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Engineering Path Forward – Tanks 5 & 6: Record of Additional Grouting Actions

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1. Background Statement

As outlined in the *Grout Strategy for Tanks 5 and 6 Closure* document [1], the process of completing operational closure by stabilizing the tanks with grout has been completed. During this process, situations have transpired that warrant additional documentation. This path forward will outline (1) the events that have occurred, (2) the actions taken or planned to be taken to properly manage each event, and (3) the reasoning behind the corresponding decision(s). In addition, this document can be used as a means to decrease the likelihood of discovering unexpected conditions during this and future grouting efforts through the identification of potential causes.[1]

2. Events Summary

2.1. Tank 6, Riser 4 Transfer Jet Not Disassembled

Prior to the approval of the *Grout Strategy for Tanks 5 and 6 Closure* document [1], in August 2013, the facility performed evaluations using approved documentation (DCFs, DCPs, Tank Relevant Historical Documents, etc.) and/or in-tank camera/video inspections to confirm expected conditions and equipment configuration. These evaluations identified the Tank 6, Riser 4 Transfer Jet as disassembled and suspended approximately 24 feet above the tank floor. In November 2013, several months later, photographic evidence identified the Tank 6, Riser 4 Transfer Jet as intact and suspended several feet above the tank floor.

2.1.1. Actions Taken

- The Tank 6, Riser 4 Transfer Jet has been grouted internally to the extent practical [2].
- The Tank 6, Riser 4 Thermowells have been grouted internally to the extent practical [2].
- The Grout Strategy Document, SRR-LWE-2012-00087, was revised to reflect the noted conditions. (See STAR Item 2013-CTS-015144)

2.1.2. Additional Discussion

On July 2, 2004, P-DCP-F-03005 [3] was classified as "Field Installed." This Design depicts the conditions initially expected and presented in the *Grout Strategy for Tanks 5 and 6 Closure* document. Another design, P-DCF-F-00390 [4], was issued to amend the instructions in the DCP from "The existing transfer jet pump will be partially D&R'd and…be *partially* relocated to and abandoned in Riser #4" to "The existing transfer jet pump will be disconnected and relocated to Riser #4." In addition, instructions to disassemble the jet were removed. Similar designs/actions were applied with regard to Tank 5. In that case, the transfer jet was confirmed to be left disassembled in its riser as expected.

[1] At this time, the Grouting Strategy Document is currently on Revision 2. As needed, the Grouting Strategy document is being revised to reflect the conditions noted in this path forward.

The P-DCF-F-00390 was declared "Field Installed" on June 3, 2004.

Consistent with equipment information provided in the *Grout Strategy for Tanks 5 and 6 Closure*, the Tanks 5 and 6 Closure Module [5] identified the transfer jet as "Suspended from Riser 4 and terminates in vapor space."

The configuration in P-DCF-F-00390 was not recognized. Furthermore, obstructions such as cooling coils and columns hindered efforts to accurately document the field state of the transfer jet. The in-tank video inspection was unsuccessful at capturing this condition and having it properly reflected in the document[2]. Figure 2.1.2-1 gives a view of the obstructions looking toward the Tank 6 Riser 4.

Figure 2.1.2-1: Obscured Jet in Tank 6, Riser 4
(View Looking toward Tank 6 Riser 4)

Upon discovery of the new configuration, C&WDA was notified. A decision was made to grout the equipment and eliminate any potential for a vertical fast flow path. Subsequently the jet riser and thermowells have been grouted per WO# 001199254 [2].

[2] In November 2013, new information became available. Photographic evidence from an adjacent riser identified the Transfer Jet in Tank 6, Riser 4 was intact and not disassembled.

2.2. Displaced Liquid in Tank Risers

At the completion of the tank grouting, it was discovered that liquid was displaced by the tank fill grout and had been forced up into several of the risers associated with the two tanks. This liquid must be safely dispositioned before completing tank grouting to ensure there is not a spread of potential liquid contamination as the grout levels continue to rise. Figure 2.2-1 gives a typical example of what has been seen in these instances.

