

Proposal to Cease Waste Removal Activities in Tank 4 and Enter Sampling and Analysis Phase

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*Waste Disposal Authority
December 16, 2024*



- **Meeting Objective**
- **Summary/Recommendations**
- **Waste Removal History and Results**
- **Additional Cleaning Considerations**
- **Path Forward**
- **Request for Department of Energy (DOE), South Carolina Department of Environmental Services (SCDES), and Environmental Protection Agency (EPA) Concurrence**
- **Background**

Acronyms



ALT	Alternate	LWTRSAPP	Liquid Waste Tank Residuals Sampling and Analysis Program Plan
BWRE	Bulk Waste Removal Efforts	MCL	Maximum Contaminant Level
CGCP	Consolidate General Closure Plan	PCWR	Preliminary Cease Waste Removal
CM	Closure Module	S&A	Sampling and Analysis
DOE	Department of Energy	SCDES	South Carolina Department of Environmental Services*
DWPF	Defense Waste Processing Facility	SCDHEC	South Carolina Department of Health and Environmental Control*
EPA	Environmental Protection Agency	SMP	Submersible Transfer Pump
FFA	Federal Facility Agreement	SPF	Saltstone Production Facility
FTF	F-Area Tank Farm	STD	Standard
IW	Inhibited Water	STP	Submersible Transfer Pump
LL	Liquid Level	SWPF	Salt Waste Processing Facility
		WCS	Waste Characterization System

*South Carolina Department of Environmental Services (SCDES) was known as South Carolina Department of Health and Environmental Control (SCDHEC) prior to July 1, 2024. Throughout this presentation figures and text reproduced from existing documents may still reflect SCDHEC nomenclature.

Meeting Objective

Obtain mutual agreement among DOE, SCDES, and EPA to:

- 1. Suspend waste removal activities in Tank 4; and**
- 2. Enter the Sampling and Analysis phase in Tank 4 consistent with the *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems (CGCP)* and *Liquid Waste Tank Residuals Sampling and Analysis Program Plan (LWTRSAPP)***

Tank 4 Primary



- **>99% of the waste volume in Tank 4 has been removed**
- **A qualitative assessment indicates that the CGCP performance objectives will not be challenged**
- **Additional waste removal in Tank 4 would have minimal impact on estimated doses/performance objectives in F-Area Tank Farm (FTF) Performance Assessment**
- **A quantitative assessment utilizing final residual waste volumes and results of sampling and analysis will be included in the Closure Module covering Tank 4**
- **A formal discussion on the “practicability” of additional waste removal will be included in the Closure Module covering Tank 4**

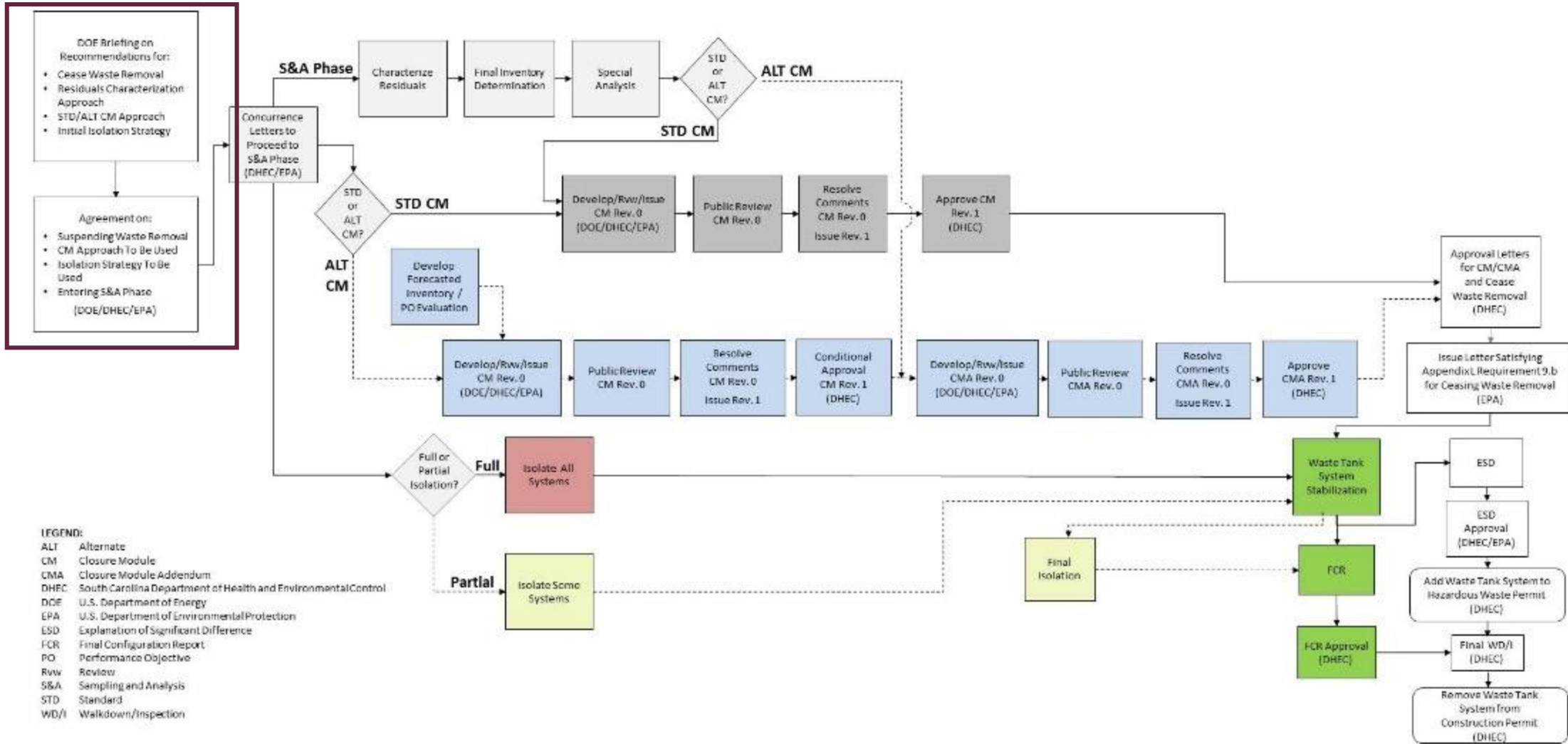
Based on the characteristics and estimated volume of the waste remaining in Tank 4, performance objectives are expected to be met.

- **Anticipate that concentration values in the groundwater for FTF will be below the Maximum Contaminant Level (MCL) values for all the non-radiological inorganic constituents listed in Table 9.2-1 of the CGCP**
- **Anticipate that concentration values in the groundwater for FTF will be below the MCL values for radionuclides consistent with the State Primary Drinking Water Regulations including:**
 - 4 mrem/yr dose for beta- and gamma-emitting nuclides
 - 15 picocuries per liter (pCi/L) for alpha-emitting nuclides (including Ra-226 but excluding radon and uranium)
 - 5 pCi/L for radium (Ra-226 plus Ra-228)
 - 30 micrograms per liter ($\mu\text{g/L}$) of uranium

- **Anticipate that the peak dose from Tank 4 alone will be <5 mrem/year during both the 1,000 year and 10,000-year periods after FTF closure***
- **To put this radiological dose into perspective**
 - Per NCRP-160, the average annual dose to a person in the United States is approximately 620 mrem primarily from:
 - *Approximately 310 mrem from naturally occurring background*
 - *Approximately 300 mrem from medical procedures*

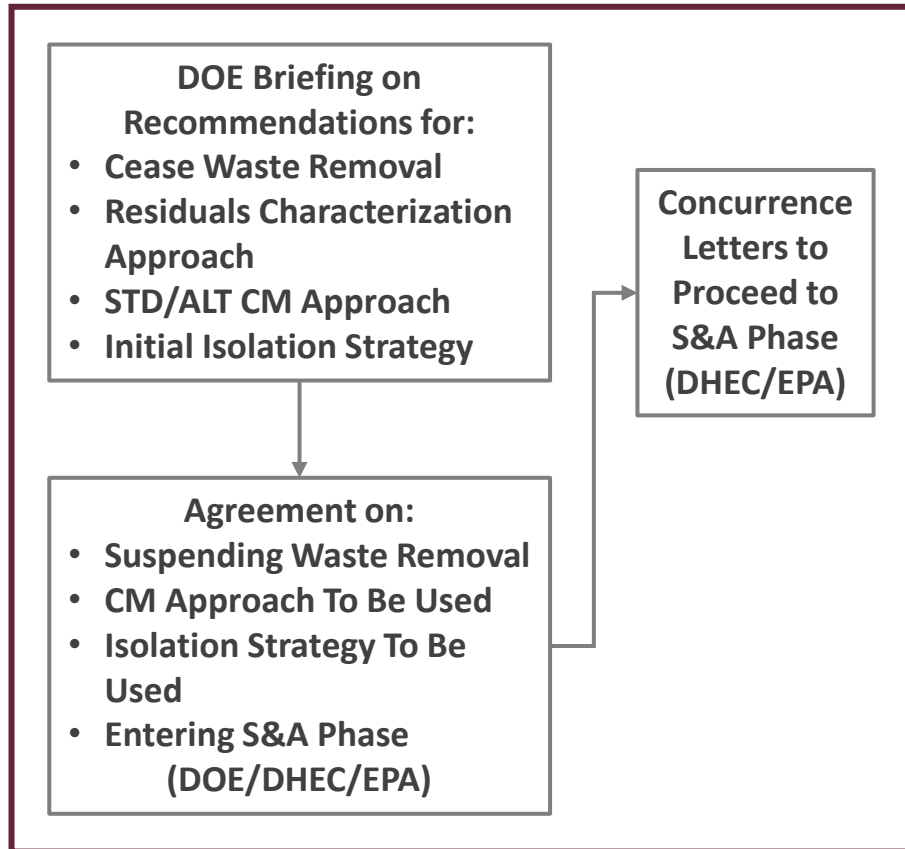
*Based on a preliminary estimate of the volume. Final inventories will be included in the Closure Module.

Pathway to Closure



Closure Module Approval and Waste Tank System Removal from Service Process (CGCP Figure 11.4-1)

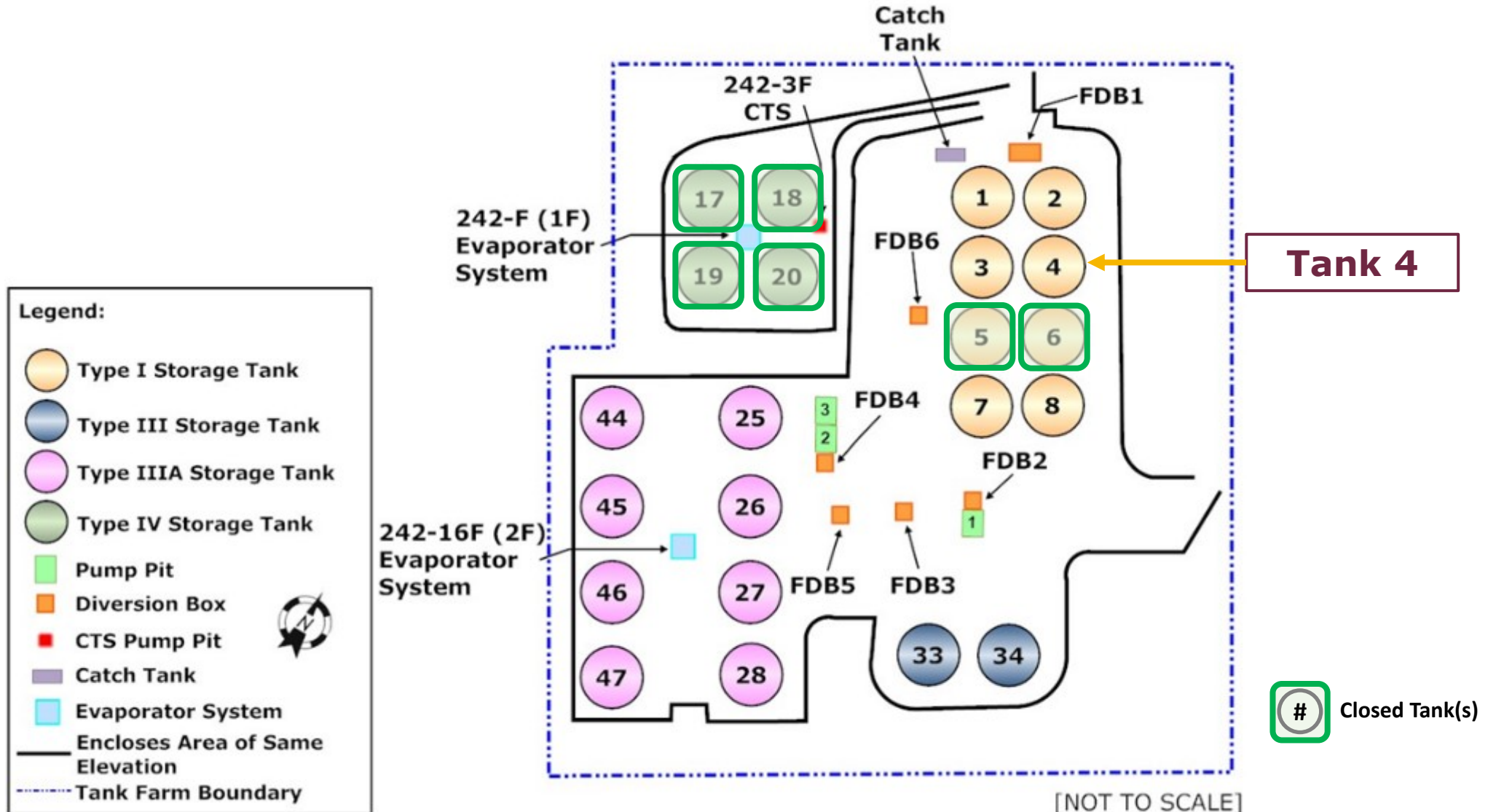
[SRR-CWDA-2017-00015]



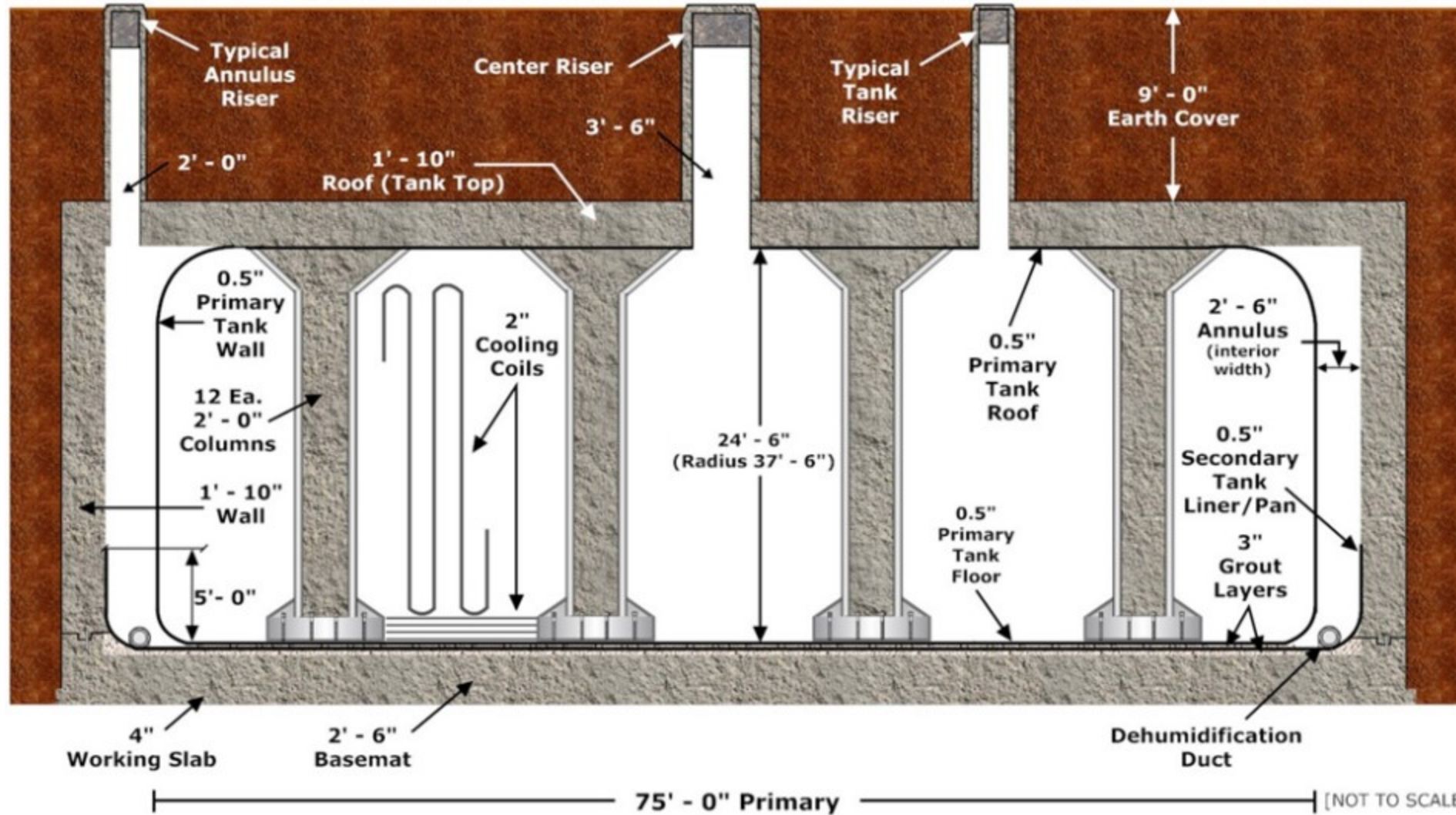
[SRR-CWDA-2017-00015]

- 1. Suspending waste removal activities in Tank 4 and enter the Sampling and Analysis phase.**
 - Sampling and analysis to be performed per the LWTRSAPP
- 2. DOE will draft a Closure Module using the *Standard Closure Module Approach***
- 3. The Closure Module will include appropriate isolation and stabilization provisions using the *Partial Isolation approach***

F-Area Tank Farm (FTF) Layout



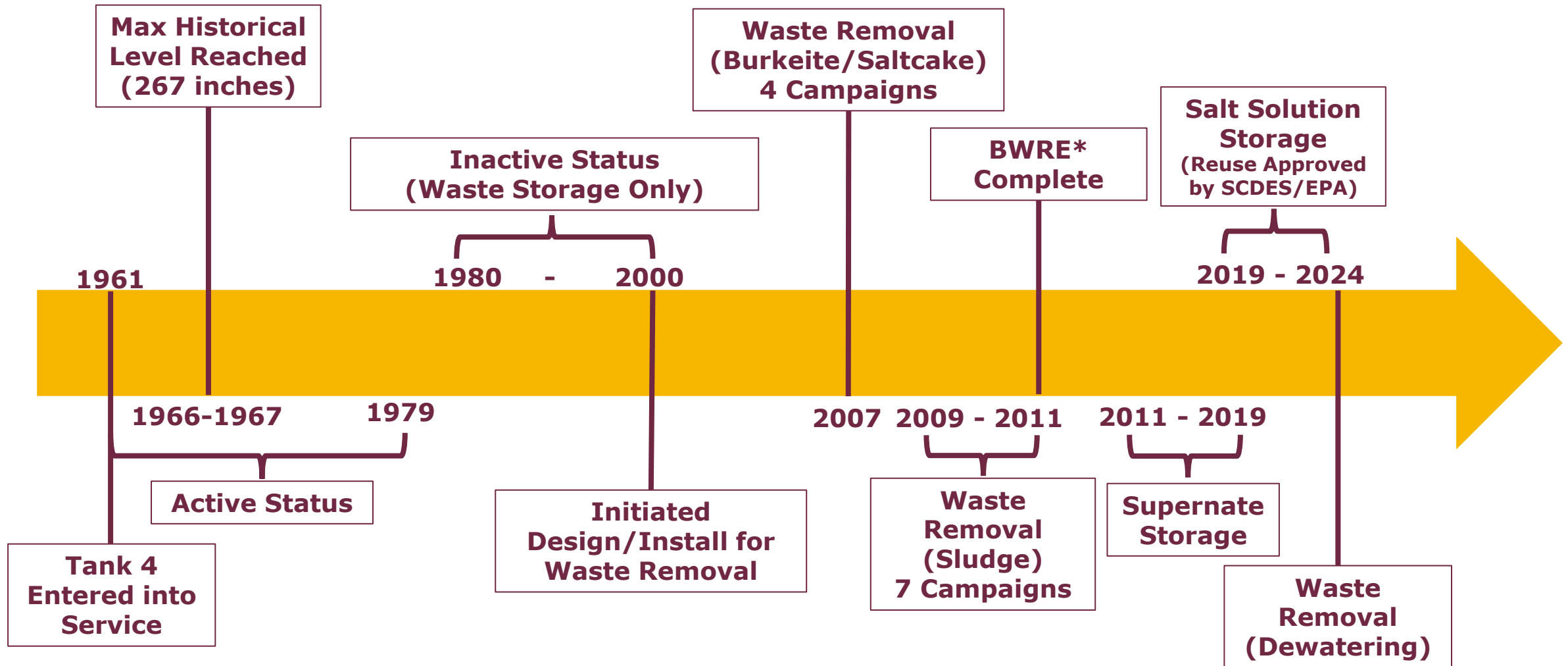
Tank 4 - Type I Tank Design



Nominal working capacity: 750,000 gallons
 For a Type I Tank, 1" of waste equals 2,710 gallons

