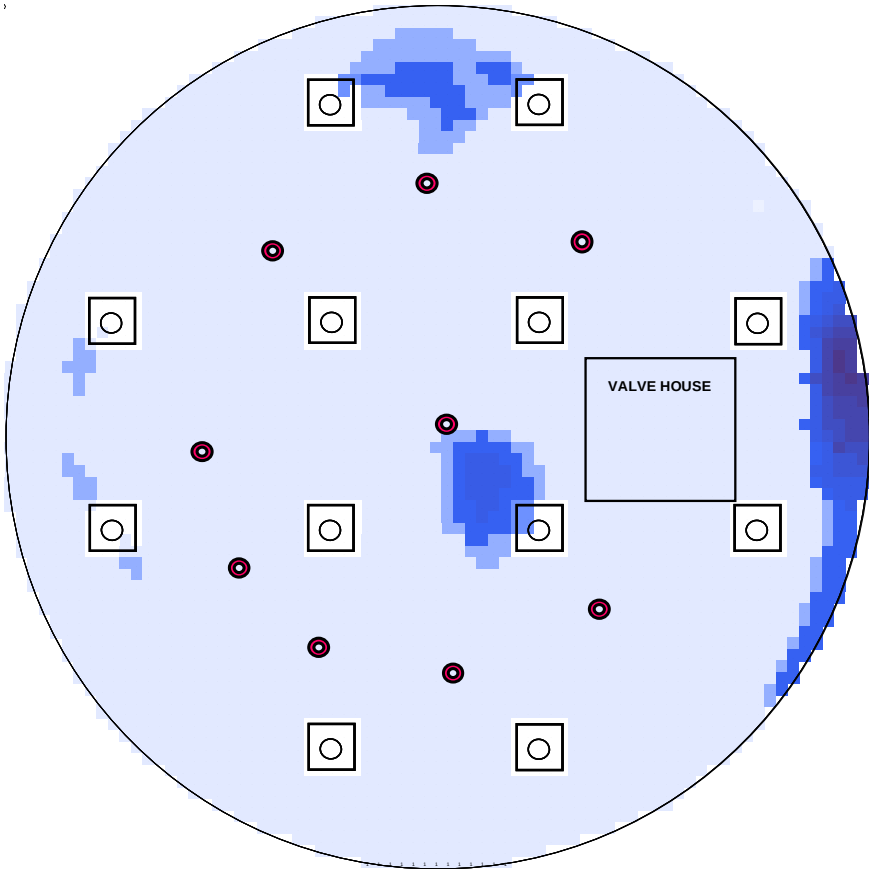



CSR = Chemical Sludge Removal

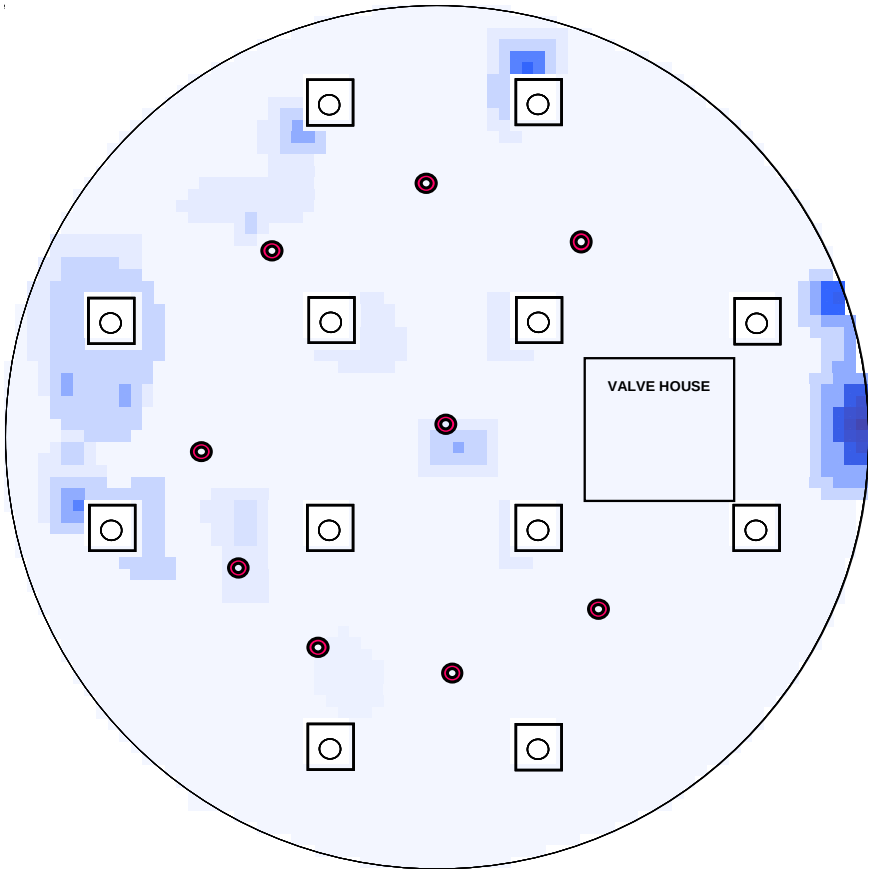
# Waste Movement and Mixing



**After MSR-III**
**4,400 gallons**




**After CSR-II**
**<2,000 gallons**



# Tank 12 Panorama
