Savannah River Remediation
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SRR-CWDA-2021-00010
RSM Track #: 10667

February 3, 2021

Mr. Shawn Clarke, Director
Water Facilities Permitting Division
Bureau of Water
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Dear Mr. Clarke:

REQUEST FOR APPROVAL TO USE ALTERNATE FILL MATERIALS FOR OPERATIONAL CLOSURE OF TANK FARM ANCILLARY STRUCTURES AT THE SAVANNAH RIVER SITE, AIKEN, SOUTH CAROLINA

Ref: 1. SRR-CWDA-2017-00015*, Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems*, Rev. 1, April 2017.

Savannah River Remediation (SRR) is requesting South Carolina Department of Health and Environmental Control (SCDHEC) approval to use alternate fill materials to operationally close ancillary structures in the F-Area Tank Farm (FTF) and H-Area Tank Farm (HTF) at the Savannah River Site (SRS).

The *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems* (CGCP), Reference 1, lists the SCDHEC-approved grouts used for operational closure of waste tanks and ancillary structures at the SRS FTF and HTF. The only two fill grouts listed in the CGCP at this time are, "Bulk-Fill Grout", specification C-SPP-F-00055, and "High-Flow Grout", specification C-SPP-Z-00012.

As noted in the CGCP, "Potential use of an alternate grout will undergo an evaluation against applicable operational and performance documents. If the evaluation determines that it is acceptable to use the alternate grout, the change will be provided to SCDHEC for their review and approval prior to using the alternate grout."

Grout evaluations supporting closure of F-Area Diversion Box 5 (FDB-5) and FDB-6 identified two additional fill materials that will efficiently and effectively fill ancillary structures. The two alternate fill materials are:

1) Low Slump Concrete [mix A2000-6-0-2-A in specification C-SPS-G-00096] and,
2) Zero-Bleed Controlled Low Strength Material (ZB-CLSM) [mix ZB-FF-8-D in specification C-SPS-G-00096].

Attachment 1 to this letter provides the evaluation demonstrating that these alternate fill materials are acceptable for use in operational closure of FTF and HTF ancillary structures.

SRR is hereby requesting SCDHEC approval to use "Low Slump Concrete" and "ZB-CLSM" as alternate fill materials for the operational closure of F-Area and H-Area ancillary structures. If it is determined that these alternate fill materials meet operational and performance requirements for use in waste tank closures, a separate approval request will be made.

Please direct any questions to Steve Thomas at (803) 557-8960.

Sincerely,

Kenneth R. Wells
Chief Engineer and Waste Determination Manager
Savannah River Remediation LLC

Attachments: *Technical Justification for use of Low Slump Concrete and Zero-Bleed CLSM for Operational Closure of F and H Tank Farm Ancillary Structures*

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Attachment 1: Technical Justification for use of Low Slump Concrete and Zero-Bleed CLSM for Operational Closure of F and H Tank Farm Ancillary Structures

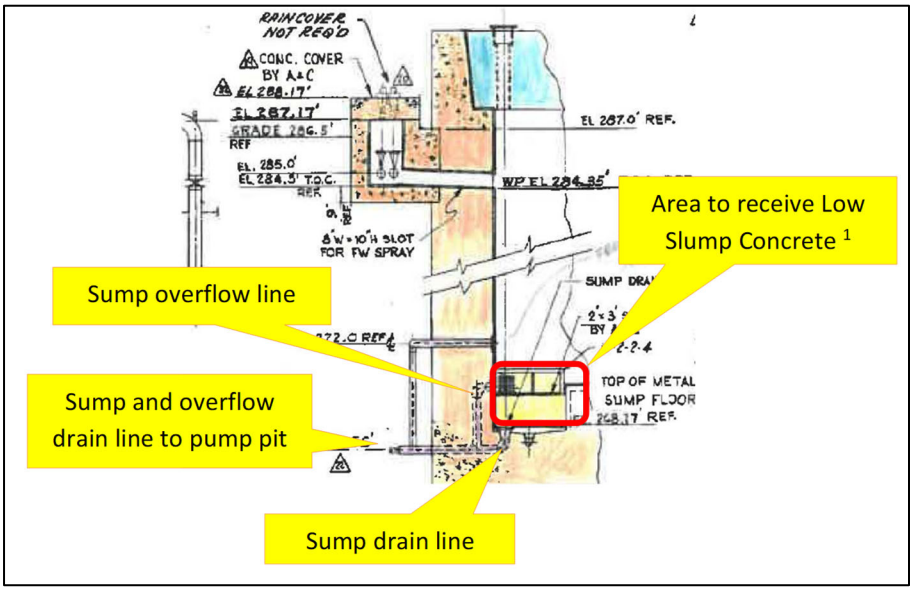
The *Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems* (CGCP) lists the current approved fill grouts for operational closure of waste tanks and ancillary structures. [SRR-CWDA-2017-00015] At this time Bulk-Fill Grout [C-SPP-F-00055] and High-Flow Grout [C-SPP-Z-00012] are approved bulk fill grouts. Two additional fill materials are proposed for use in operational closure of ancillary structures in F-Area Tank Farm (FTF) and H-Area Tank Farm (HTF): 1) Low Slump Concrete, and 2) Zero-Bleed Controlled Low Strength Material (ZB-CLSM). As noted in the CGCP, "Potential use of an alternate grout will undergo an evaluation against applicable operational and performance documents. If the evaluation determines that it is acceptable to use the alternate grout, the change will be provided to SCDHEC for their review and approval prior to using the alternate grout."