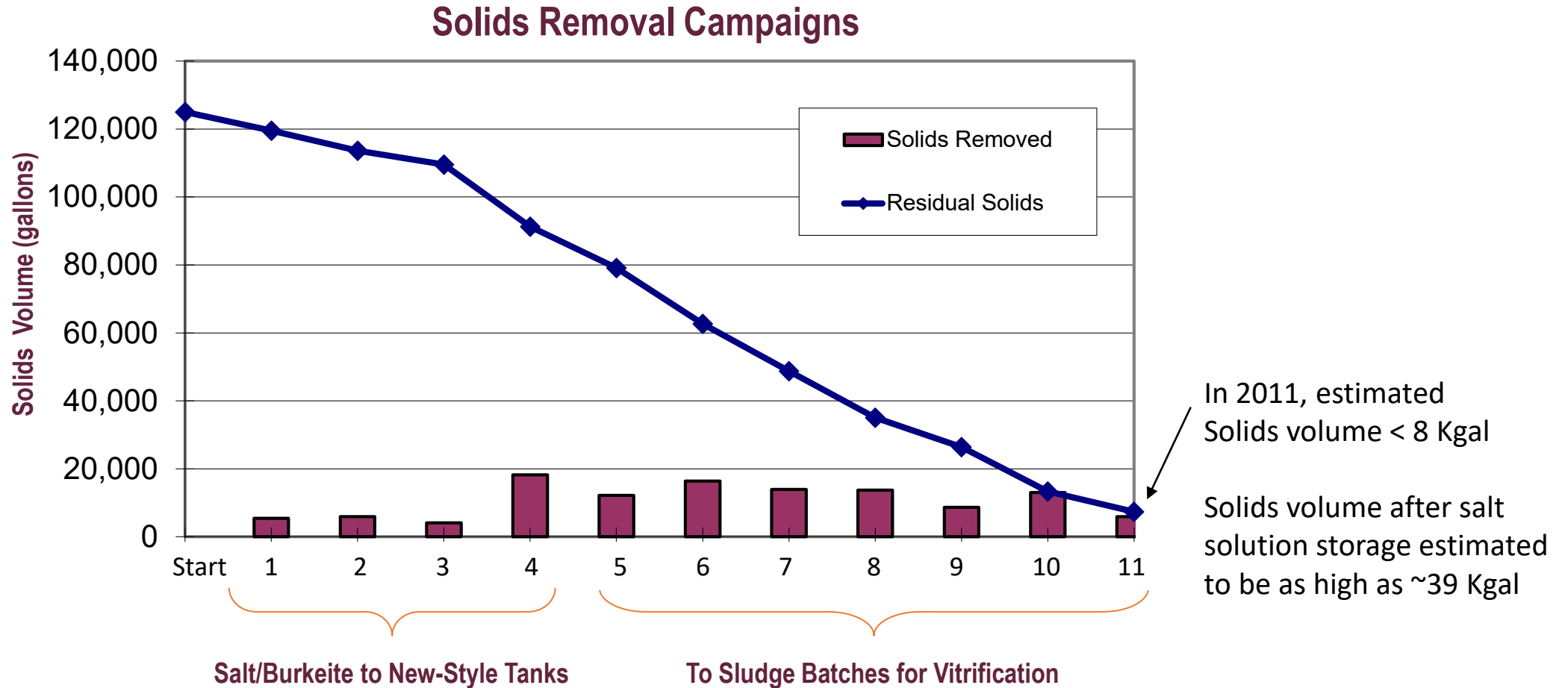
[SRR-CWDA-2017-00015]

Tank 4 Historical Timeline



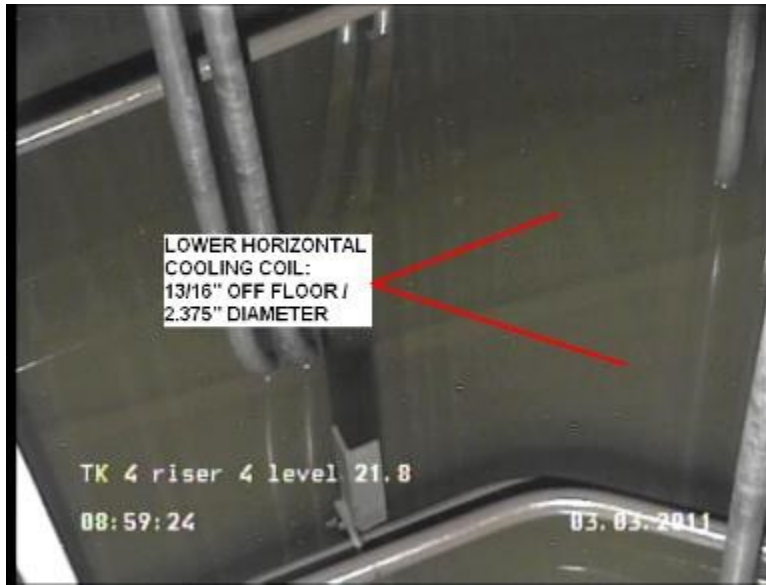
*BWRE – Bulk Waste Removal Efforts

Tank 4 Waste Removal Summary



[DPSPU 80-11-9, SRR-LWE-2011-00100, SRMC-LWP-2024-00020]

Tank 4 Post Solids Removal (March 2011)



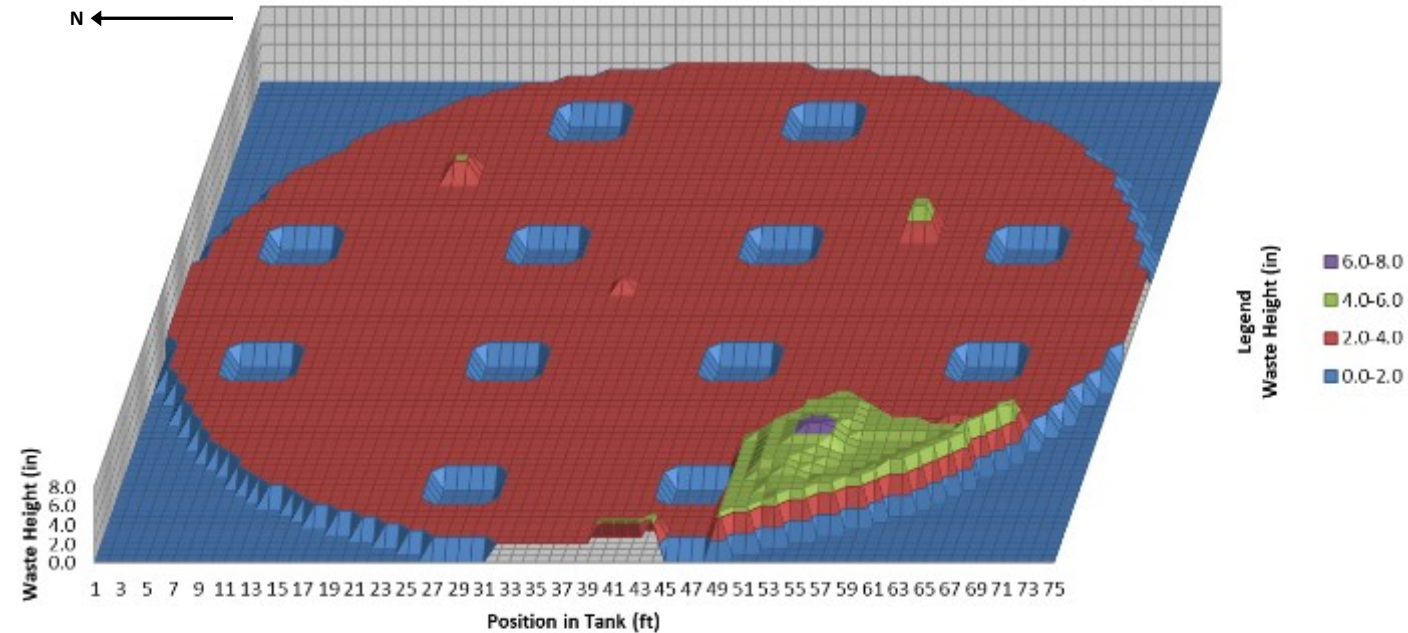
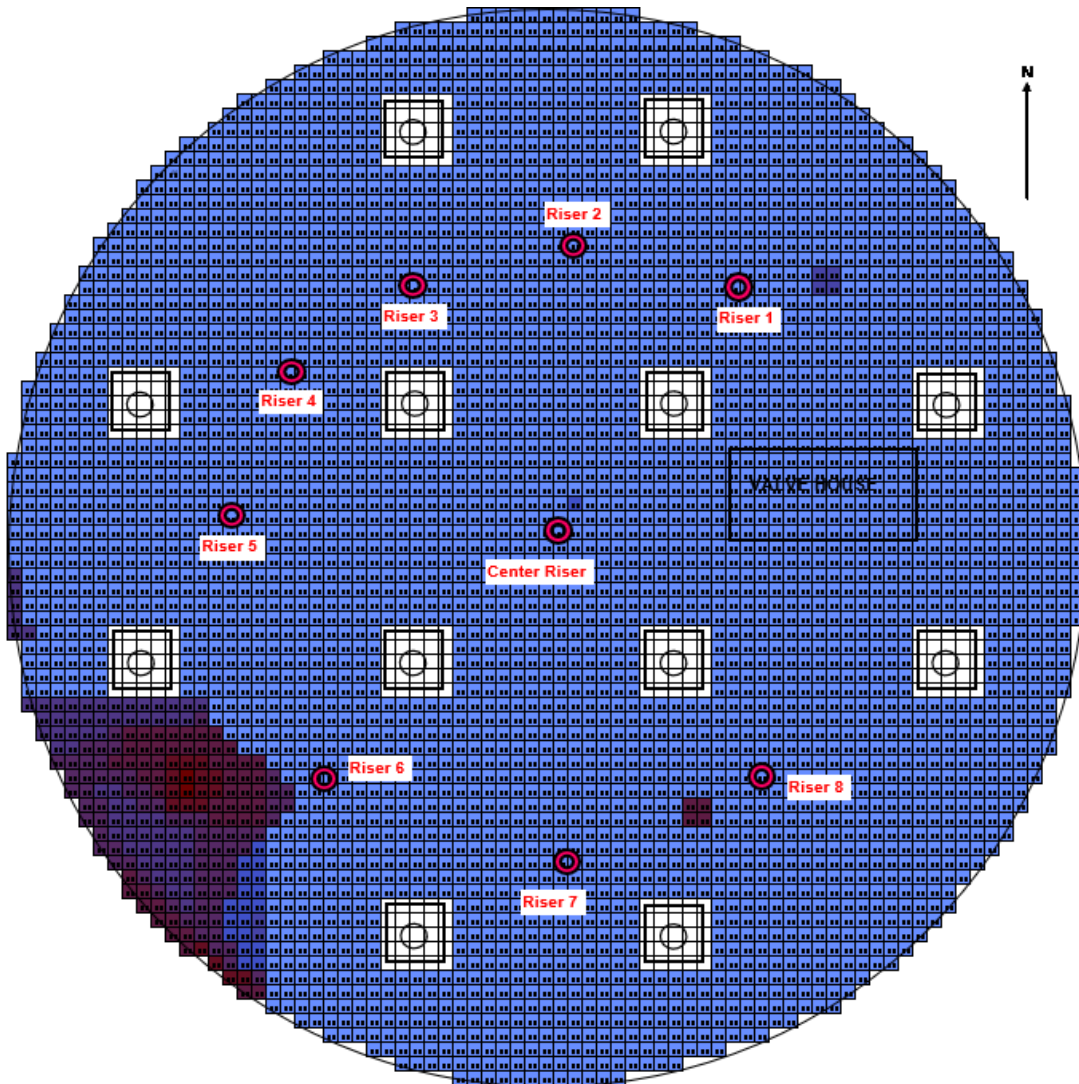
Tank 4 Dewatering

- **Prior to dewatering, Tank 4 contained ~370 Kgal (~136 inches) of supernate**
- **Existing Submersible Transfer Pump (STP) utilized during sludge removal campaigns needed to be replaced**
 - STP could not be lowered to tank bottom due to cooling coil interference
- **New STP designed and installed in the tank**
- **First attempt to dewater not successful due to pump ground fault**
- **STP replaced and supernate removed in August 2024 to a final liquid level of ~7 inches**
 - Liquid level continues to drop due to evaporation

Tank 4 Dewatering Pump Installation



Tank 4 Primary Tank Current Status



Remaining Solids < 6 Kgal

[U-ESR-F-00125]

Tank 4 - Current Status

SW Quadrant



Waste Mound SW Quadrant



Riser 6 STP Lower Horizontal Coils Visible



Waste Mound SE Quadrant



Column Baseplate



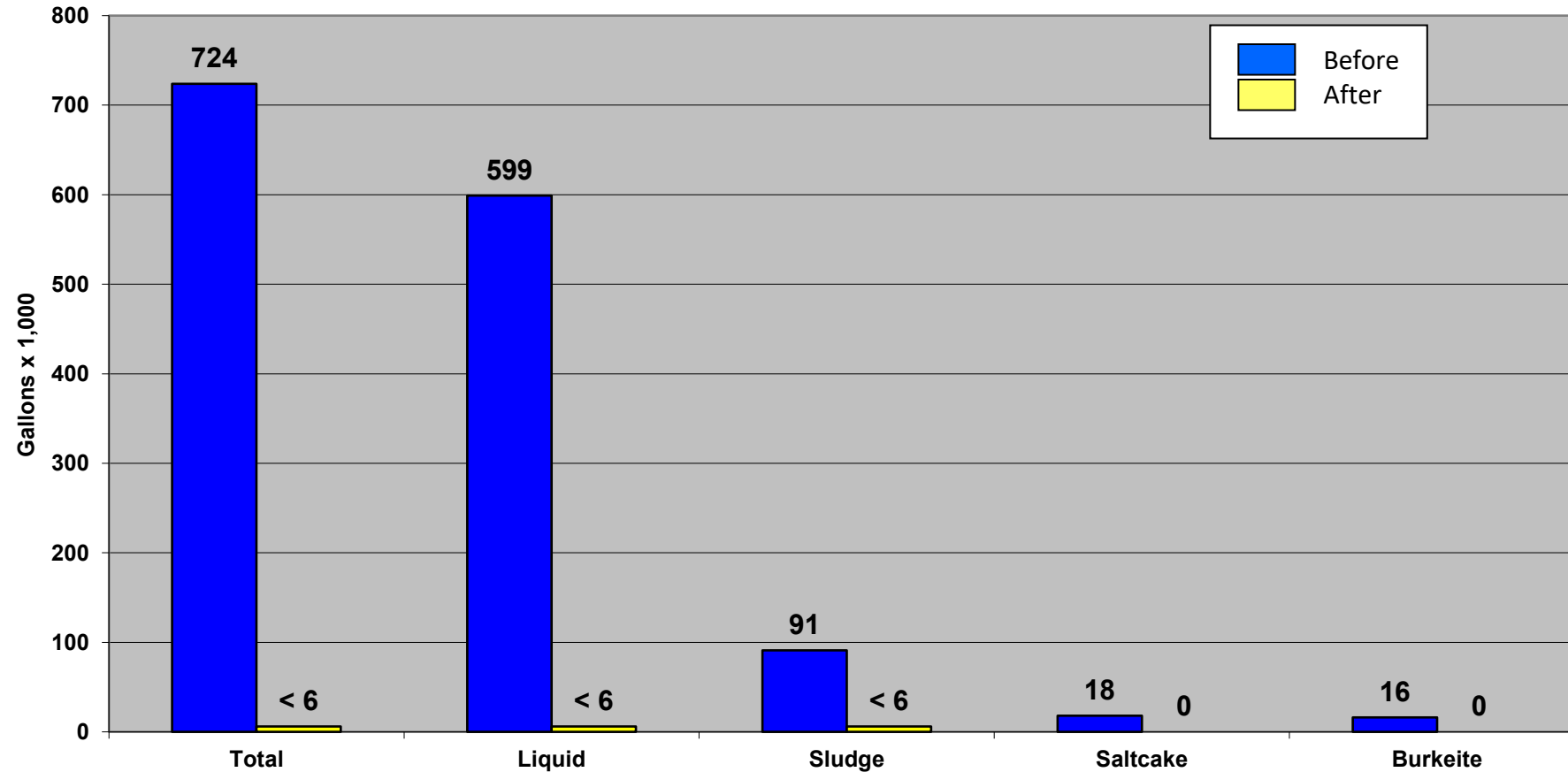
Tank Floor NE Quadrant



Tank 4 Waste Removal Summary



Waste Volumes Before and After Waste Removal



[DPSPU 80-11-9, SRR-LWE-2011-00100, U-ESR-F-00125]

- **Through November 2023**

- A total of four leak-sites documented
 - *First identified in 2011*
 - *Three additional in 2013*
- Four annulus risers available for inspection: North, South, East and West
- 25% inspection capability
- All leak-sites identified are located at 234" from the tank bottom
- No history of waste on annulus floor

North Leak-site



[SRMC-STI-2024-00076]

Tank 4 Annulus

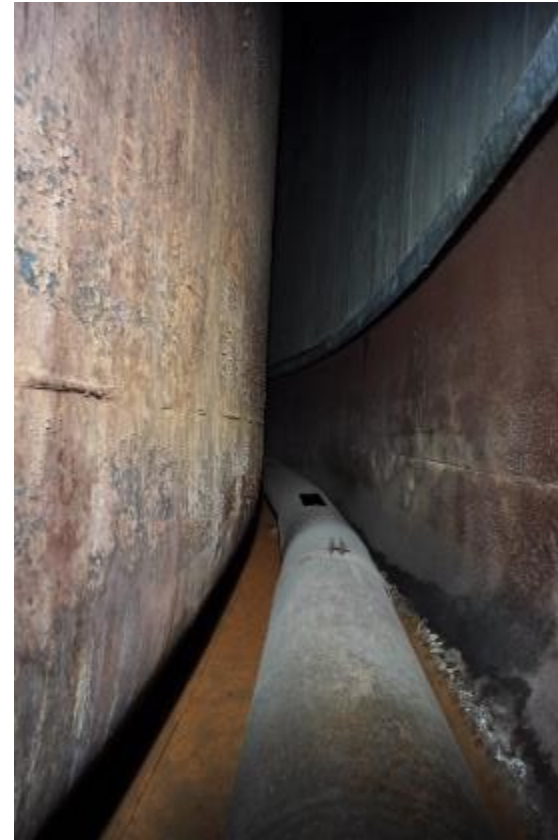
East Riser Facing South



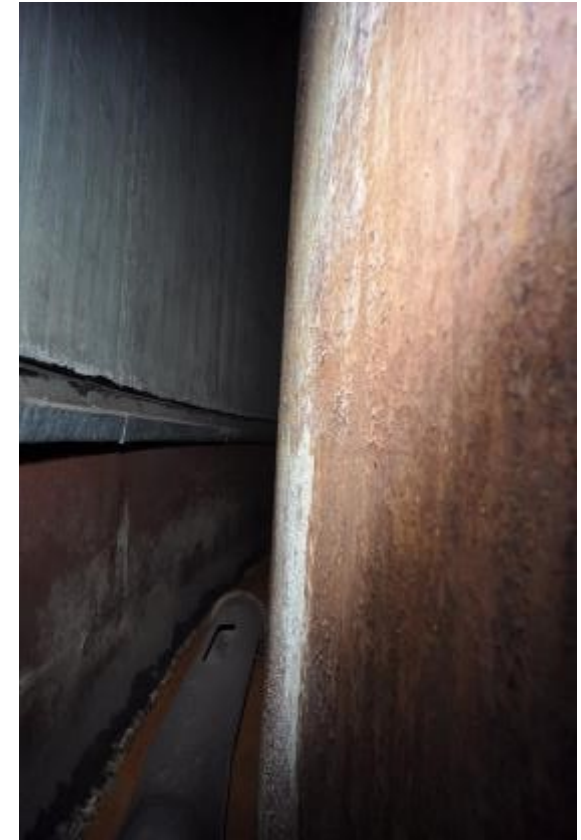
East Riser Facing North



West Riser Facing South



West Riser Facing North



[SRMC-STI-2024-00076]

Tank 4 Annulus

South Riser Facing East



South Riser Facing West



North Riser Facing East



North Riser Facing West



[SRMC-STI-2024-00076]

Overall Cleaning Results



Maximum Waste Volume (gal)	724,000
Maximum Solids Volume (gal)	125,000
Maximum Salt Volume (gal)	54,200
Total Salt Remaining (gal)	0
Total Solids Remaining (gal)	< 6,000 ¹
Total Waste Remaining (gal)	< 6,000 ²

¹ Based on a preliminary estimate of the solids remaining in the primary. Final volume determination will be included in the Closure Module.