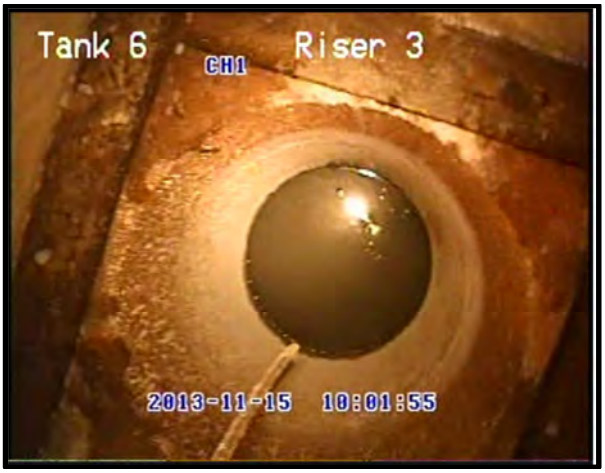

Figure 2.2-1: Liquid Present in Tank 6, Riser 3
(View Looking Down Into Riser)

2.2.1. Actions Taken

- A new Work Order Task was issued for Tanks 5 and 6 to allow, if required, the liquid in the riser to be removed [6].

2.2.2. Additional Discussion

The liquid present in the risers is a direct result of the addition of liquid intended to lubricate the tank grout addition lines, thus ensuring the grout flowed continuously into the Waste Tanks. The amount of liquid present in the identified risers varies from "minimal" (less than a few inches) to "high" (12 inches or greater)[3]. A sufficient volume of liquid could have become a hindrance during the grouting process. For this reason, work packages were issued to allow the option to remove the liquid from the riser [6]. However, as a result of liquid reconstitution during grout addition and evaporation, the liquid level was deemed negligible and its removal unnecessary.

[3] Water levels identified via riser video inspection.

2.3. Some Cooling Coils Could not be Fully Grouted

Because they would not accept any additional grout, a total of five of the seventy-two cooling coils have not been fully grouted:

- Tank 5 Cooling Coil 17 (3 gallons of an estimated 107 gallons ~ 3% filled)
- Tank 5 Cooling Coil 18 (40 gallons of an estimated 148 gallons ~ 27% filled)
- Tank 6 Cooling Coil 16 (75 gallons of an estimated 107 gallons ~ 70% filled)
- Tank 6 Cooling Coil 24 (13 gallons of an estimated 99 gallons ~ 13% filled)
- Tank 6 Cooling Coil 36 (7 gallons of an estimated 148 gallons ~ 5% filled)

Note: The cooling coil volume is a rough estimate. During tank construction, the cooling coils were installed "field to fit". Field dimensional variations from the design drawings resulted.

Furthermore, testing indicated a volume of 35 gallons was required to transition from water to 100% grout [1] . Specifically, once grout was visually detected at the cooling coil outlet, a total of 35 gallons of additional grout is required. In two cases this did not occur:

- Tank 5 Coil # 14 was only given an additional 15 gallons of grout
- Tank 5 Coil # 16 was only given an additional 25 gallons of grout

Because these actions varied from what was typically performed on the majority of intact cooling coils, these anomalies are documented.

2.3.1. Actions Taken

- The potential for some cooling coils to not be fully filled was discussed with C&WDA. It was agreed that a limited number of coils partially filled did not represent a change to the waste tank final equipment configuration assumed in the closure documentation. The FTF Performance Assessment [7] and supporting documentation (e.g., SRR-CWDA-2012-00051 [8]) assumed only that the coils would be filled to the extent practical and recognized the potential for cooling coils to be partially filled.

2.3.2. Additional Discussion

Tanks 5 and 6 are Type I waste tanks. Each contain cooling coils of nominal 2 inch diameter pipes consisting of 34 vertical coils and 2 horizontal (bottom) coils with an inlet and an outlet line for each coil. During cooling coil operations, the inlet side is where the chromate cooling water would enter the coil and the outlet is where the chromate cooling water exits the coil.

As outlined in the *Grout Strategy for Tanks 5 and 6 Closure* document [1], grout filling of coils was declared complete upon finding that cooling coils could not accept any additional grout. In addition, the document states that, "No further evaluation will be required prior to proceeding. Discrepancies identified between the amount of grout added to a particular cooling coil and the amounts estimated to be needed to fill that coil are documented in the implementing work document." The implementing work orders [9] & [10] document the coil grouting activities in detail.

Probable causes for the five cooling coils not being fully filled:

Tank 5 Cooling Coils 17 and 18 - debris or solids (hardened grout) in the grout addition line became detached and plugged the lines. Once recognized, multiple controls/actions were implemented to ensure the probability of reoccurrence would be minimized: Increased flush frequency of line, more comprehensive line flush, installed screens to capture solids prior to coil inlet, and the use of a larger diameter grout line cleaning device were actions implemented.