# Center Riser - August 2013

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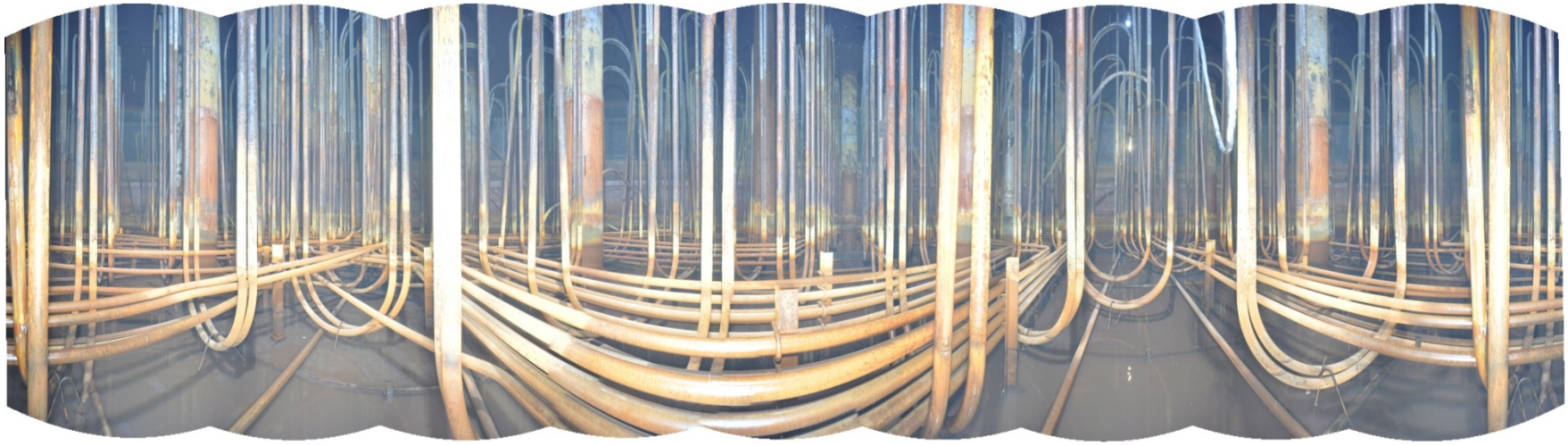


Preliminary volume estimate of 1,000 gallons for floor residual material, and 400 gallons for cooling coil residuals