² Based on a preliminary estimate of the primary plus annulus. Final volume determination will be included in the Closure Module.

Total Percent Waste Removed >99%

[DPSPU-80-11-9, SRR-LWE-2011-00100, U-ESR-F-00125]

- **Mechanical Cleaning**

- Further waste removal campaigns will require installation of new mixing devices and supporting equipment
 - *Estimated cost ~\$7M*
- Additional waste removal would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities
 - *Funding and resources could be used to accelerate waste removal on other FTF tanks*
- Each waste removal campaign requires approximately 200k gallons of water be added to allow for mixing pump operation, creating additional new waste
 - *Additional new waste must be handled within the Liquid Waste System which is already challenged by available tank space to support Salt Batch compilation/qualification and Sludge Batch compilation/qualification necessary to feed Salt Waste Processing Facility (SWPF) and the Defense Waste Processing Facility (DWPF), respectively*
 - *Additional new waste must be processed through SWPF then subsequently DWPF or the Saltstone Production Facility (SPF), resulting in additional costs and impacts (i.e., extension) to the Liquid Waste System life-cycle*
- Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses

Additional Removal Options



- **Chemical Cleaning**

- Chemical cleaning will require installation of new mixing devices and supporting equipment
 - *Estimated cost ~\$7M*
- Additional waste removal would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities
 - *Funding and resources could be used to accelerate waste removal on other FTF tanks*
- Any chemical cleaning campaign would require approximately 200k gallons of water/chemicals be added to allow for mixing pump operation, creating additional new waste
 - *Additional new waste must be handled within the Liquid Waste System which is already challenged by available tank space to support Salt Batch compilation/qualification and Sludge Batch compilation/qualification necessary to feed SWPF and DWPF, respectively*
 - *Additional new waste must be processed through SWPF then subsequently DWPF or SPF, resulting in additional costs and impacts (i.e., extension) to the Liquid Waste System life-cycle*
- Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses
 - *Low-Temperature Aluminum Dissolution anticipated to have minimal impact due to low Aluminum content expected in Tank 4 solids*
 - *Bulk Oxalic Acid Cleaning would have additional adverse impact of introduction of additional oxalates into the system*

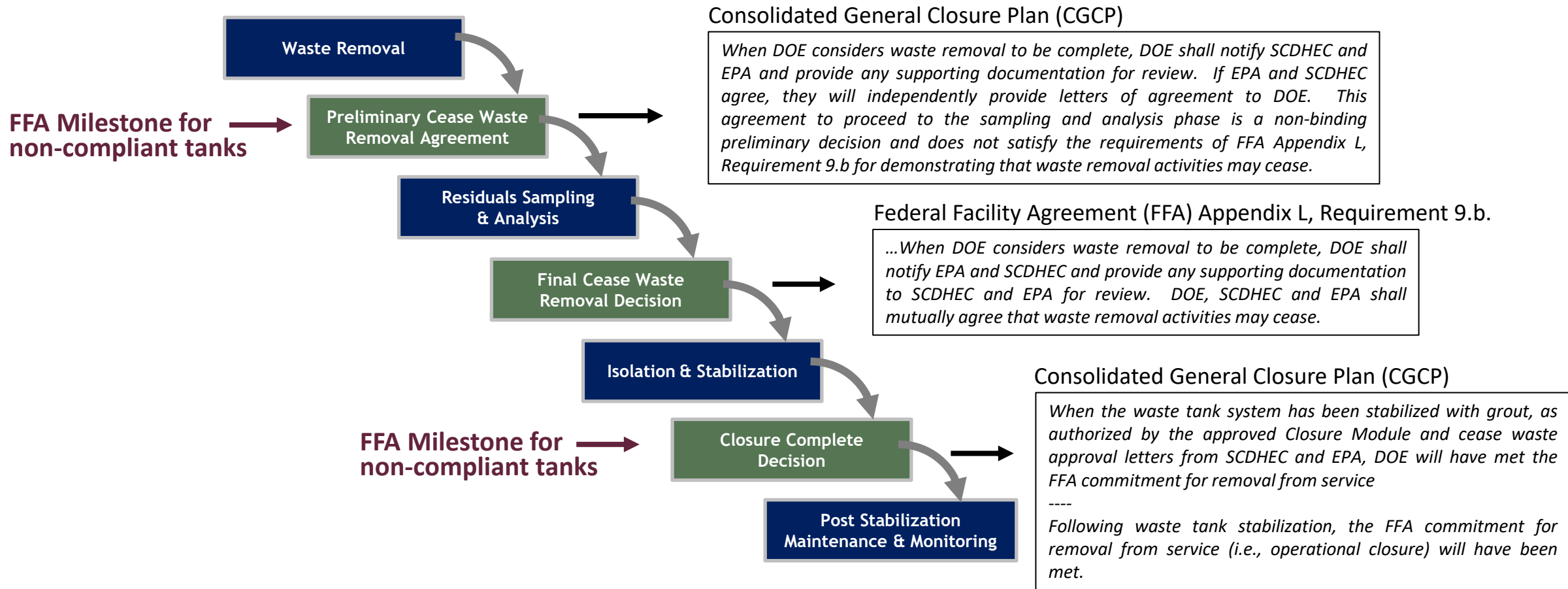
• Vacuum Technology

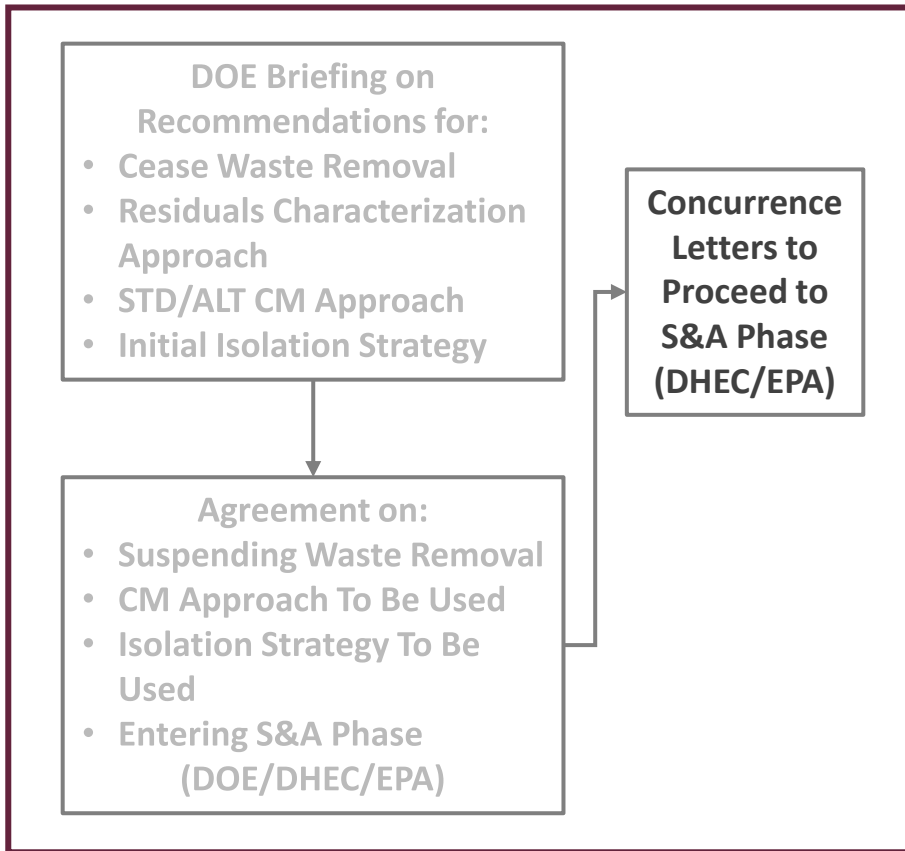
- Proven Mantis technology that was utilized in Tanks 18 and 19 cannot be deployed due to in-tank obstructions
- Alternate technology utilizing a smaller robotic platform with vacuum capability would require considerable development
 - *Very limited applicability at the time due to mobility around and over in-tank obstacles and associated tether management*
 - *Any water added to support removal, if required, would result in new waste and have same impact as previously described for additional mixing campaigns and chemical cleaning*
 - *Development/deployment of a new vacuum technology would divert resources (i.e., funding and personnel) from other Liquid Waste System risk reduction activities*
- Level of additional waste removal uncertain, but even removing the majority of the remaining material, if possible, would have a minimal impact on final performance objective concentrations and doses

- **Annulus Waste Removal**

- Based on results from annulus inspections, Tank 4 does not have any accumulated waste on the annulus floor. Water addition/removal campaigns would have no impact on overall doses associated with Tank 4 while adding additional new waste into the Liquid Waste System.

Tank Closure Process





[SRR-CWDA-2017-00015]

The three agencies agree that, based upon the described qualitative assessment, there is reasonable assurance that it is appropriate to suspend waste removal activities and enter the Sampling and Analysis phase of the operational closure process for Tank 4.

- **DOE will forward a letter to SCDES and EPA formally requesting concurrence to proceed to the Sampling and Analysis phase in Tank 4**
 - This presentation will be attached as a primary reference
 - The requested action is a non-binding preliminary decision based on the qualitative information available at this time and presented today
- **DOE and the Liquid Waste Contractor will proceed in developing the regulatory documentation necessary to operationally close Tank 4**
 - DOE will coordinate with SCDES and EPA to establish a schedule for the development, review and approval of the Closure Module consistent with the approach described in the CGCP

Values

1. **Maintain transparency with open communication between regulators, DOE, and the contractor on program progress, and significant emerging issues.**
2. **Ensure DOE's strategy and plans are subject to stakeholder engagement and input, including SCDES permitting processes, and CERCLA, as appropriate.**
3. **Maximize the amount of curies (especially long-lived radionuclides) vitrified and ready for ultimate disposal out of state.**
4. **Limit disposal of curies onsite at SRS so that residual radioactivity is as low as reasonably achievable.**

Goals

1. **Reduce risk to the environment by removing waste and closing tanks with a goal of completion of the liquid waste program by 2037.**
2. **Reduce operational and environmental risk by aggressively removing curies from the waste tanks.**
3. **Reduce operational and environmental risk by optimizing operations to minimize liquid waste program total life cycle.**
4. **Complete waste removal and subsequent grouting of all waste tanks and ancillary structures with a risk-based priority order: first to tanks in the water table, **followed by F-Area Tank Farm tanks**, followed by remainder of waste tanks, followed by ancillary structures, recognizing the potential for future emergent conditions or opportunities.**

*From Federal Facility Agreement (FFA) 2022 High Level Waste Tank Milestones Agreement [WSRC-OS-94-42]

Summary for Closed/PCWR Complete Tanks



Waste Tank	PCWR Date	Operational Closure Date	Max. Dose within 10,000 years ¹ (mrem/year)	Primary Tank Residual Solids Volume ² (%)	Primary Tank Residual Solids Volume (Gallons)	Annulus Residual Volume (Gallons)	Annulus Cleaning
5	11/2010	12/2013	3	0.26	1,900	<15	No – negligible
6	11/2010	12/2013	3	0.41	3,000	<50	Yes ~ 100 gal.
9 ³	10/2024	-	<3	<1	<7,500	Negligible	Yes
10 ³	5/2024	-	<2	<0.40	<3,000	<400	Yes
12	1/2014	4/2016	6	0.20	1,500	30	No – negligible
16	4/2013	9/2015	2	0.21	356	1,910	No – not practical
17	N/A	12/1997	3	0.18	2,400	N/A	N/A
18	10/2009	9/2012	3	0.30	3,900	N/A	N/A
19	10/2009	9/2012	3	0.15	2,000	N/A	N/A
20	N/A	7/1997	3	0.08	1,000	N/A	N/A

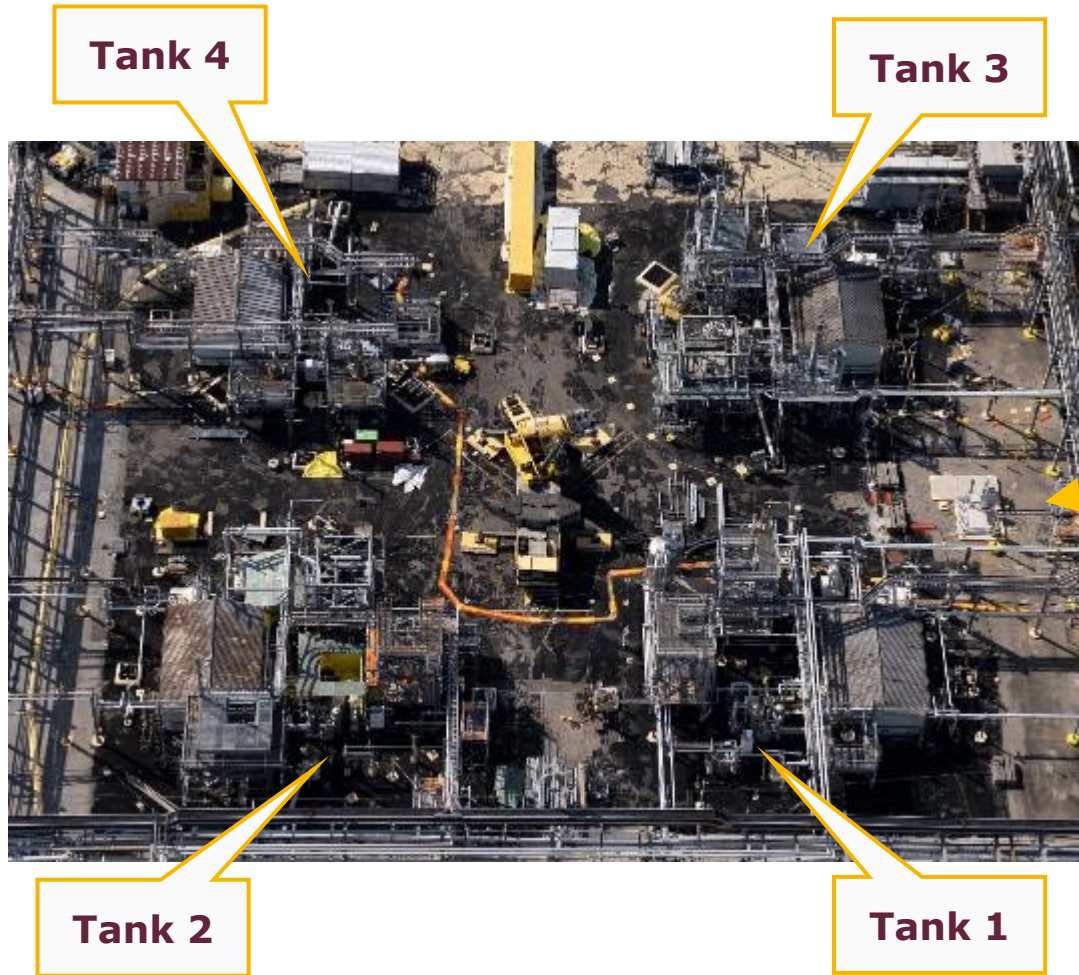
¹ Dose for FTF tanks represents maximum all sources dose utilizing actual inventories for Tanks 5, 6 and 17-20. Dose for HTF tanks represents maximum contribution from individual tanks. [SRR-CWDA-2012-00106, SRR-CWDA-2015-00073, SRR-CWDA-2014-00106]

² Based on historic maximum waste volume for each tank. [DOE/SRS-WD-2012-001, DOE/SRS-WD-2014-001]

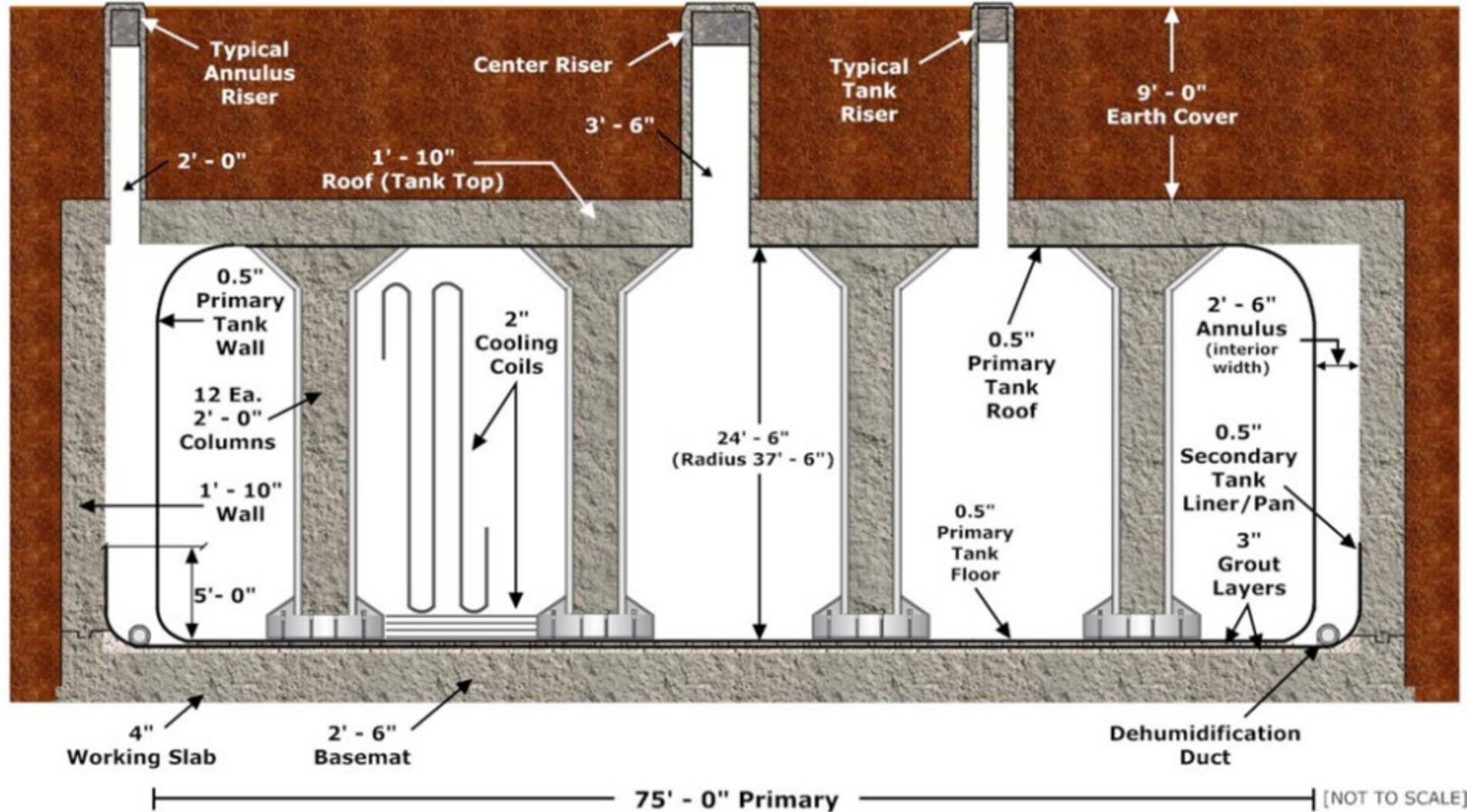
³ Values based on preliminary information, sampling and analysis has not been performed

Background Information

Tank 4 Within FTF



Typical Type I Tank Design



[SRR-CWDA-2017-00015]