Tank 6 Coil 16 - high radiation rates (flush water) and exceeding the workplace RWP suspension limits during the initial grout installation resulted in the cessation of finishing the grouting of the coil.

Tank 6 Cooling Coils 24 and 36 – prior to grouting, these coils were identified as containing indeterminate size holes but considered intact with minimal damage. It is likely that bulk fill grout from the tank fill plugged these coils.

The inlet sides of these coils are grouted. There is no intention to attempt to introduce grout into the discharge (outlet) side of the coils. The discharge side of the coils contains flush water up to the introduced grout. Any grout forced into this side will displace contaminated flush water. Based on the following items, it is not warranted to implement efforts to grout coils from the discharge side:

(1) Likelihood of inserting an appreciable amount of grout is minimal because there is not vent path for displaced liquid/air
(2) Considerable efforts that would be needed to contain the displaced contaminated flush water
(3) Potential for contamination is high
(4) Potential for worker radiation exposure is high

The requirement to introduce an additional 35 gallons of grout upon visual detection of grout at the cooling coil outlet was intended to ensure transition from water to 100% grout[4]. The water present in the coils was the result of water introduced into the coils – prior to the introduction of grout – to lubricate the grout addition lines and cooling coils to ensure grout flowed continuously through the coils without plugging. As previously mentioned, in two instances the grouting efforts were stopped short of the 35 gallons. Due to the variability and uncertainty of the required cooling coil volume, the necessary grout volume exceeded the anticipated batch size for these coils. Insufficient grout was prepared and staged. The time required to prepare a subsequent batch challenged the setup time of the grout in the lines. However, in each of these coils a 100% transition was visually verified prior and a solid homogeneous solution of grout was observed prior to completion. It was concluded to move forward and declare coil grouting complete. Subsequent coils had more than two batches of grout staged in anticipation of the occurrence.

Recommended Actions

All actions for this path forward have been completed and the one STAR Item 2013-CTS-015144 generated is closed.

[4] This number resulted from full scale demonstrations performed in conjunction with the Savannah River National Laboratory [11].

References

[1] P. E. Carroll and E. Monaco, "Grout Strategy for Tanks 5 & 6 (SRR-LWE-2012-00087, Revision 2)," LWDPE~Closure Engineering, SRS, 2013.

[2] Savannah River Remediation, LLC - Closure Projects, "Tank 6 Grout Placement STP Equipment (Work Order # 01199254, Task 58)," LWPDE~Closure Projects, SRS, 2013.

[3] A. A. Maniquis and M. Simmons, "Tank 6 D&R Risers #3 and #6 (P-DCP-F-03005 DCN-P-002, Revision 0)," Project # UPMTF03076, SRS, 2003.

[4] R. W. Forty and M. Simmons, "Tank 6 Waste Removal Transfer Jet Relocation (P-DCF-F-00390, Revision 0)," Project # W183, SRS, 2003.

[5] Savannah River Remediation, LLC - Closure & Waste Disposal Authority, "Industrial Wastewater Closure Module for the Liquid Waste Tanks 5F and 6F F-Area Tank Farm, Savannah River Site (SRR-CWDA-2012-00071, Revision 1)," C&WDA~C & WD Determinations, SRS, 2013.

[6] Savannah River Remediation, LLC - Closure Projects, "Tanks 5-6 Pump Standing Riser Water (Work Order # 01199254, Task 65)," LWPDE~Closure Projects, SRS, 2013.

[7] M. Layton and T. Robinson, "Performance Assessment for F-Tank Farm at the Savannah River Site, Rev 1," C&WDA~Program Management, Aiken, SC, 2010.

[8] S. Hommel, "Critical Assumptions in the F-Tank Farm Closure Operational Documentation Regarding Waste Tank Internal Configurations, Rev. 0," C&WDA~C&WD Assessment, Aiken, SC, March 28, 2012.

[9] Savannah River Remediation, LLC - Closure Projects, "Tank 5 Grout Operable Cooling Coils in Valve House (Work Order # 01199252, Task 53)," LWPDE~Closure Projects, SRS, 2013.

[10] Savannah River Remediation, LLC - Closure Projects, "Tank 6 Grout Operable Coolling Coils in Tank 6 Valve House (Work Order # 01199254, Task 62)," LWPDE~Closure Projects, SRS, 2013.

[11] E. Hansen and A. Cozzi, "Closure of HLW Tanks - Phase 2, Full Scale Cooling Coils Grout Fill Demonstrations (WSRC-STI-2008-00298, Revision 0)," CES~Technology Development, SRS, 2008.

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