Application of Alternate Grouts in Ancillary Structures

Grout evaluations supporting closure of F-Area Diversion Box 5 (FDB-5) and FDB-6 identified two alternative fill materials that will efficiently and effectively fill these first two ancillary structures selected for closure. The purpose of this technical justification is to demonstrate that these two alternate bulk fill grouts are acceptable for FDB-5 and FDB-6 and for future use to grout other FTF and HTF ancillary structures.

Current grouting plans identify an alternate fill material, Low Slump Concrete, mix A2000-6-0-2-A [C-SPS-G-00096], for delivery into the sumps of FDB-5 and FDB-6 until the sump drain and overflow drain openings are sealed. Low Slump Concrete is proposed for this function because it has minimal flow causing it to mound and seal the drain openings associated with the sumps. This will ensure that no bulk fill grout, a higher flow material, will flow into the drains and subsequently into other structures. (See Figure 1 below). Once the sump drain line and overflow drain line openings are covered and effectively sealed, pouring will stop to allow the Low Slump Concrete to gel before the rest of the diversion box is filled. [SRR-LWE-2020-00005]

Figure 1: FDB-5 and FDB-6 Sump Drain Line Configuration (Elevation View - Typical)



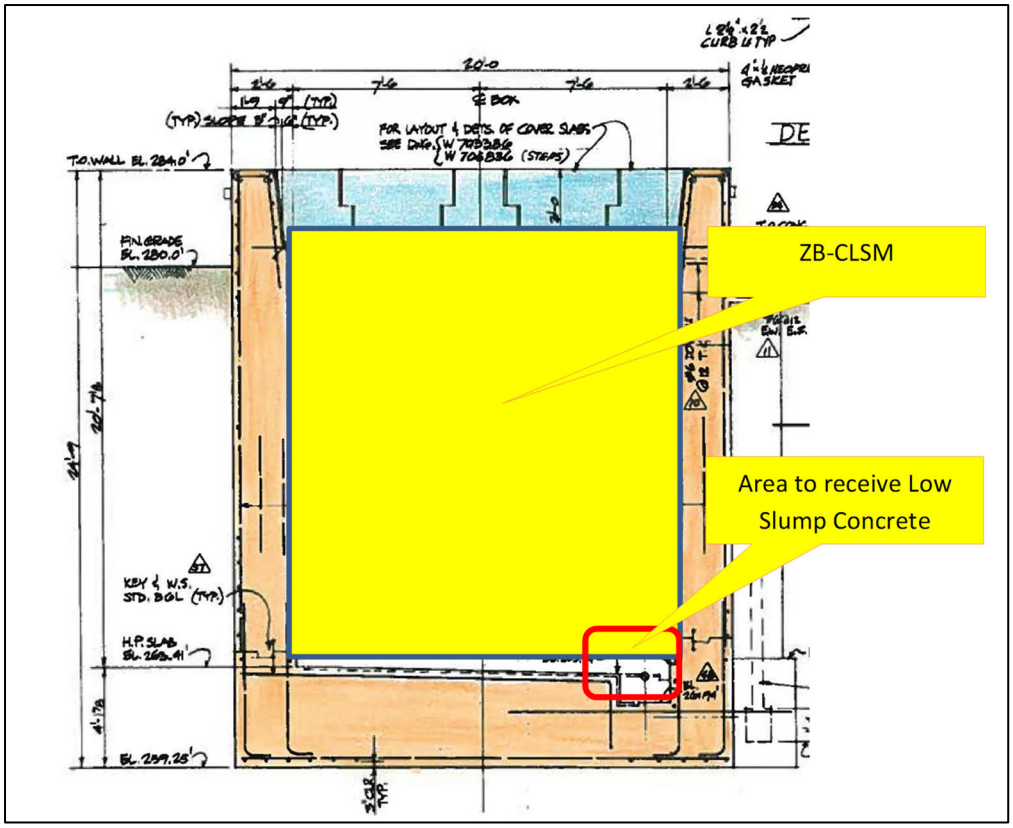
Note 1: Low Slump Concrete will be poured in the general vicinity of the sump based on the location of access ports, and it may also collect in other areas in addition to the area shown.