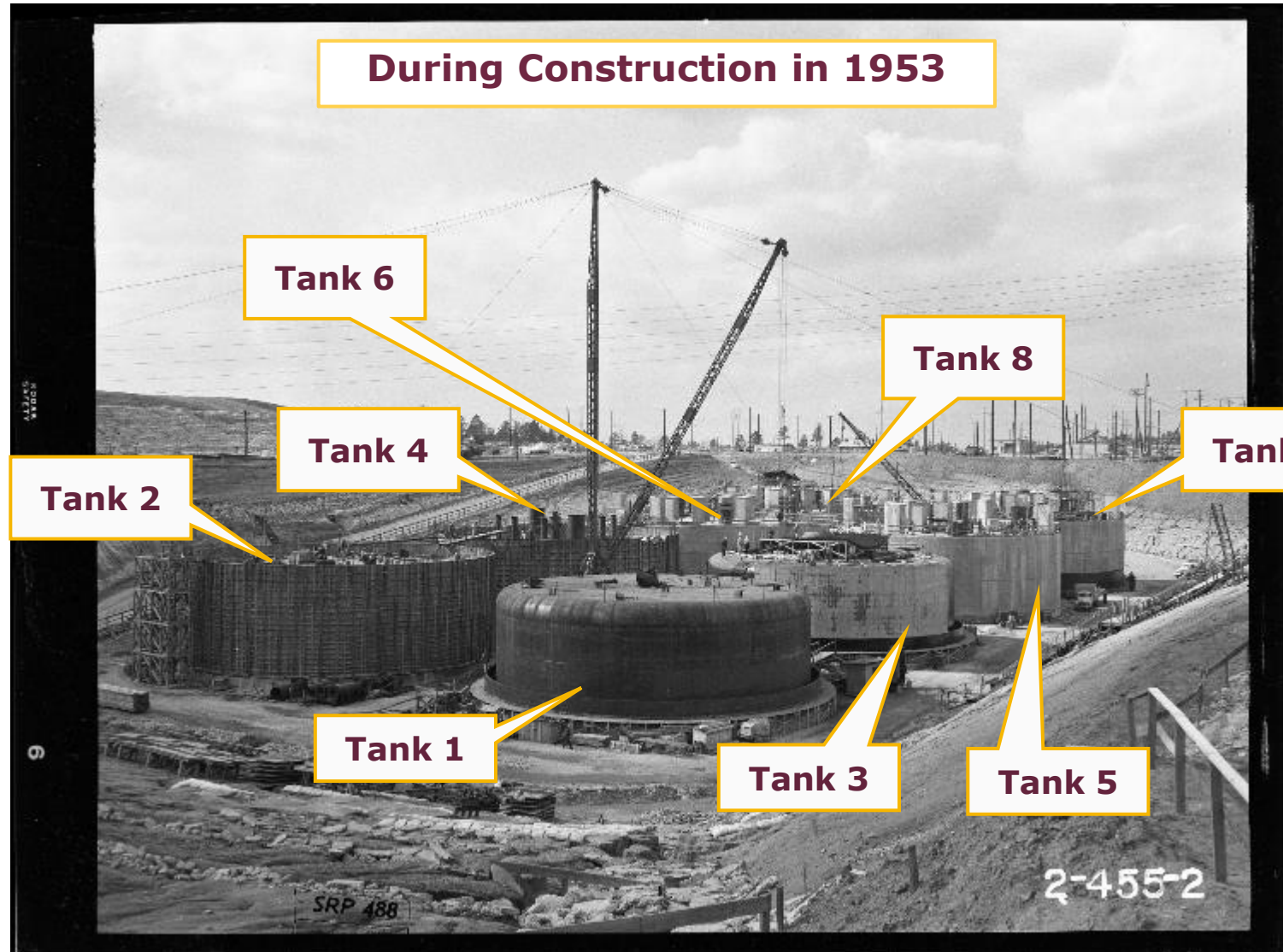
Typical Type I Tank



- **Carbon steel primary tank and secondary liner (annular pan) all contained in a concrete vault**
- **Nominal working capacity: 750,000 gallons**
- **For a Type I Tank, 1" of waste equals 2,710 gallons**
- **Primary tank diameter: 75 feet**
- **Primary tank height: 24.5 feet**
- **Annular pan diameter: 80 feet**
 - 2.5-foot annular space surrounding primary
- **Annular pan height: 5 feet**
- **12 interior support columns**
 - 2-foot diameter
- **34 vertical cooling coil runs suspended from the ceiling**
- **2 horizontal cooling coil runs supported above the floor**

[SRR-CWDA-2017-00015]

FTF Type I Tanks



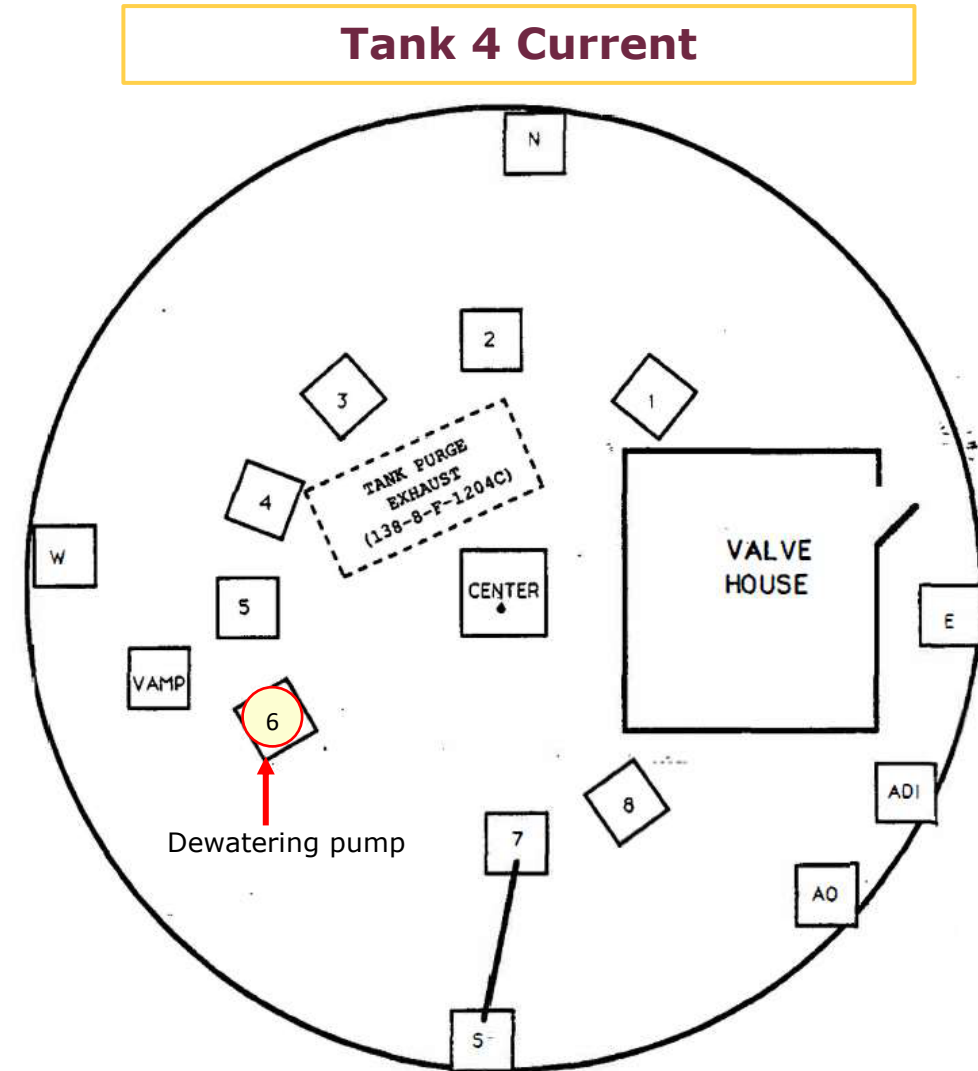
Typical Type I Tank Challenges



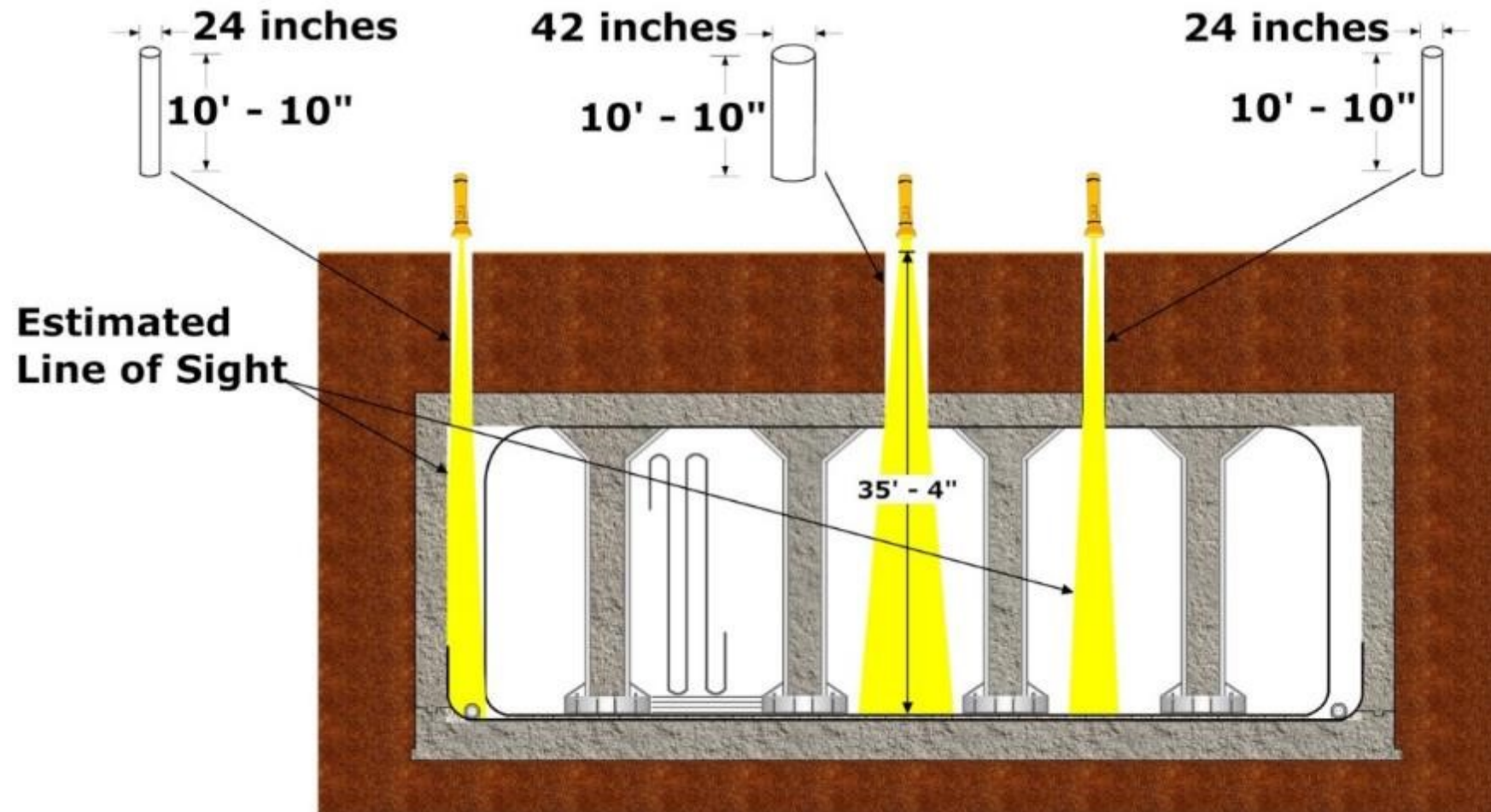
- **Type I tanks are some of the most challenging waste tanks for waste removal**
- **Challenges include:**
 - Limited access ports (risers)
 - Presence of roof support columns
 - Approximately 22,800 linear feet (over four miles) of 2-inch diameter vertical and horizontal cooling coils
 - “Field-to-fit” horizontal cooling coil “fences”
- **Tanks were not designed with waste removal in mind**

Type I Tank Riser Limitations

- **Primary access**
 - Eight 24-inch risers
 - One 42-inch central riser
- **Annulus access**
 - Four 24-inch risers
- **Limited riser entrances hinder:**
 - Pump placement
 - Cleaning operations
 - Camera viewing
 - Sampling options



Type I Tank Riser Limitations



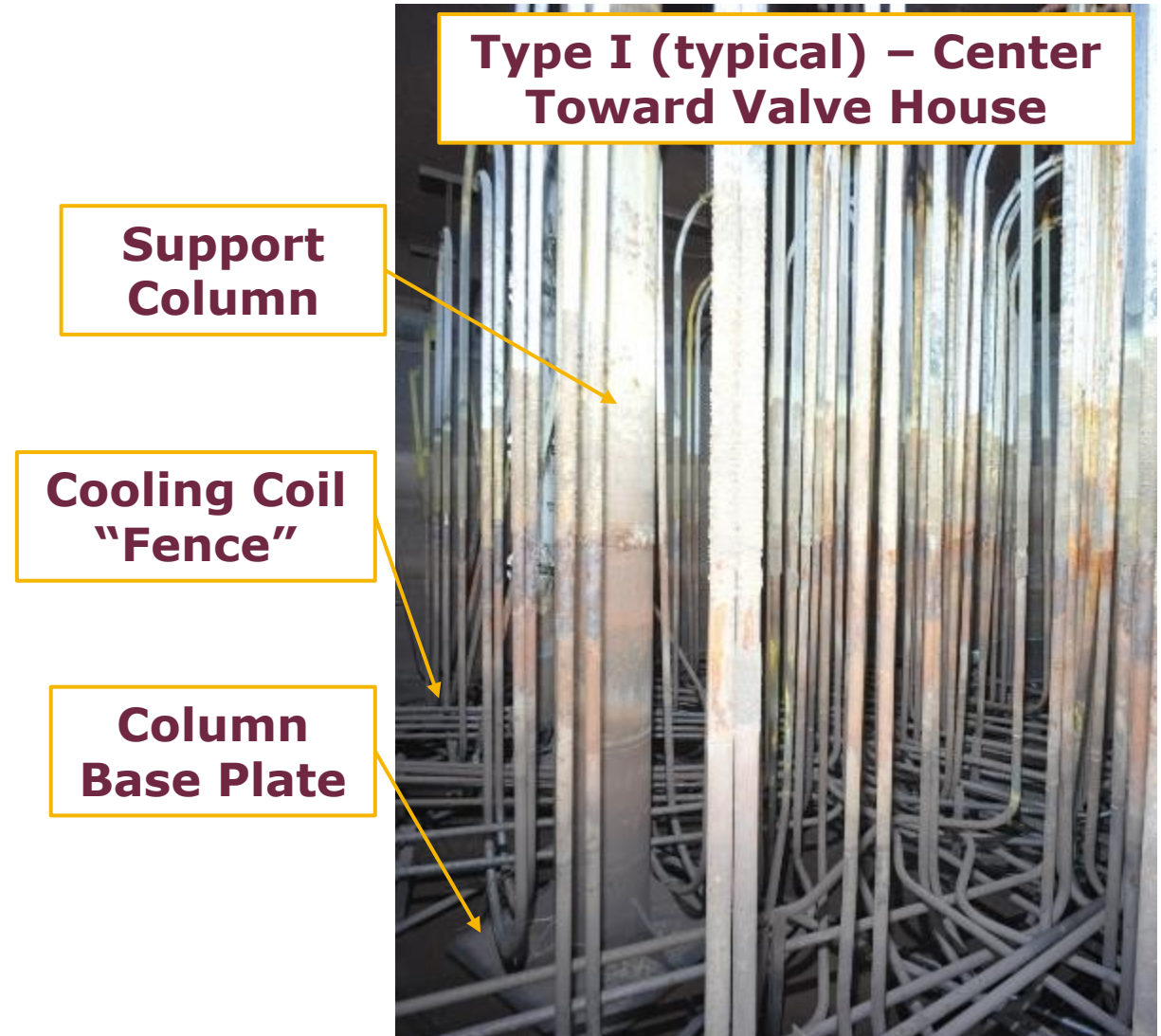
NOTE: Risers may be impeded by installed equipment.

[NOT TO SCALE]

[SRR-CWDA-2017-00015]

Type I Tank Columns and Cooling Coils

- **A total of 12 support columns in each Type I tank**
 - Carbon steel filled with concrete
 - 2-foot diameter
 - 4.5-foot x 4.5-foot x 4.5-inch base plate
- **Type I tanks contain approximately 22,800 linear feet of 2-inch diameter cooling coils**
- **Horizontal coils were installed “field-to-fit”**
- **Columns and cooling coils together impact installation and/or operation of waste removal related equipment**
 - Effective cleaning radius of pumps
 - Full installation of pumps
 - Sampling device deployment



Type I Tank Cooling Coil Valve House

Valve House Interior

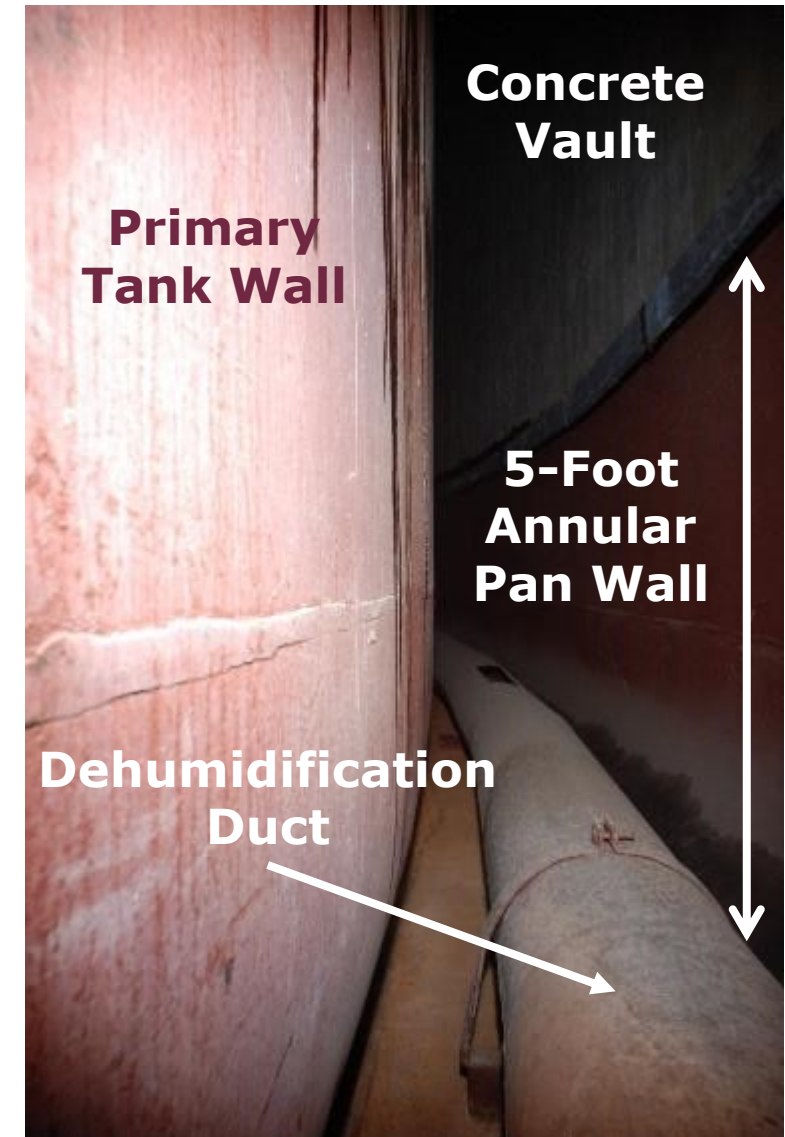
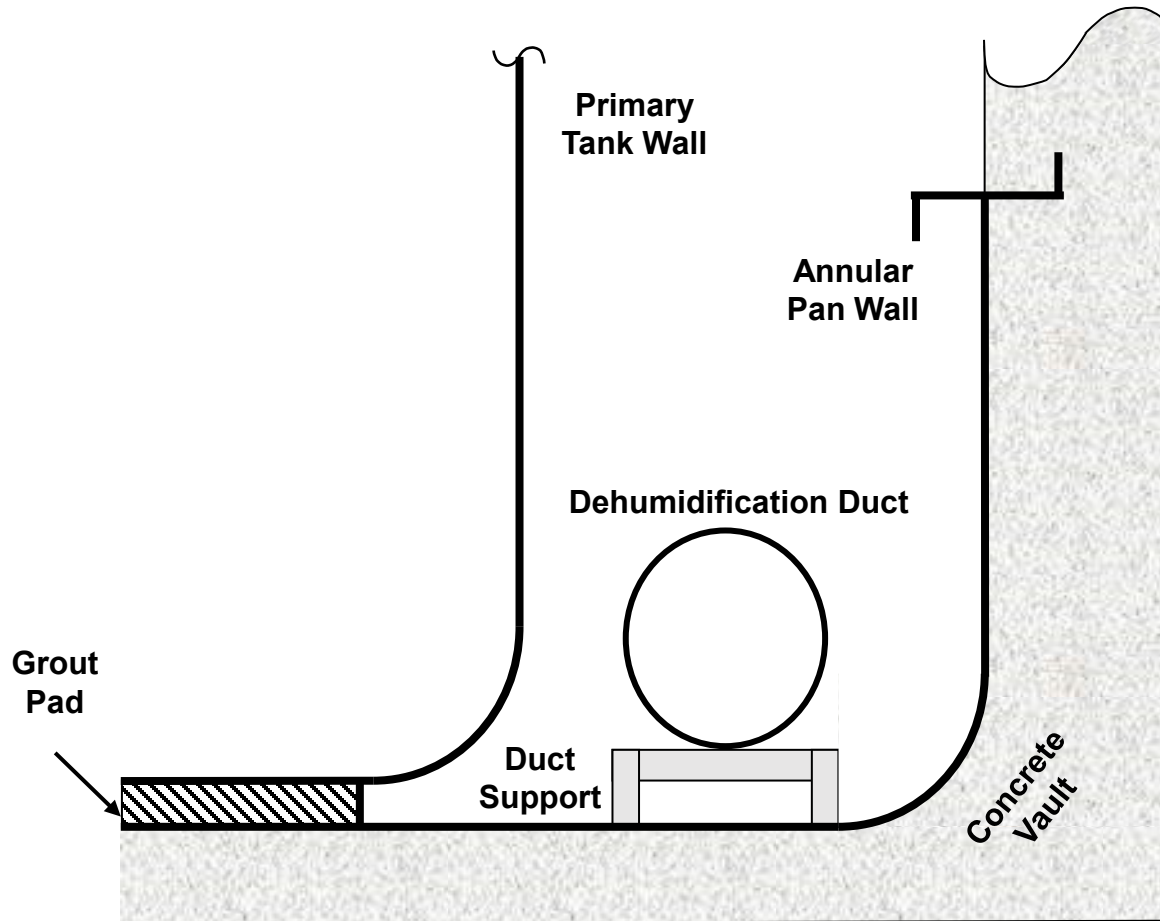
View From Inside Tank (Under the Valve House)