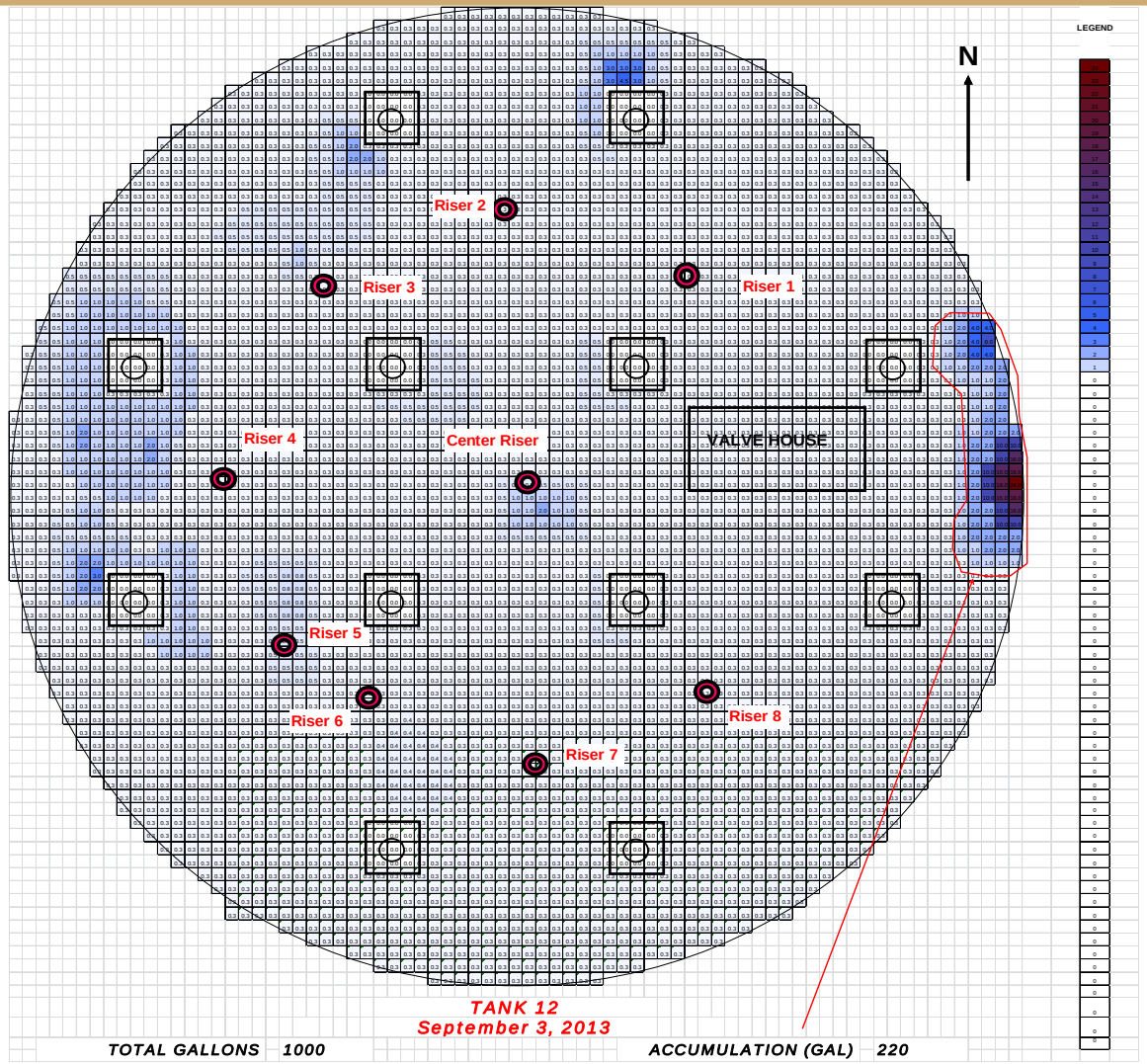
# Floor Residual Mixing



- Assumption is that the floor residuals are “well-mixed”.
  - Mapping during waste removals show that, except for the mound behind the valve house piping, the material has been moved and redeposited several times
  - Few, small accumulations are present along the north and west tank perimeter

# Residual Floor Solids





# Residuals for Sampling



- Preliminary Solids Volume Estimate was 1,000 gallons
  - 220 gallons in a mound behind the valve house piping
  - 780 gallons on the remainder of the tank floor
  - (25 gallons of dried waste in annulus will not be sampled)
- An additional 400 gallons of material are estimated to be on the cooling coils
- **Total residuals volume for characterization is 1,400 gallons**

  If a free liquid layer is present above the floor solids at the time of sampling, it will be characterized separately

# Mound Behind Valve House Piping



Mound edge showing steep sides, rubbly top surface, and sloughed material covering the base.

# Residuals Sampling Approach



The Liquid Waste Tank Residuals Sampling and Analysis (LWTRSAPP) approach uses 3 arrays, each with 5 samples (15 samples total), for compositing. The number of sample locations in the residual material "segments" are based on volume proportioning.