Based on the need to use Low Slump Concrete to seal drain lines in FDB-5 and FDB-6, it is likely that this concrete will be beneficial for this or similar functions in future ancillary structure closure activities.

The alternate grout proposed for bulk filling FDB-5 and FDB-6 is a zero-bleed variant of CLSM. CLSM has been widely used in applications across the Savannah River Site for various fill applications, and its properties are well understood and documented. CLSM was one of three grout formulations used in the stabilization of Tanks 17F and 20F when these tanks were operationally closed in the late 1990s. ZB-CLSM, mix ZB-FF-8-D [C-SPS-G-00096], is recommended as the bulk fill material for FDB-5 and FDB-6 because the performance of this material has shown to be adequate relative to performance requirements pertinent to FDB-5 and FDB-6, and other ancillary structures, as discussed later in this document.

The advantages of using ZB-CLSM for stabilizing FDB-5 and FDB-6 are ease of use and low bleedwater. ZB-CLSM is highly flowable prior to gelling which allows it to flow and completely fill the enclosing space with little chance of leaving voids. ZB-CLSM is self-consolidating and self-leveling and does not require mechanical assistance to become level. Zero net bleedwater is desired to avoid potential voids and material segregation in the cured material if subsequent pours are made on top of pooled water, and to preclude the need to manage excess water through removal, treatment, and disposal. ZB-CLSM has admixtures to reduce bleedwater which limits the amount of liquid accumulating on the grout surface during placement. Testing of ZB-CLSM showed net bleed as a fraction of cured grout volume at 24 and 48 hours was 0.62% and 0.38%, respectively. [SRR-CWDA-2020-00045] Figure 2 shows the plan for using ZB-CLSM as bulk fill for FDB-5 and FDB-6.

Figure 2: Bulk Fill of FDB-5 and FDB-6 with ZB-CLSM (Elevation View - Typical)



Based on the desire to use ZB-CLSM to bulk fill FDB-5 and FDB-6, it is likely that ZB-CLSM will be beneficial for this or similar functions in future ancillary structure closure activities.

Performance Assessment Assumptions Regarding Diversion Box Fill Grout

Performance Assessment (PA) modeling for both FTF and HTF treat ancillary structures similarly. As discussed in Section 3.2.4.2 of the FTF PA [SRS-REG-2007-00002], ancillary structures (including diversion boxes) would remain in place after operational closure. The ancillary structures would be filled with grout or other materials, as practical, to eliminate subsidence potential. The ancillary structure fill grout is not credited as a deterrent to the inadvertent intruder (per FTF PA Section 3.2.2.6.2, the FTF closure cap and concrete structures will serve as a deterrent to the inadvertent intruder).

The impact of ancillary structure degradation (e.g., corrosion leading to failure of the stainless steel liner) was considered in PA modeling. As described in FTF PA Section 4.2.3.2, the failure estimates considered general and localized corrosion mechanisms of the stainless steel exposed to SRS soil conditions and do not credit corrosion control. As discussed in Section 4.4.2.7 of the FTF PA, the ancillary structures were assumed to be completely intact at the time of closure with contaminant release from all ancillary structures assumed to occur simultaneously when the stainless steel transfer lines are assumed to fail at approximately 500 years after closure. The source term associated with the ancillary structures was assumed available for release directly in the backfill soil surrounding the ancillary structure at that time. No hold up or containment of the source term is assumed to be provided by any of the cementitious materials surrounding secondary

containment structures (such as diversion boxes) or by the cementitious materials filling secondary containment structures.

In contrast to tank fill grout, no grout performance assumptions were made in the PA modeling with respect to ancillary structure fill grout (e.g., no assumptions regarding grout reducing capacity or grout hydraulic conductivity are used in the PA contaminant release modeling). After structure failure for an ancillary structure, the flow through the inventory is set equal to the closure cap driven infiltration rate. [SRS-REG-2007-00002]

Bulk Fill Grout Attributes of Interest

Table 1 contains a list of bulk fill grout attributes that are applicable to waste tank closures with appreciable amounts of residual waste. Ancillary structures typically do not contain significant radiological inventory relative to waste storage tanks and therefore are modeled differently in the PAs and have different required grout attributes. A discussion of applicability of each attribute to ancillary structures is provided.