**Cooling coil lines entering
and exiting waste tank**

Type I Tank Annular Region

5-foot high, 80-foot diameter annular pan provides secondary containment

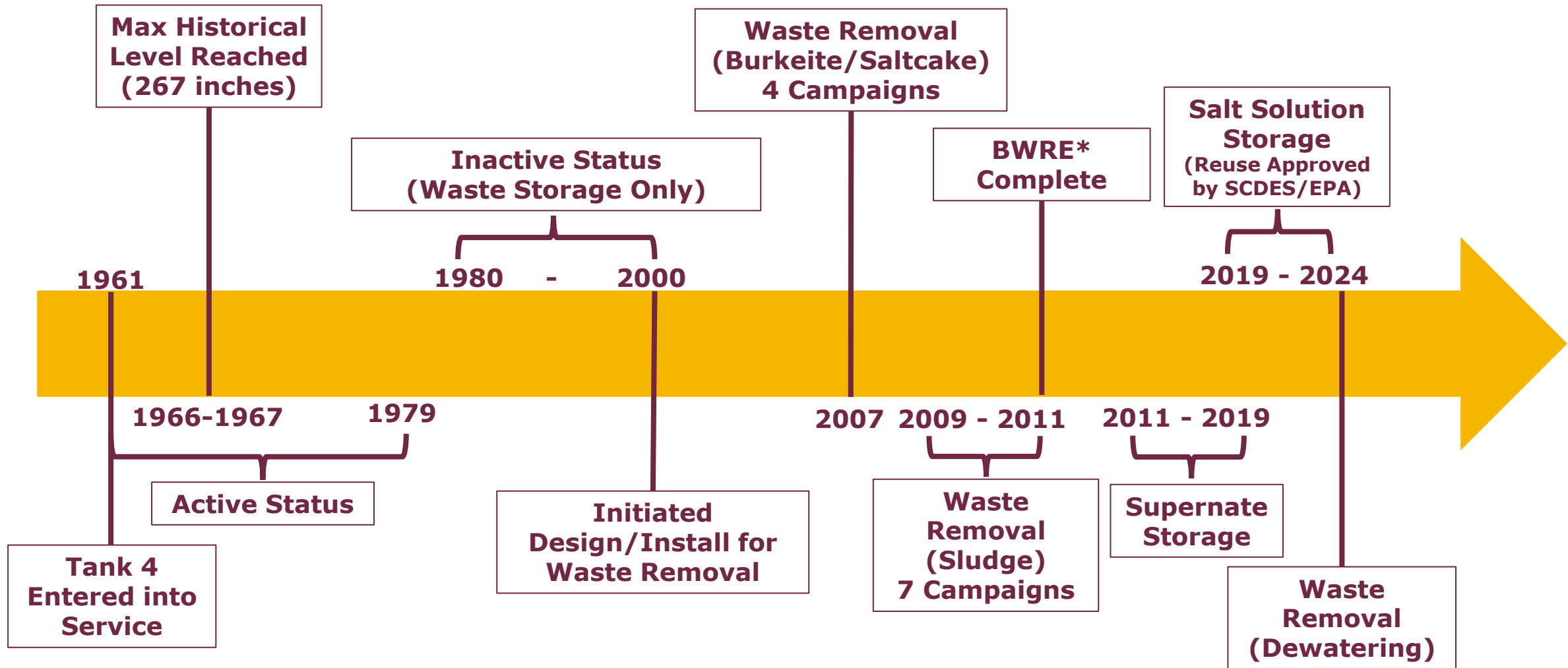


Tank 4 Operational History



- **Placed into service in April 1961**
- **Received F-Canyon waste from 1961 through 1982**
- **Maximum historical waste level (January 1967)**
 - 267" or 724,000 gallons
- **Inactive status from 1980 through 2000**
- **Initiated BWRE modifications in 2000**
- **Burkeite removal and saltcake dissolution performed in 2007**
- **Sludge removal performed in 2009-2011**
- **Four leak-sites identified at 234" above the tank bottom, but no leakage observed [C-ESR-G-00003, SRMC-STI-2024-00076]**

Tank 4 Historical Timeline



*BWRE – Bulk Waste Removal Efforts

- **Burkeite removal and saltcake dissolution performed in 2007 (Campaigns 1 – 4)**
 - A hard layer of material was encountered in late 2004 at ~44 - 46" from the tank bottom during jet removal activities for the installation of Submersible Mixer Pumps (SMPs) and Submersible Transfer Pump (STP) in support of waste removal to provide feed material for the DWPF [CBU-LTS-2005-00118]
 - Salt core samples of the hard crust layer were obtained and characterized
 - *Major component identified as Burkeite ($\text{Na}_6(\text{CO}_3)(\text{SO}_4)_2$). [WSRC-TR-2005-00441]*
 - *Thermodynamic modeling and Burkeite solubility test indicated Inhibited Water (IW) would dissolve all the Burkeite.*
 - The Burkeite and saltcake layer were dissolved in four campaigns utilizing ~207k gallons of IW [CBU-PIT-2005-00232, LWO-LWE-2007-00063, LWO-LWE-2007-00190]

Tank 4 Waste Removal (Burkeite & Saltcake)



Burkeite & Saltcake Removal Summary

Campaign	Date	Water Added (Kgal)	Waste Level* Start (inches)	Waste Level* End (inches)	Riser 1 SMP Elevation (inches) & Run Time [hours]	Riser 3 SMP Elevation (inches) & Run Time [hours]	Riser 8 SMP Elevation (inches) & Run Time [hours]	STP Elevation (inches)
1	5/2007	55	~46	44.75 [#]	N/A	N/A	N/A	42
2	6/2007	48	44.75	41.25 [#]	N/A	N/A	N/A	42
3	7/2007	50	41.25	42 [#]	N/A	N/A	N/A	42
4	8/2007	54	42	33.50 ^{\$}	N/A	N/A	N/A	42
Total	9/2007	207	~46	33.50 ^{\$}	N/A	N/A	N/A	42

*Waste level refers to burkeite/salt.

[#]Determined by sounding.

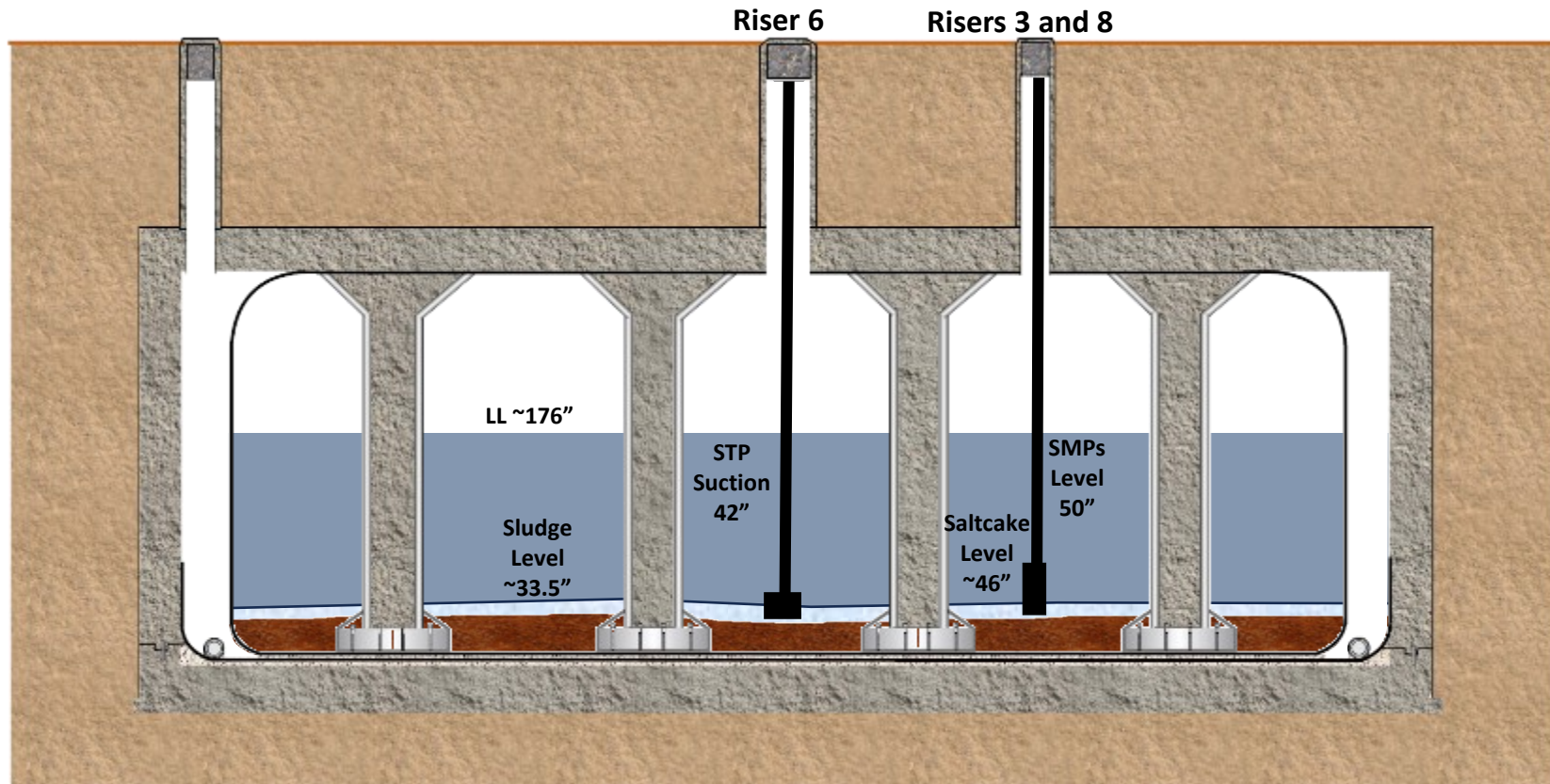
^{\$}Determined by probing. No burkeite/salt remaining

[LWO-LWE-2007-00063, LWO-LWE-2007-00190]

Tank 4 Waste Removal (Burkeite & Saltcake)



At the start of the Burkeite/Saltcake Dissolution Campaigns (May 2007)



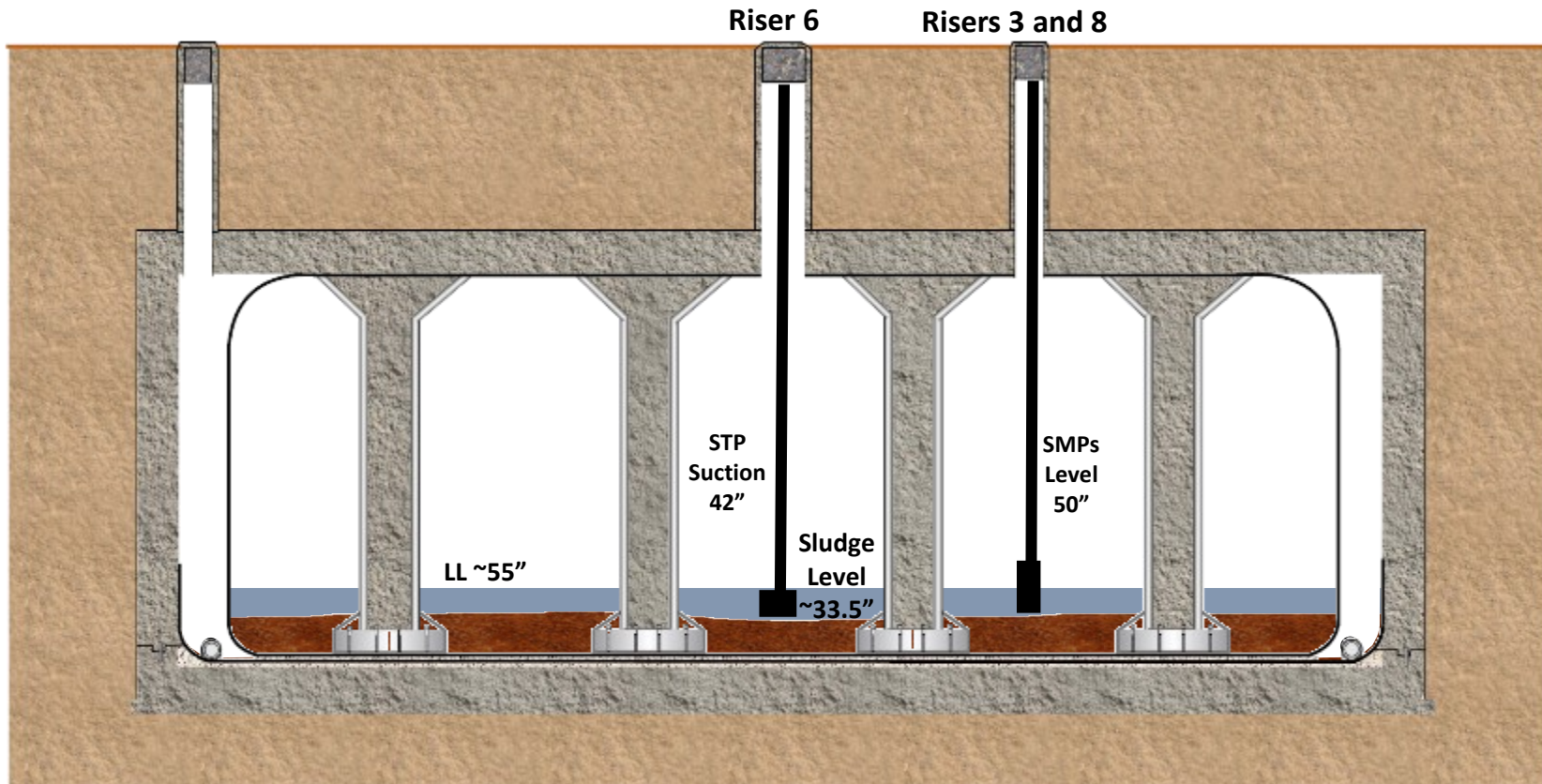
LL - Liquid Level
SMPs not operated

[LWO-LWE-2007-00063, LWO-LWE-2007-00190]

Tank 4 Waste Removal (Burkeite & Saltcake)



At the completion of the Burkeite/Saltcake Dissolution Campaigns (August 2007)



[LWO-LWE-2007-00063]

Tank 4 Waste Removal (Sludge)

- **Sludge removal (Campaigns 5-11) started in 2009 in support of DWPF Sludge Batch 6 & 7. [U-ESR-F-00026, SRR-LWP-2010-00049]**
 - Campaign 5
 - *Two SMPs were initially installed in Risers 3 and 8 and lowered to 40" from the tank bottom*
 - *A STP without a caisson was installed 42" from the tank bottom in Riser 6*
 - *136Kgal of sludge slurry transferred to support Sludge Batch 6*
 - Campaigns 6-11
 - *A third SMP was installed in Riser 1 after sludge removal Campaign 6 transfer in 2010*
 - *STP failed and replacement placed at 19" from the tank bottom for Campaigns 10 & 11*
 - *Combined 1,217 Kgal sludge slurry transferred to support Sludge Batch 7*
 - Sludge volume reduced by 88%
 - *Estimated remaining sludge volume of ~8,000 gallons (3") of sludge at the end of Campaign 11*

Submersible Mixing Pump

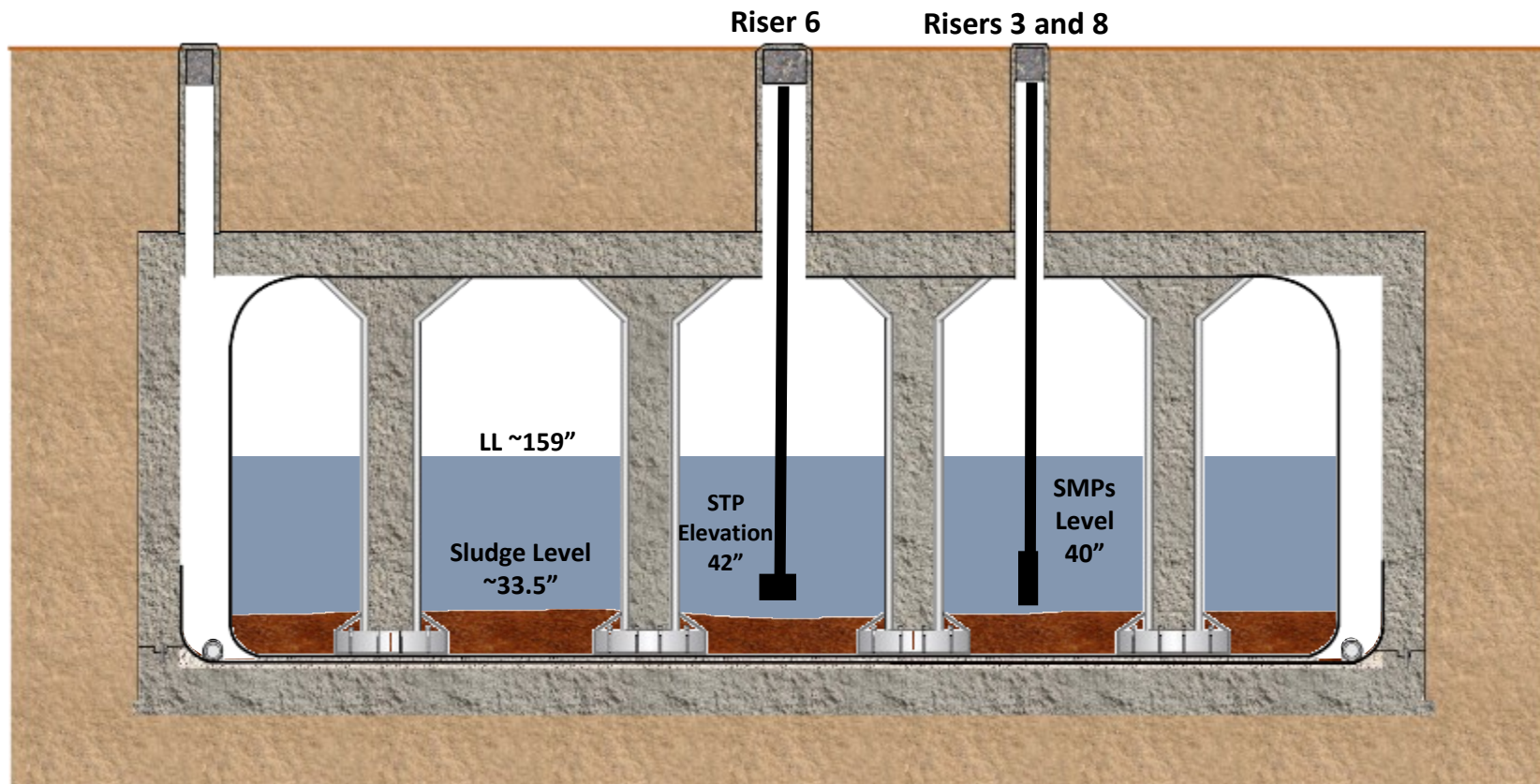


• Campaign 5

- Starting sludge level ~33.5"
 - *SMPs operated for 100 hours at an elevation of 40" from the tank bottom*
 - *SMPs were lowered to 30" from the tank bottom and operated for 100 hours*
 - *Riser 8 SMP and Riser 3 SMP lowered to 20" and 22" from the tank bottom, respectively and operated for 140 hours*
 - *The Riser 8 SMP was lowered again to 13" from the tank bottom*
 - *The slurry was transferred to Tank 51 in October 2009*
 - *The Riser 3 SMP was then lowered to 15" from the tank bottom*
- Estimated sludge level after campaign ~30"

Tank 4 Waste Removal (Sludge)