Applying the LWTRSAPP approach for Tank 12, each 5 sample array would consist of:

220 gals/1400 gals = 0.157; (0.157 x 5) = 0.78 ≈ 1 mound sample

780 gals/1400 gals = 0.557; (0.557 x 5) = 2.78 ≈ 3 floor samples

400 gals/1400 gals = 0.286; (0.286 x 5) = 1.42 ≈ 1 coil sample

*But the one mound sample might not be representative of the assumed mound heterogeneity*

# Residuals Sampling Approach



We knew that the mound had not been mobilized and redeposited and was assumed to be heterogeneous.

- Because of that fact and possible heterogeneity in the cooling coil material, SRNL performed a statistical evaluation of the sampling approach.
- The evaluation focused on how best to represent the possible heterogeneity in the mound, floor, and cooling coil residual materials.

The recommendation was to use 6 mound, 6 general floor and 3 cooling coil samples for the compositing.

Each composite sample for analysis would be made from:

- 2 mound,
- 2 floor, and
- 1 cooling coil sample

# Residuals Sampling Approach



The statistical evaluation also showed that to minimize the sampling uncertainty in the mound, three random samples should be collected from the upper portion of the mound and three random samples should be collected from the lower mound.

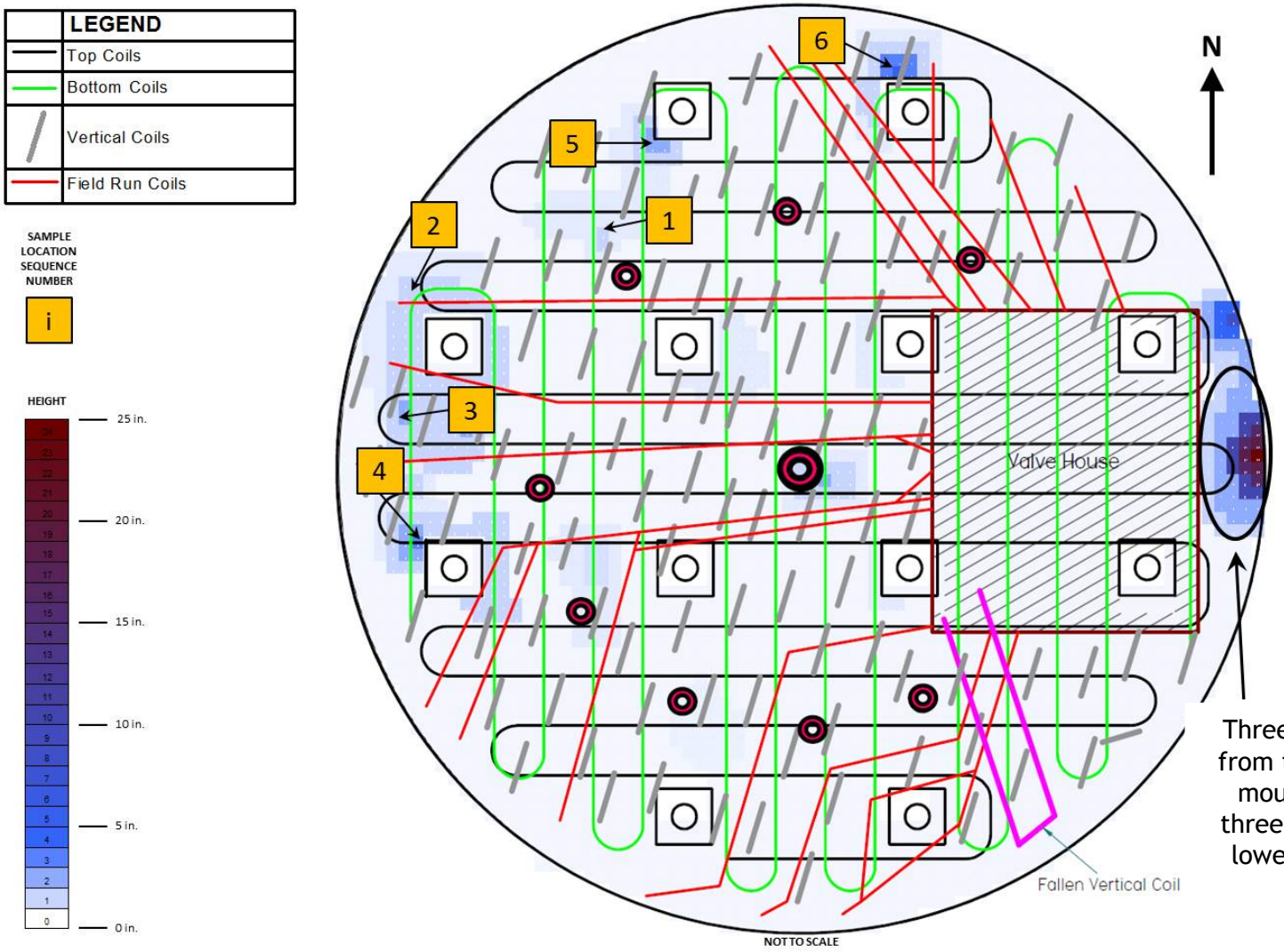
- One upper and one lower mound sample would be used for each composite sample creation.