Table 1: Tank Closure Grout Attribute Applicability to Ancillary Structures

Grout Attribute	Applicable to Ancillary Structures	Discussion
1. Stabilization: Replacing void spaces with grout prevents subsidence and strengthens the overall structure, thus stabilizing the residual material and containment barriers, which over sufficiently long periods will be subject to external mechanical stresses such as facility cover system overburden and seismic events.	Yes	The proposed Low Slump Concrete and ZB-CLSM will fill void spaces for stabilization in ancillary structures and prevent future subsidence of the structures. The U. S. Nuclear Regulatory Commission (NRC) *Technical Position on Waste Form (Revision 1)* pertaining to 10 CFR Part 61 requires a minimum compressive strength of 60 psi for cementitious stabilization materials and recommends at least 500 psi. Low Slump Concrete has a 90-day compressive strength of approximately 2,000 psi, and ZB-CLSM has a 90-day compressive strength of approximately 1,000 psi.
2. Intruder barrier: Cured grouts are monolithic and have a compressive strength that is typically much higher than that of unconsolidated materials, such as the native sediments and backfilled soil surrounding SRS liquid waste tanks. An inadvertent intruder attempting to install a domestic drinking water well head over a closed tank with the standard mud-rotary drilling technique would experience drill stem refusal upon contact with a sufficiently strong tank grout (if not sooner due to roof concrete and/or a steel liner).	No	The ancillary structure fill grout is not credited as a deterrent to the inadvertent intruder in the PAs. Ancillary structures typically have rebar reinforced concrete cell covers that will serve as an adequate intruder barrier. Additionally, Low Slump Concrete and ZB-CLSM provide adequate intruder barrier 90-day compressive strengths of approximately 2,000 psi and 1,000 psi, respectively.

Grout Attribute	Applicable to Ancillary Structures	Discussion
3. Infiltrating water barrier: Cured grouts typically have a saturated hydraulic conductivity that is much lower than the native sediments and backfilled soil surrounding SRS liquid waste tanks. The lower permeability tends to divert water around the grout and immediately underlying residual material layer, thus minimizing advective release of contaminants.	No	No grout performance assumptions, such as hydraulic conductivity, were made in the PA modeling with respect to ancillary structure fill grout.
4. Chemical conditioning (reducing capacity): The pore water within cured grout will have a high pH, initially around 12.5. High pH generally increases solid-to-liquid phase waste partitioning, depending on the chemical element, thus retarding contaminant release. Eh may be positive or negative depending mainly on the absence or presence, respectively, of ground blast furnace slag in the dry mix. Some species are redox sensitive. For example, Tc concentrations are solubility-controlled for sufficiently low Eh (and high waste loading). Intimate contact between grout and the residual material layer and downward moisture flow tend to impart the chemistry of the grout onto the residual material layer, generally improving contaminant retention depending on the element.	No	No grout performance assumptions, such as reducing capacity, were made in the PA modeling with respect to ancillary structure fill grout.
5. Steel corrosion protection: Grout pore water will have pH > 10 initially and protect steel tank liners from aggressive corrosion until the grout has significantly aged.	No	In PA modeling, ancillary structures were assumed to be completely intact at the time of closure with contaminant release assumed to occur all at one time. Ancillary structure fill material is not credited for corrosion control.

[SRR-CWDA-2020-00045]

In summary, two alternate bulk fill materials are proposed for use in operational closure of FTF and HTF ancillary structures: 1) Low Slump Concrete, and 2) ZB-CLSM. Both fill materials will fill void spaces and provide adequate compressive strength for stabilization and the prevention of future subsidence. Other grout attributes typically required for tank closure are not applicable to ancillary structures. Therefore, the use of these two alternative fill materials are technically justified to be used to operationally close applicable ancillary structures where PA modeling only assumes the fill materials provide stabilization and subsidence prevention.

References

C-SPP-F-00055, *Furnishing and Delivery of Tank Closure Grout*, Rev. 6, October 27, 2016.

C-SPP-Z-00012, *Vault 4 Clean Cap Grout*, Rev. 1, March 20, 2014.

C-SPS-G-00096, *Designing, Furnishing and Delivery of Ready Mixed Concrete, Grout and CLSM (GS & PS)*, Rev. 3, September 9, 2015.

SRR-CWDA-2017-00015*, Consolidated General Closure Plan for F-Area and H-Area Waste Tank Systems*, Rev. 1, April 2017.

SRR-CWDA-2020-00045, *Characterization and Assessment of CLSM Grouts for Potential Use in Waste Tank Operational Closures*, Rev. 0, June 22, 2020.

SRR-LWE-2020-00005, *F-Tank Farm Diversion Box 5&6 Grout Strategy*, Rev. 0, August 12, 2020.

SRS-REG-2007-00002, *Performance Assessment for the F-Tank Farm at the Savannah River Site*, Rev. 1, March 31, 2010.