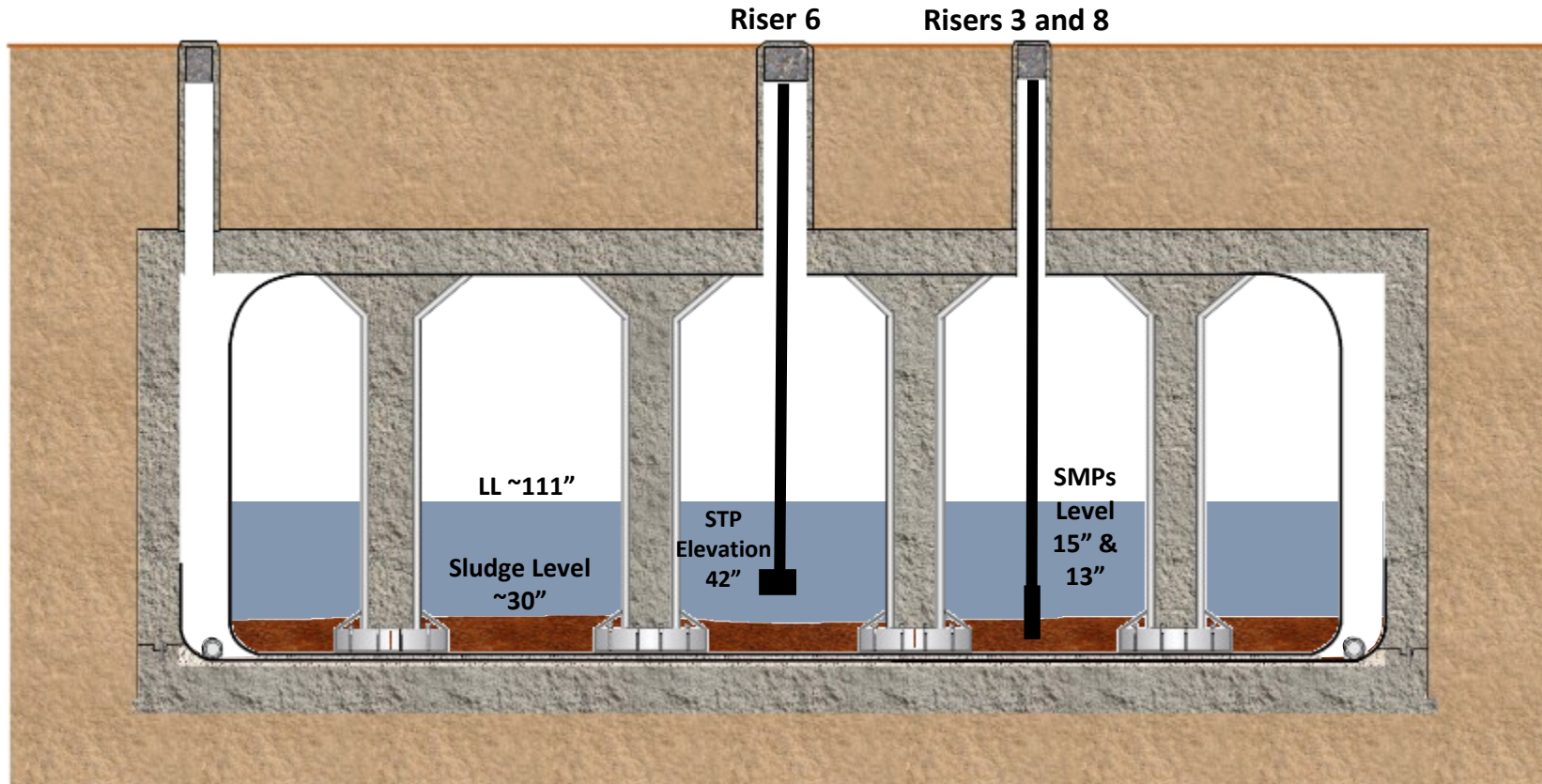
At the beginning of Campaign 5 (April 2009)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal (Sludge)

At the end of Campaign 5 (October 2009)



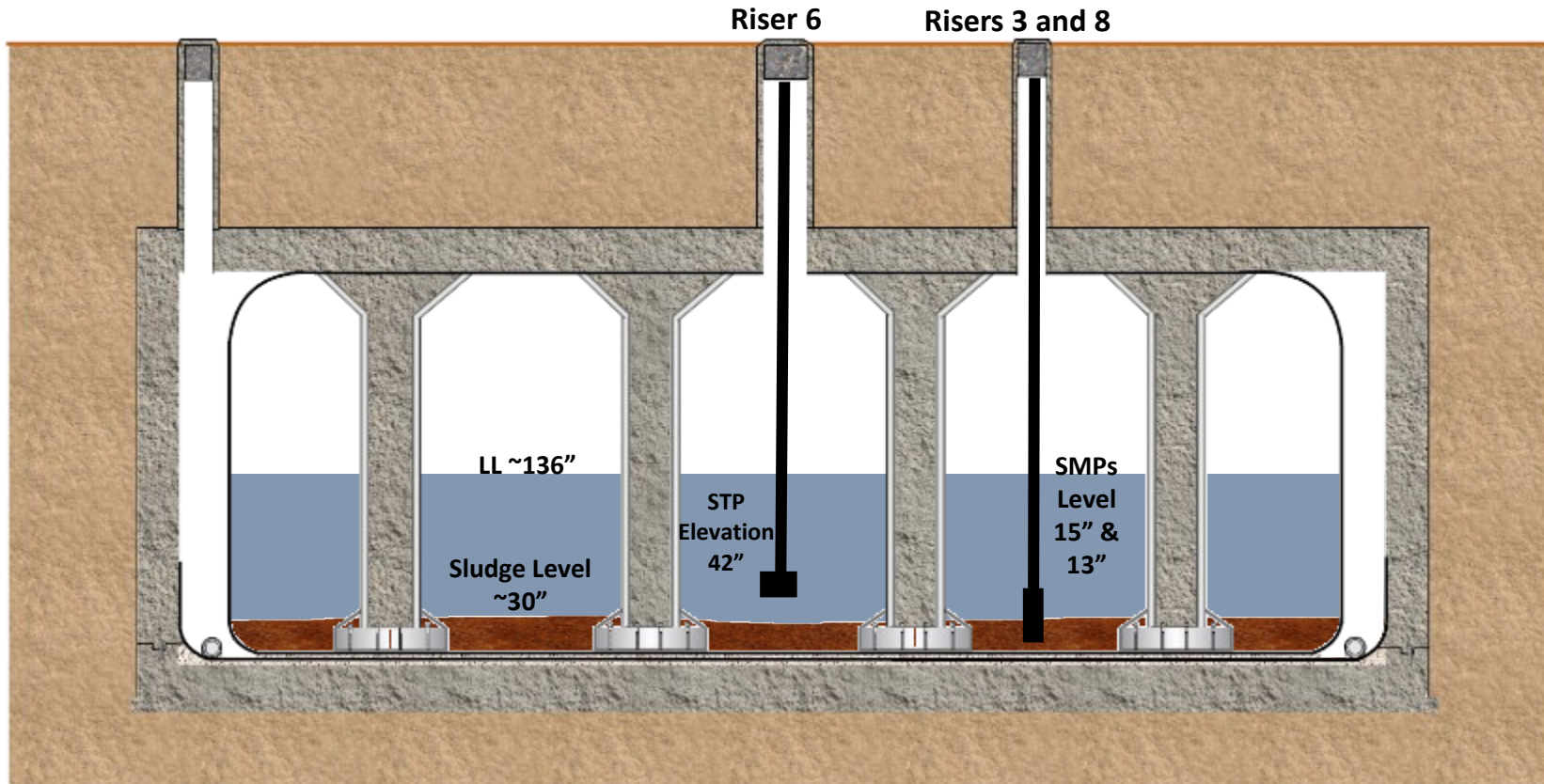
[SRR-LWE-2011-00100]

- **Campaign 6**

- Starting Sludge Level ~30"
 - *Two 8-hour mixing runs*
 - *Riser 3 SMP elevation – 15"*
 - *Riser 8 SMP elevation – 13"*
 - *STP elevation – 42" from the tank bottom*
 - *The slurry was transferred to Tank 51 in September 2010*
- Estimated sludge level after campaign ~23"

Tank 4 Waste Removal (Sludge)

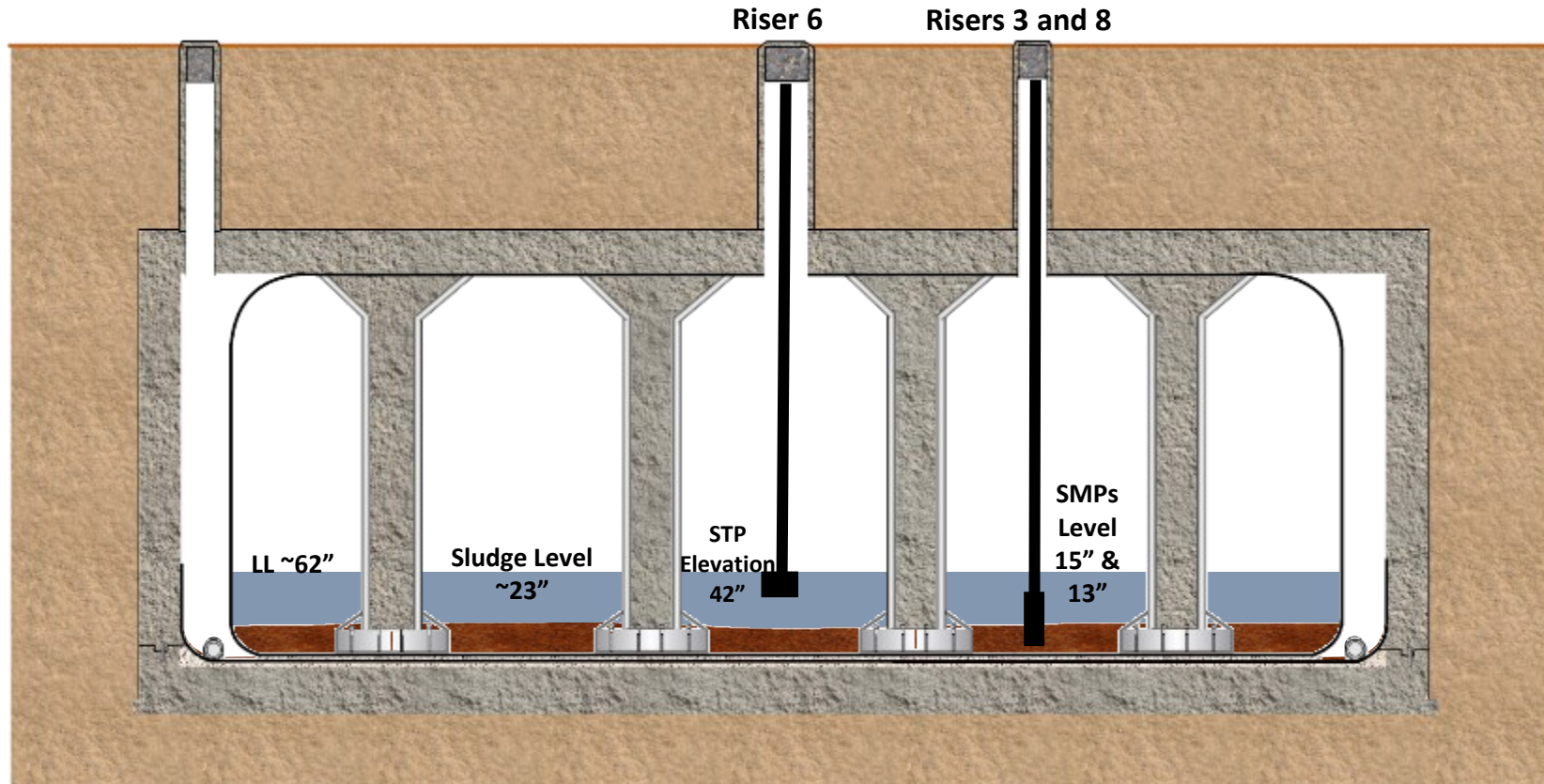
At the beginning of Campaign 6 (September 2010)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal (Sludge)

At the end of Campaign 6 (September 2010)



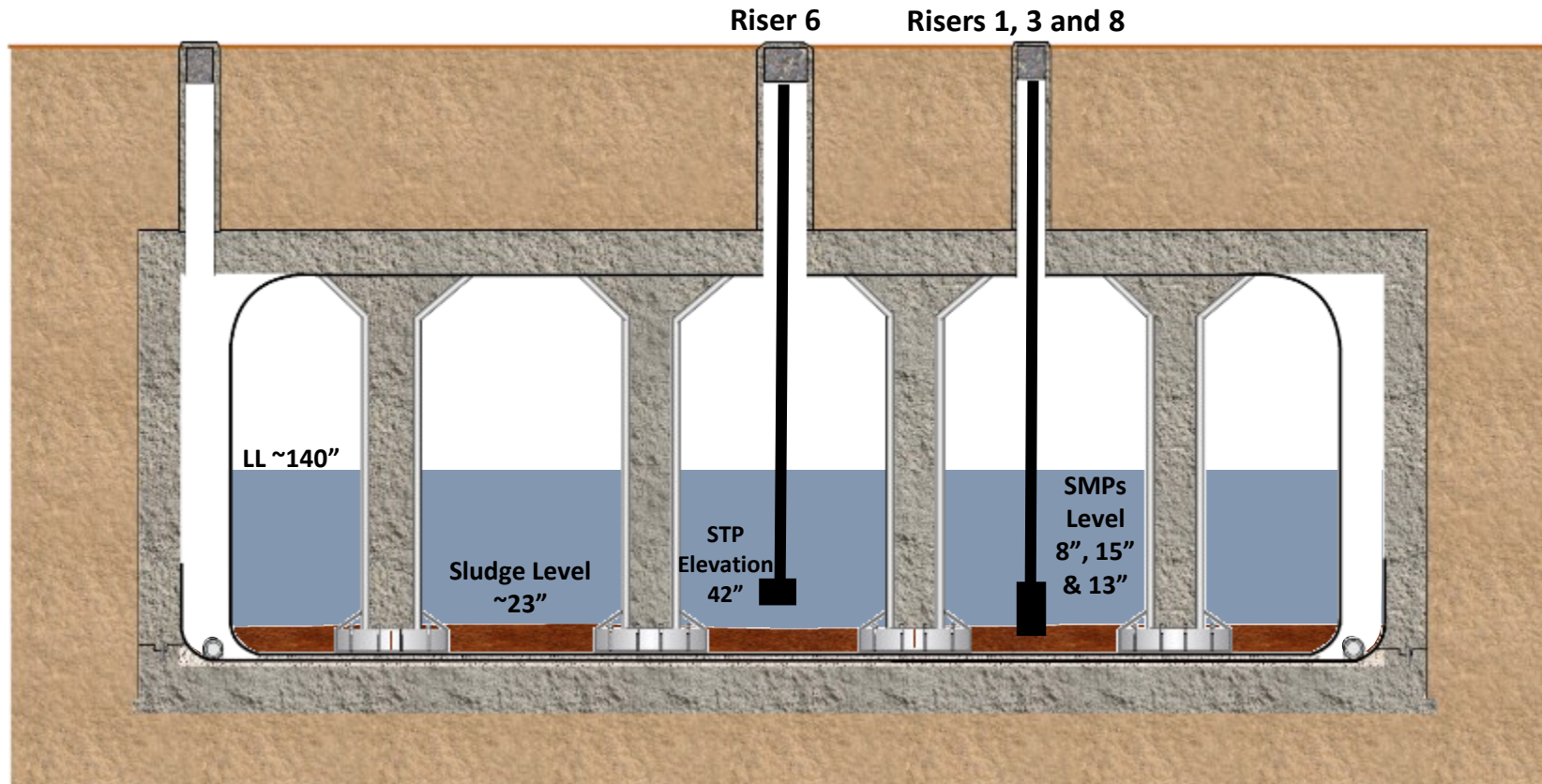
[SRR-LWE-2011-00100]

• Campaigns 7 – 9

- Starting sludge level at beginning of Campaign 7 ~23"
 - "recycle cycles" between Tank 4 and Tank 7
 - "recycle cycle" - supernate from Tank 7 transferred into Tank 4, tank mixed, and resulting sludge slurry transferred from Tank 4 into Tank 7
 - A third SMP was installed in Riser 1.
 - Riser 1 SMP elevation – 8". Lowered to 3" after the first pump run
 - Riser 3 SMP elevation – 15"
 - Riser 8 SMP elevation – 13"
 - STP elevation – 42" from the tank bottom. STP failed during Campaign 9 transfer into Tank 7
- Estimated sludge level at the end of Campaign 9 ~9"

Tank 4 Waste Removal (Sludge)

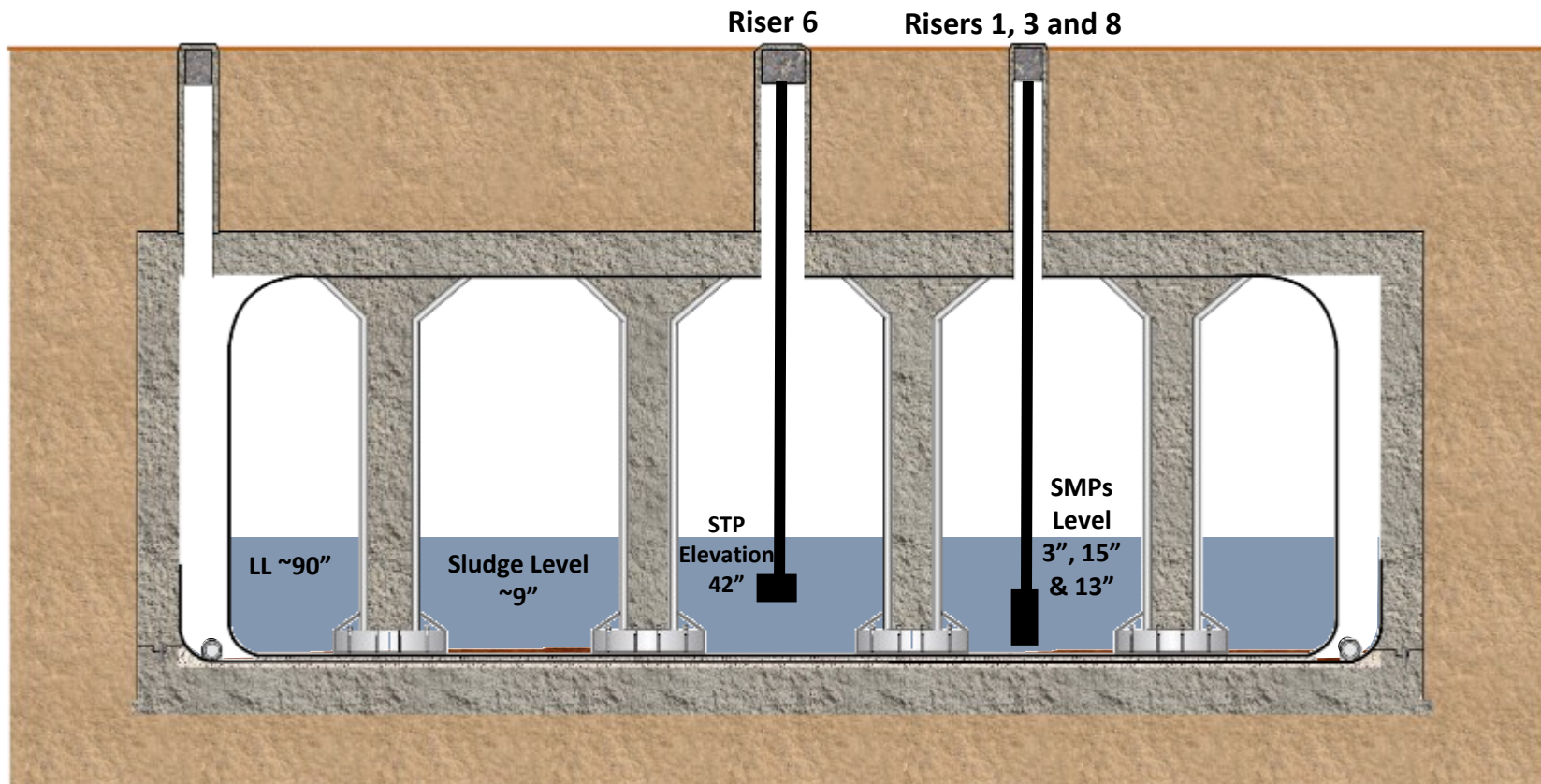
At the beginning of Campaign 7 (November 2010)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal (Sludge)

At the end of Campaign 9 (November 2010)



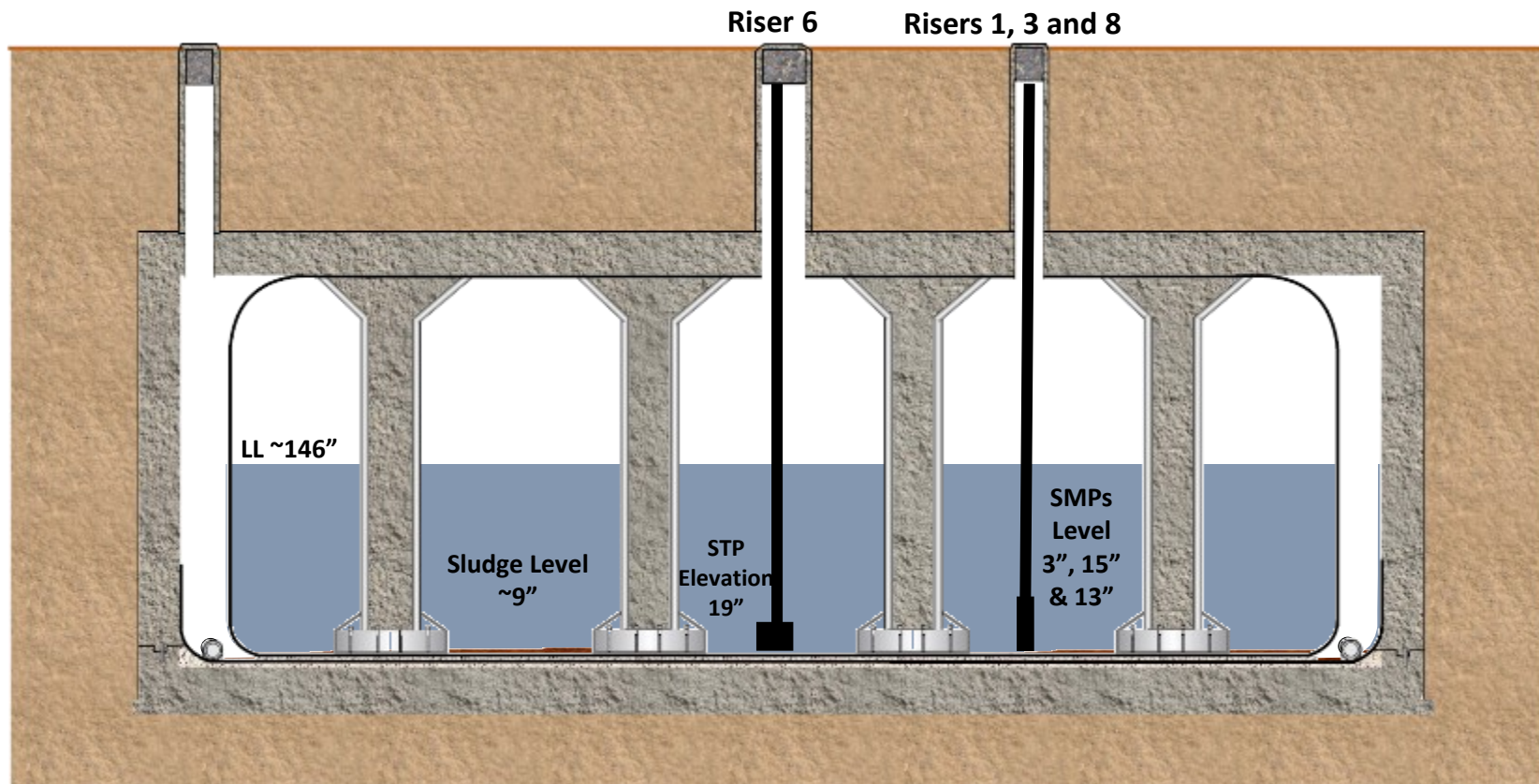
[SRR-LWE-2011-00100]