And to minimize sampling uncertainty in the cooling coil material, one of the three planned coil samples would be used for each of the three composites.

Based on accessibility, the floor sampling locations were selected. Crawler entry would be through Riser 3 (by sample #1 on next slide)

# Tank 12 Floor Residuals Sample Locations






Three samples from the upper mound, and three from the lower mound

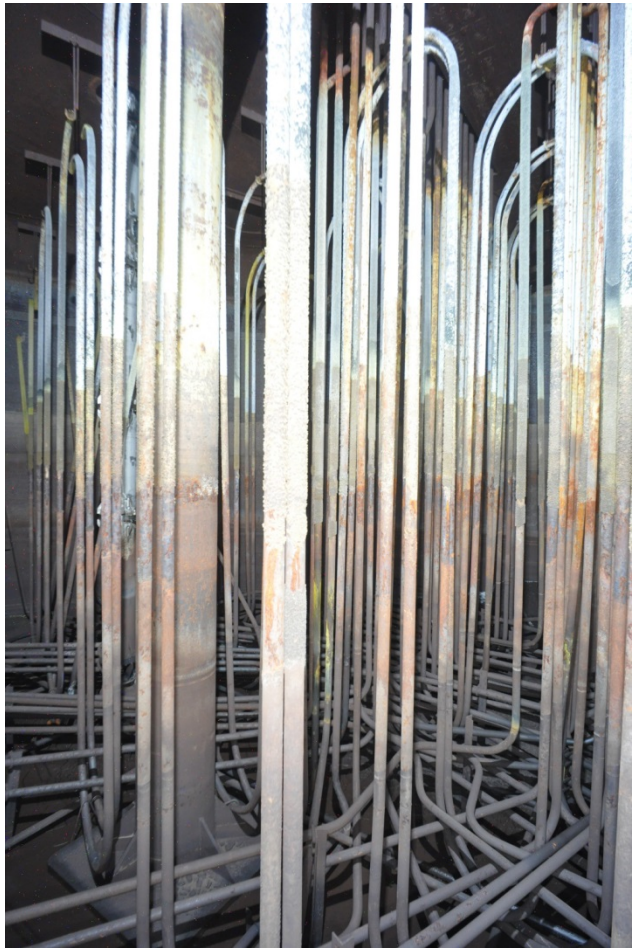
# Cooling Coil Sampling



- The cooling coil portions above the 140-inch liquid level height in the tank are encrusted with a crystalline-appearing material, thought to be crystallized supernate.
- The material appears to be more solid (denser) and coarser crystalline at lower elevations and transitions upward into a thinner, finer crystalline material near the top of the coils.
- The material also appears to be similar at the same elevation across the tank.