- **Campaign 10**

- Starting Sludge Level ~9"
 - *Recycle cycle*
 - *Riser 1 SMP elevation -3"*
 - *Riser 3 SMP elevation - 15"*
 - *Riser 8 SMP elevation - 13"*
 - *SMPs oscillated for >12 hours prior to Tank 4 to Tank 7 transfer and operated during transfer*
 - *Failed STP redesigned and replaced prior to Campaign 10*
 - New design allowed it to be lowered to 19" from the tank bottom.
- Estimated sludge level at the end of Campaign 10 ~4"

Tank 4 Waste Removal (Sludge)

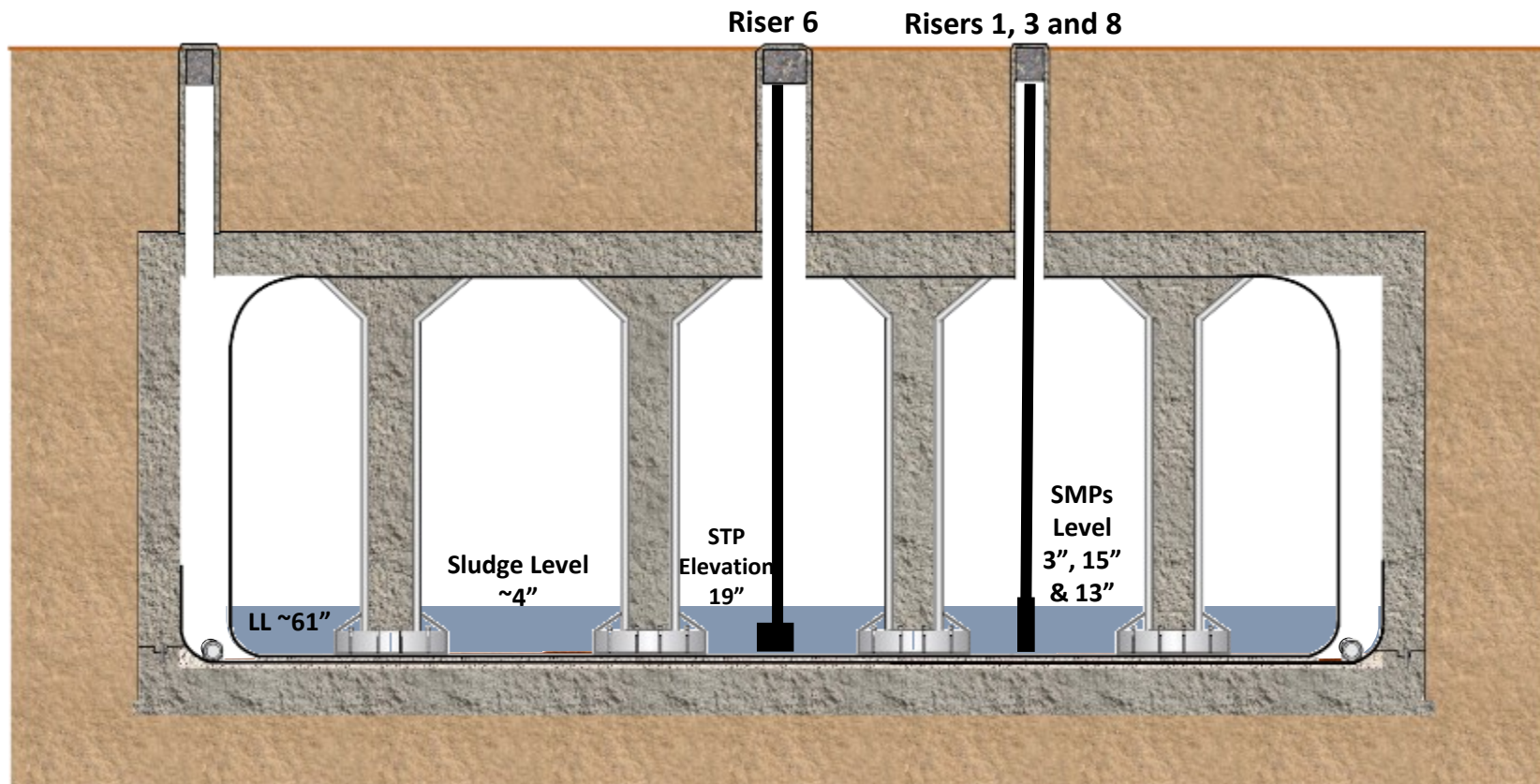
At the beginning of Campaign 10 (February 2011)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal (Sludge)

At the end of Campaign 10 (March 2011)



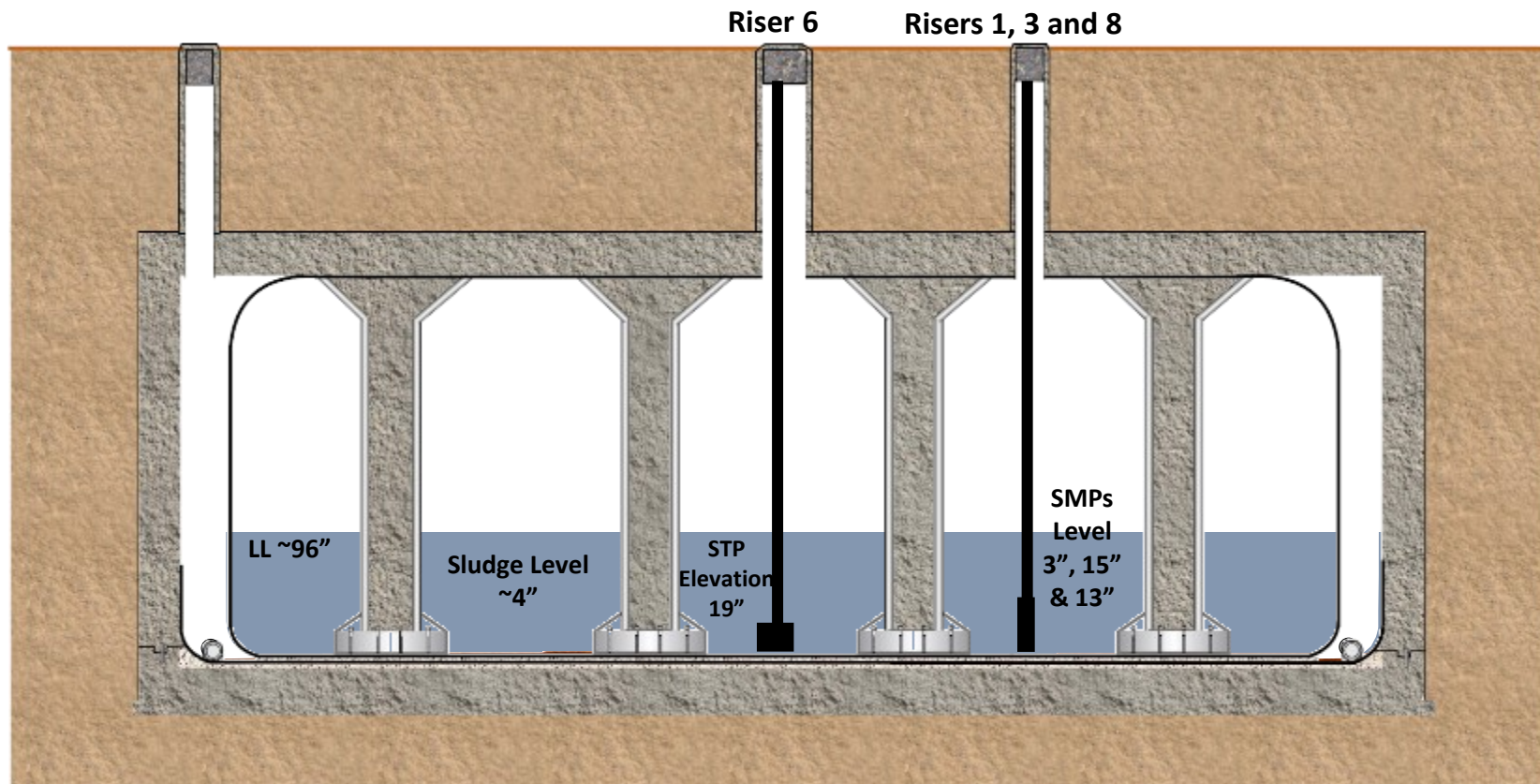
[SRR-LWE-2011-00100]

- **Campaign 11**

- Starting Sludge Level $\sim 4''$
 - *Recycle cycle*
 - *Riser 1 SMP elevation $-3''$*
 - *Riser 3 SMP elevation $-15''$*
 - *Riser 8 SMP elevation $-13''$*
 - *SMPs oscillated for >4 hours prior to Tank 4 to Tank 7 transfer and operated during transfer*
- Estimated sludge level at the end of Campaign 11 $<3''$

Tank 4 Waste Removal (Sludge)

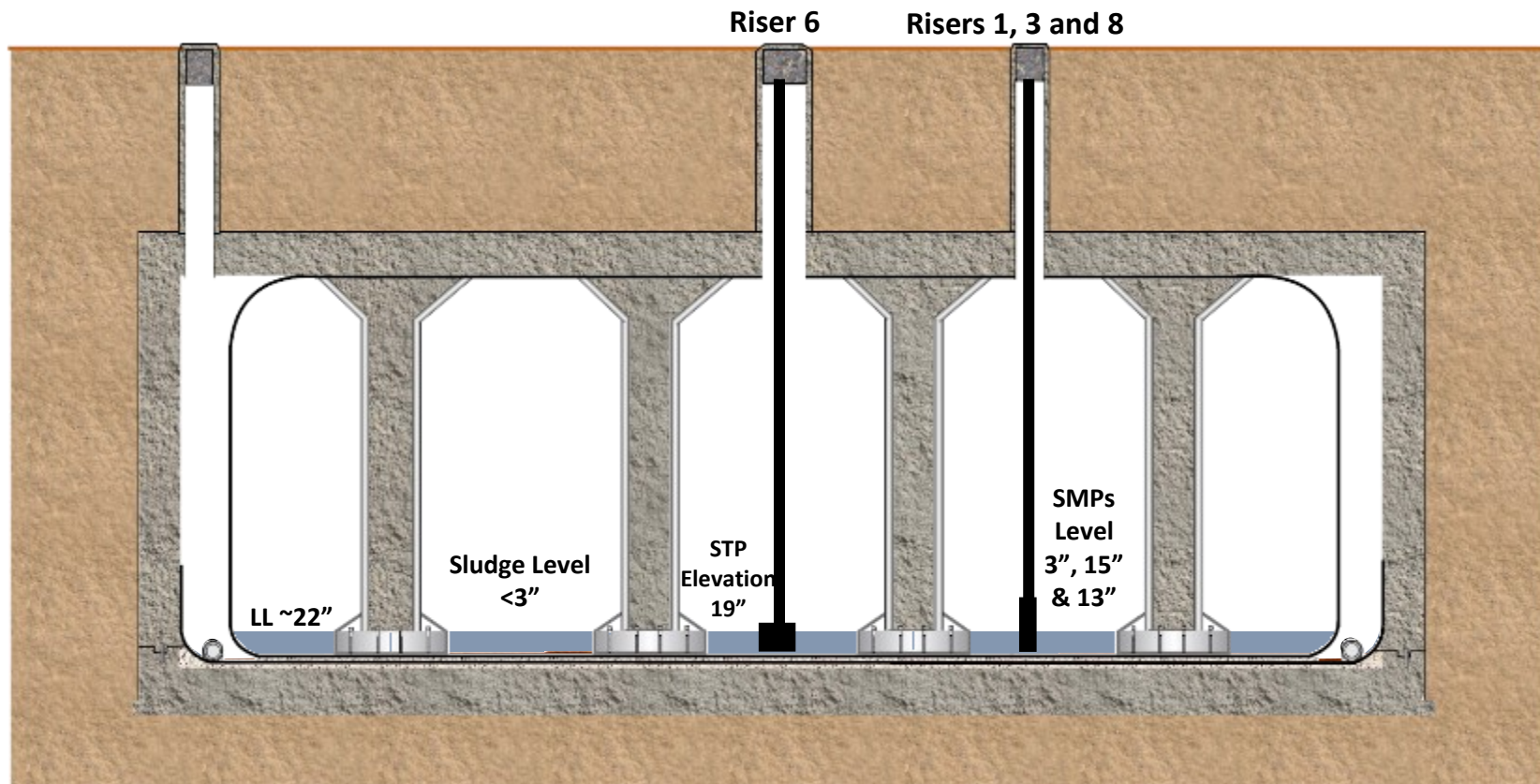
At the beginning of Campaign 11 (March 2011)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal (Sludge)

At the end of Campaign 11 (March 2011)



[SRR-LWE-2011-00100]

Tank 4 Waste Removal Overview



- **The Burkeite and saltcake layers (~12.6") were dissolved in four campaigns utilizing ~207k gallons of IW in 2007**
- **Seven sludge removal campaigns reduced the sludge level from ~33.5" (91Kgal) to <3" (<8Kgal)**
- **Total waste volume reduced by 92% during eleven campaigns**
 - Sludge volume reduced by 88%
 - Estimated remaining sludge volume of ~8,000 gallons (3") of sludge at the end of waste removal in 2011
- **In 2019 DOE requested SCDES and EPA the approval for re-use of Tank 4 to store dissolved salt solution from Tank 37 to minimize operational impacts to the 242-25H (3H) Evaporator System. [WDPD-19-47, SRR-OS-2019-00306, SRR-OS-2019-00313]**
 - Estimated approximately 11.5" of insoluble Aluminum solids may have accumulated in the tank from the Tank 37 dissolved salt solution (calculated, not measured)

Tank 4 Dewatering

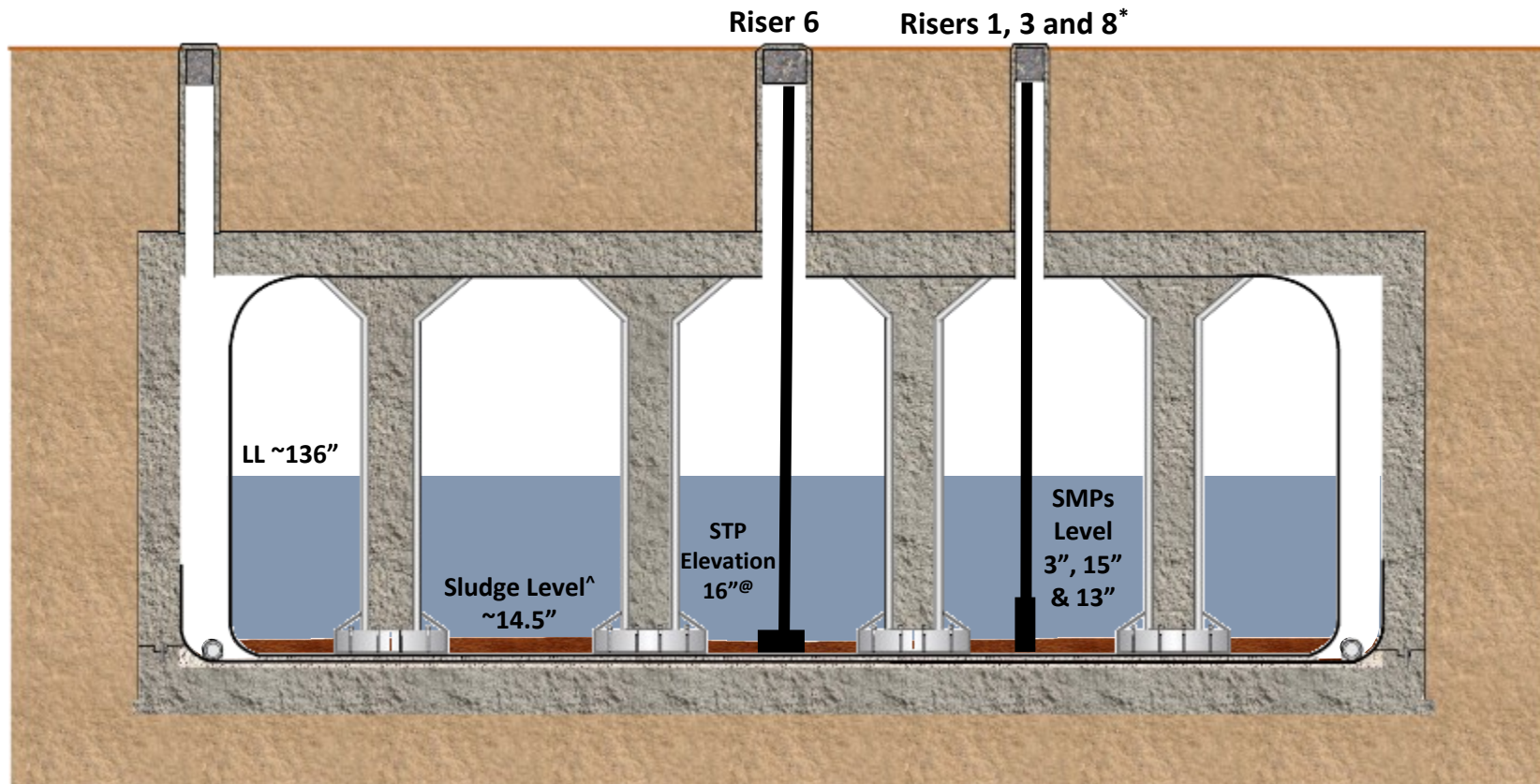
- **The existing dewatering pump was removed and a new pump installed in Riser 6 in May 2024**
 - Existing STP could not be lowered to tank bottom due to cooling coil interference
 - New STP designed and installed in the tank
 - In July 2024 an attempt was made to dewater Tank 4 into Tank 26 but a pump ground fault was received. Troubleshooting and junction box inspection revealed corrosion to terminal strips and the wires to the pumps from the junction box were shorted out.
 - The pump was removed on 8/14/24 and replaced with a new one.
 - Tank 4 to Tank 26 transfer was started on 8/18/24 and shutdown on 8/21/24 at a LL of 17" due to loss of pump suction. Transfer pump was resting on a vertical coil obstruction.
 - Repositioning of the transfer pump to tank bottom (i.e., ~1") was completed on 8/27/24 and dewatering to a final LL of ~7" completed on 8/28/24.

Tank 4 Dewatering Pump Installation



Tank 4 Dewatering

At the start of Dewatering (August 2024)



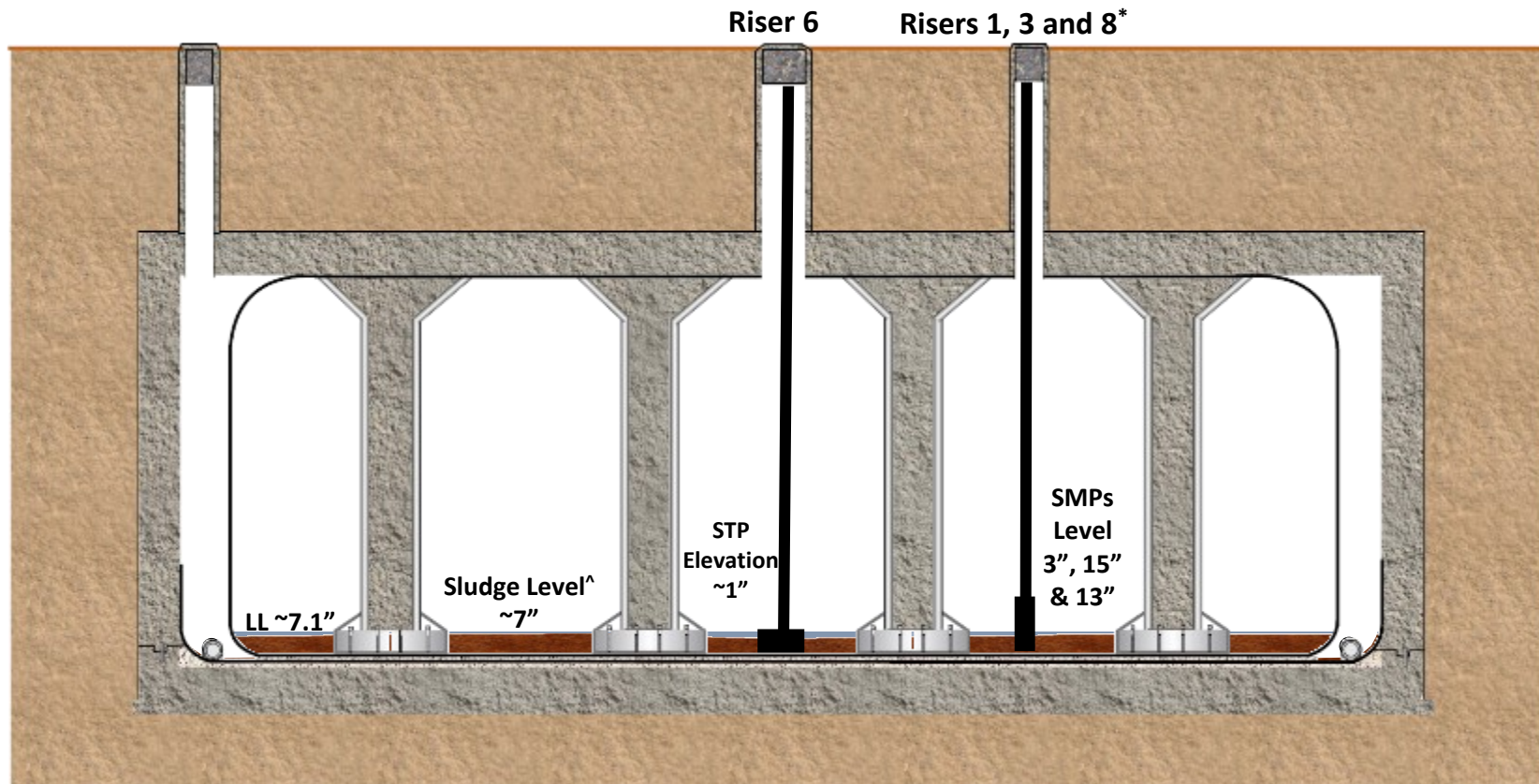
*SMPs are not operational

^Estimated assuming 11.5" insoluble Aluminum solids from storage of Tank 37 salt solution

@STP initially resting on vertical coil obstruction ~16", later lowered to bottom of tank

Tank 4 Dewatering

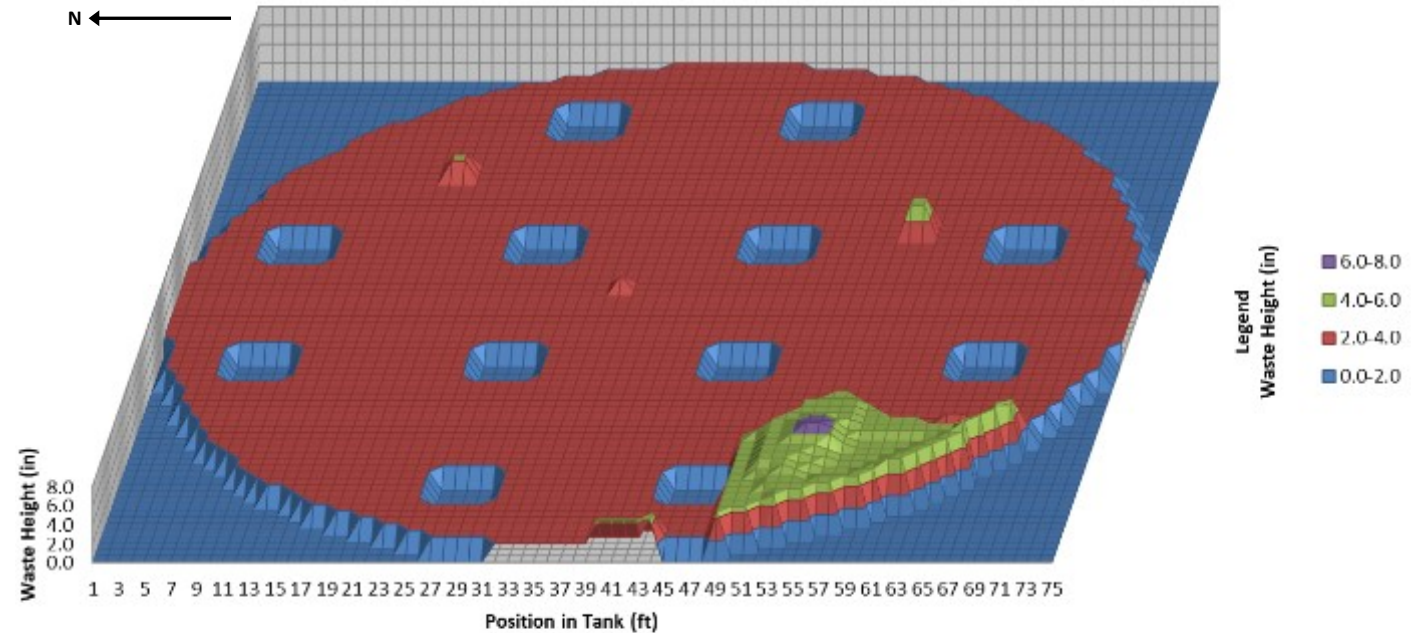
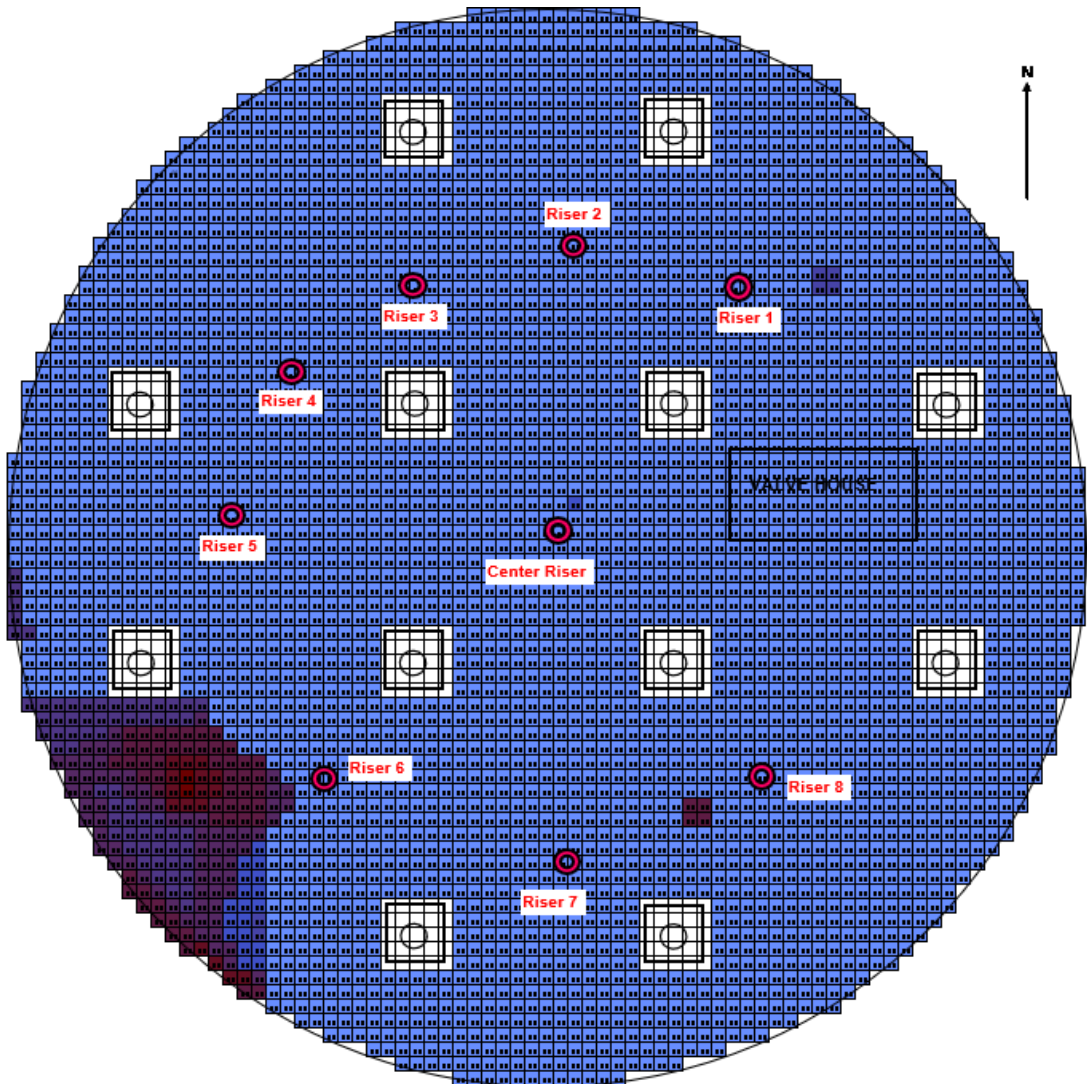
At the completion of Dewatering (August 2024)



*SMPs are not operational

^Estimated at the time assuming 4" insoluble Aluminum solids remain from storage of Tank 37 salt solution [WCS Online, 9/23/24]

Tank 4 Primary Tank Current Status



Remaining Solids < 6 Kgal

[U-ESR-F-00125]

Tank 4 Waste Removal (Sludge)



Sludge Removal Summary

Campaign	Date	Sludge Level Start (inches)	Sludge Slurry Transfer (Kgal)	Sludge Level End (inches)	Riser 1 SMP Elevation (inches) & Run Time [hours]	Riser 3 SMP Elevation% (inches) & Run Time [hours]	Riser 8 SMP Elevation% (inches) & Run Time [hours]	STP Elevation+ (inches)
5	10/2009@	33.5	136	30	N/A	(40), [100] (30), [100] (22), [140]	(40), [100] (30), [100] (20), [140] (15)	42
6	9/2010#	30	197	23	N/A	15, [8]	13, [8]	42
Third SMP installed in Riser 1 (11/2010)								
7, 8, 9^	11/2010#	23	584	9	(8 - 3), [>12]	(15), [>12]	(13), [>12]	42
STP failed during Campaign 9. STP replaced.								
10^	2/2011#	9	228	4	(3), [>12]	(15), [>12]	(13), [>12]	19
11^	3/2011#	4	208	<3	(3), [>4]	(15), [>4]	(13), [>4]	19
Dewatering	8/2024	<3	N/A	~<2	N/A	N/A	N/A	1&

@Sludge Batch 6 feed.

#Sludge Batch 7 feed.

^Transfers between Tank 4 and Tank 7. In some documents, Campaigns 7-11 also referred to as "Cycles" 1-5

%Elevations swapped in SRR-LWE-2011-00100

+From the tank bottom.

&Elevation - Dewatering pump ~1 inch.

[SRR-LWE-2011-00100]

Tank 4 Primary Tank (Current)



Riser 6 Inspection



Riser 6 STP



Riser 6 mound looking towards SW tank wall

Tank 4 Primary Tank (Current)

Riser 6 Inspection



Riser 6 mound looking towards SW wall



Riser 6 looking towards SW-S tank wall

Tank 4 Primary Tank (Current)

Riser 6 Inspection



Riser 6 looking towards SE tank quadrant by Riser 8 SMP

Tank 4 Primary Tank (Current)



Riser 2 Inspection



Riser 2 looking down



Riser 2 looking NW

Tank 4 Primary Tank (Current)



Riser 2 Inspection



Riser 2 looking NW



Riser 2 looking NW (Riser 3 SMP)

Riser 4 Inspection



Riser 4 down towards SW quadrant floor

Center Riser Inspection



Center Riser looking SW (between Riser 6 and 5)

Tank 4 Primary Tank (Current)

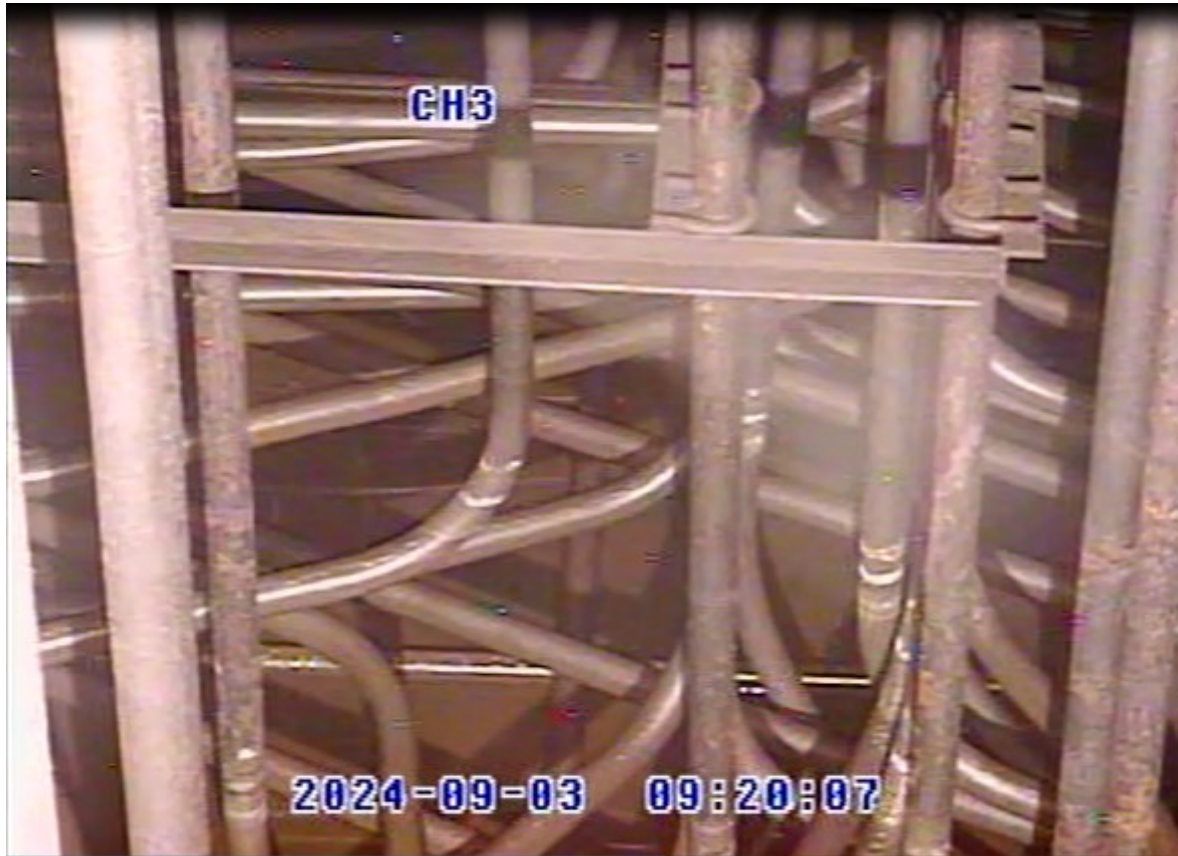
Center Riser Inspection



Center Riser looking NW towards Riser 3 SMP

Tank 4 Primary Tank (Current)

Center Riser Inspection



Center Riser looking towards Valve House piping

Tank 4 Primary Tank (Current)

Center Riser Inspection



Center Riser looking towards SE quadrant (Riser 8 SMP)

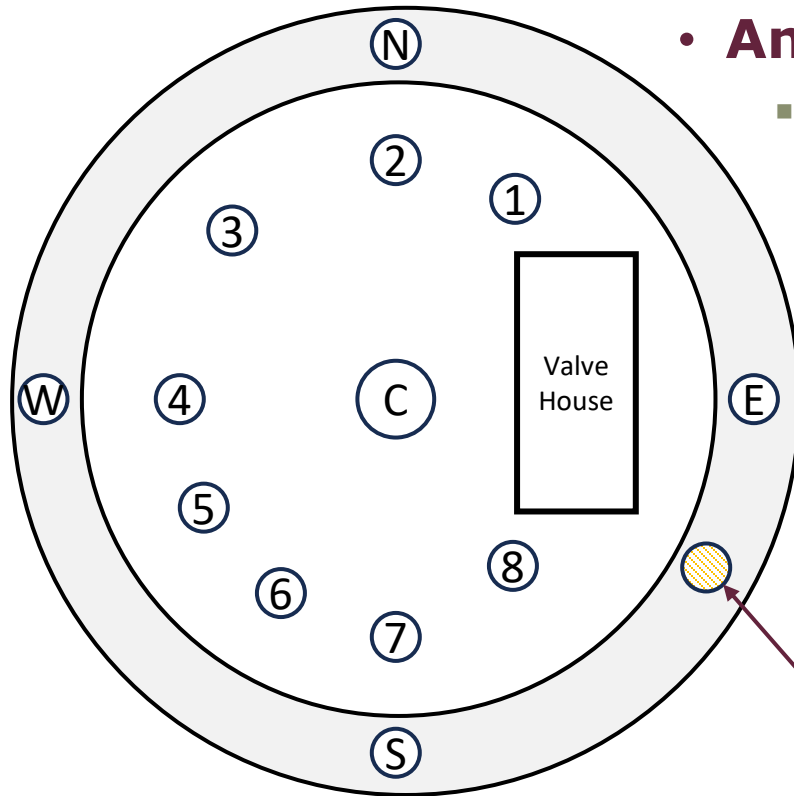
Tank 4 Annulus Inspection



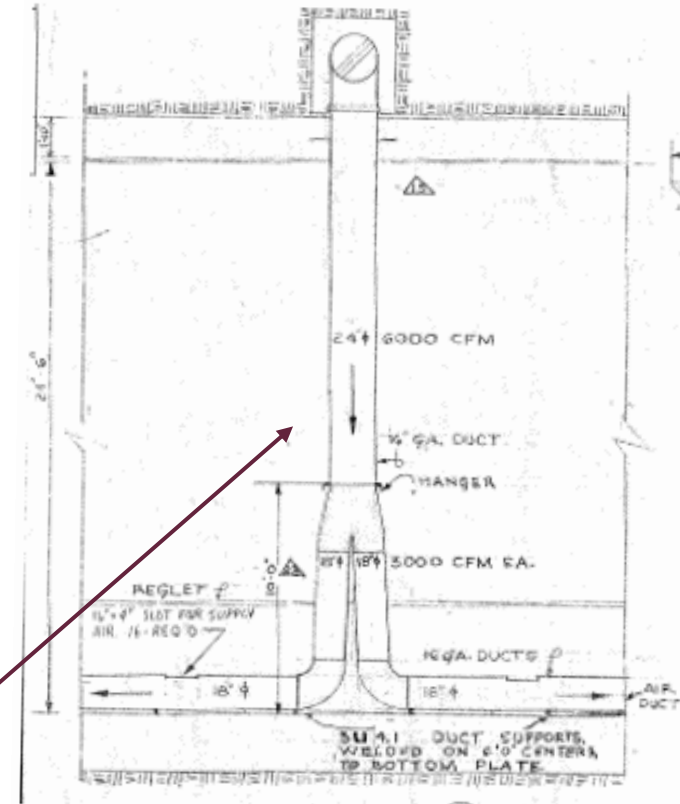
- **Through November 2023, a total of four leak-sites documented [SRMC-STI-2024-00076]**
 - First leak-site discovered in 2011, three additional in 2013
 - Four annulus risers available for inspection: North, South, East and West
 - 25% inspection capability
 - All leak-sites identified are located at 234" from the tank bottom

Tank 4 – Riser Access

- **Primary access**
 - Eight 24-inch risers
 - One 42-inch central riser
- **Annulus access**
 - Four 24-inch risers



Vertical Dehumidification Duct



- **Inspected areas of Tank 4 annulus show no leakage, significant surface corrosion or other anomalies. [SRMC-STI-2024-00076]**
 - No waste on annulus floor
 - Inspection of annular pan consistent in all inspected areas
 - *No reason to believe uninspected areas would not have similar conditions*

Tank 4 Annulus East Riser

East Riser Facing North



East Riser Facing South



Tank 4 Annulus North Riser

North Riser Facing East

North Riser Facing West



South Riser Facing East



South Riser Facing West



Tank 4 Annulus West Riser



West Riser Facing North

West Riser Facing South



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- SRR-CWDA-2014-00106, *Tank 16 Special Analysis for the Performance Assessment for the H-Tank Farm at the Savannah River Site, Savannah River Site, Aiken, SC, Rev. 1, February 2015***
- SRR-CWDA-2015-00073, *Tank 12 Special Analysis for the Performance Assessment for the H-Tank Farm at the Savannah River Site, Savannah River Site, Aiken, SC, Rev. 0, August 2015***
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