# Tank 12 Cooling Coil Coating





# Tank 12 Cooling Coil Coating



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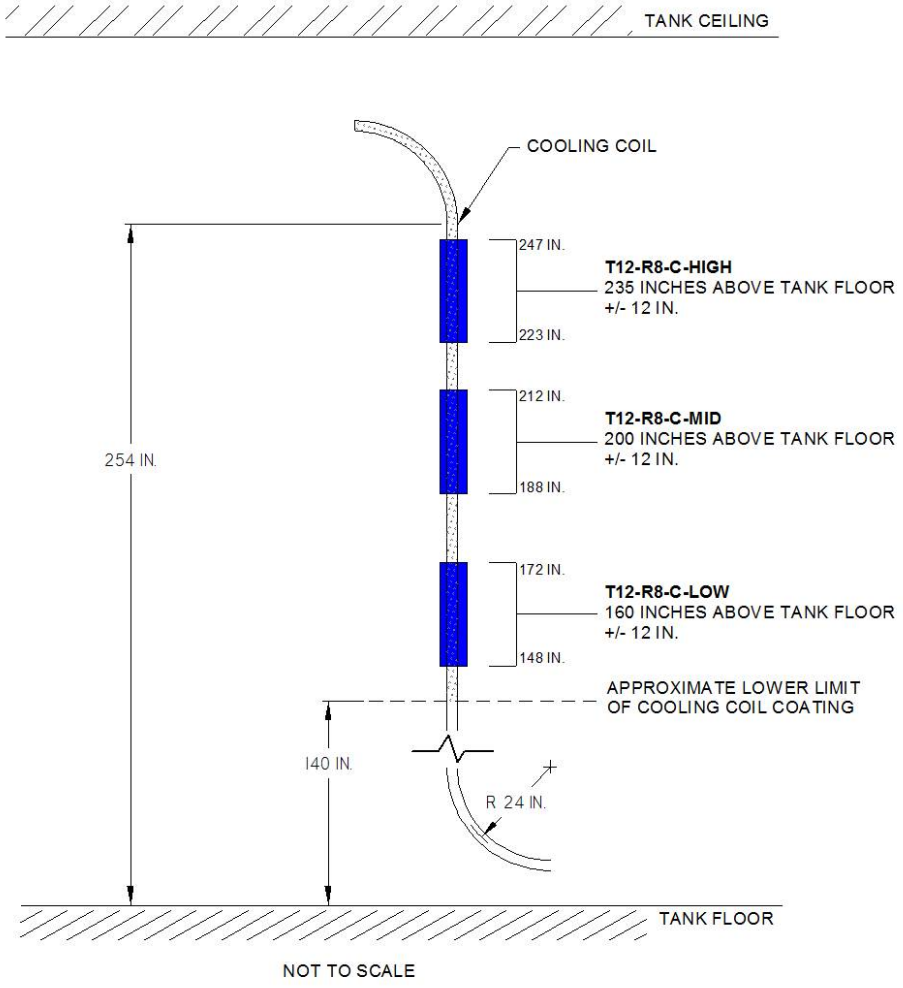
# Cooling Coil Sampling






- Collect three samples at different heights (elevations)
- Each sample would be used for a different composite sample
- If necessary, more than one coil could be sampled since samples are height, not coil dependent

# Additional Sampling



If the tank still has free-phase liquid on the surface of the solids, it will be characterized separately.

No sampling is planned for the material in the annulus because of the small volume relative to the primary tank (25 vs 1,400 gallons)

# Summary

- Three, five sample arrays will be used to create three composite samples for analysis
- Each composite will be created with:
  - 2 Floor Samples
  - 2 Mound Samples
  - 1 of the Cooling Coil Samples
- If necessary, any liquid phase will be characterized
- No sampling of the minimal annulus material will be performed

# Tank 12 Current Status



- **Tank 12 specific Sampling and Analysis Plan (TSAP) and Sample Location Determination Report (SLDR) are in final review and approval stage.**
- **Initial Tank 12 sampling currently scheduled for mid-July 2014**
  - Floor and mound samples will be collected using a robotic crawler
    - Recognized risk in being able to reach mound
  - Coil samples will be collected using a first-of-a-kind sampling tool. Mock-up testing performed to refine design and test tool operation
- **Progress will be periodically updated**

# References


- 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-CWDA-2011-00050, *Liquid Waste Tank Residuals Sampling and Analysis Program Plan,* Savannah River Site, Aiken, SC, Rev. 2, August, 2014.
- SRNL-STI-2014-00263, *Statistical Evaluation of Tank 12 Sampling Options*, Savannah River National Laboratory, Aiken, SC, Rev. 0, June 2014.