GROUT STRATEGY FOR TANKS 5 AND 6 CLOSURE

SRR-LWE-2012-00087, Revision 2

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Table of Contents

Revision History

Revision 0 Initial Issue

Revision 1 Incorporation of Project plan updates

Section 1.0 Section revised to reflect Tank 6 H&V systems have not been isolated.
Section 2.0 Corrected the number of columns from 8 to 12
Section 3.0 Grout procurement specification C-SPP-F-00055 Revision 4 used for Tanks 5 & 6 grouting
Section 4.0 Added clarification that the slicklines shall be routed to minimize their length.
Section 6.1 Added hydrogen sampling requirements due to loss of ventilation. Provided greater detail for primary tank and annulus portable ventilation systems.
Section 6.2.1 Provided additional detail for grouting method of annulus ventilation.
Section 6.2.3 Clarified the cooling coils to be flushed in this section had previously been identified as intact or operable coils.
Section 6.2.4 Provided guidance as to which risers and tank penetrations require capping.
Section 8.0 Updated references.
Grammatical corrections made throughout.

Revision 2

Revision History. Updated C-SPP-F-00055 Revision number to 4
Section 1.0 Updated to reflect Tank 6 annulus ventilation system removed.
Figure 4.1 Updated graphic
Table 5.1-01 Removed note concerning High Level Conductivity Probes
Table 5.1-02 Updated Tank 6 Equipment to remain in tank.
Section 5.0 Updated Tank 5 equipment status
Section 6.1 Updated hydrogen sampling requirements per HFPA 69
Updated field status of the Tank 5 purge ventilation system
Section 6.1 Updated hydrogen sampling requirements per HFPA 69
Section 6.2 Added Flammability Control Program requirements for grouting.
Section 8 Updated references

1.0 Summary

Waste removal has been completed in Tanks 5 and 6, residual contaminants were sampled and remaining residual inventory characterized. Tank systems have been isolated from the F-Tank Farm (FTF) facilities that remain operable, with the exception of the Tank 6 purge ventilation fan.

Upon the Department of Energy's determination that all FTF General Closure Plan [LWO-RIP-2009-00009] requirements have been met, the project will proceed with completing operational closure by stabilizing the tanks with grout. This strategy will outline the process to be used in completing the grouting of Tanks 5 and 6.

2.0 Background

Tanks 5 and 6 are part of the group of eight Type I waste tanks (Tanks 1 through 8) in the FTF. A typical Type I waste tank is shown in Figure 2.1. The FTF Type I tanks were constructed in the early 1950s. These waste tanks are 75 feet in diameter and 24.5 feet high. The tanks are fitted with vertical and horizontal cooling coils to remove radioactive decay heat.

The Type I primary tanks are completely surrounded by an annular space and enclosed in concrete vaults. The Type I waste tank roof is made of 22-inch thick concrete and supported by twelve columns. The concrete roof and columns are lined with carbon steel on the inside. The Type I tanks have a nominal capacity of 750,000 gallons that equates to 2,710 gal/in (depth) of stored material. The carbon steel tank floor is essentially flat with no sump, significant low points, or slope.

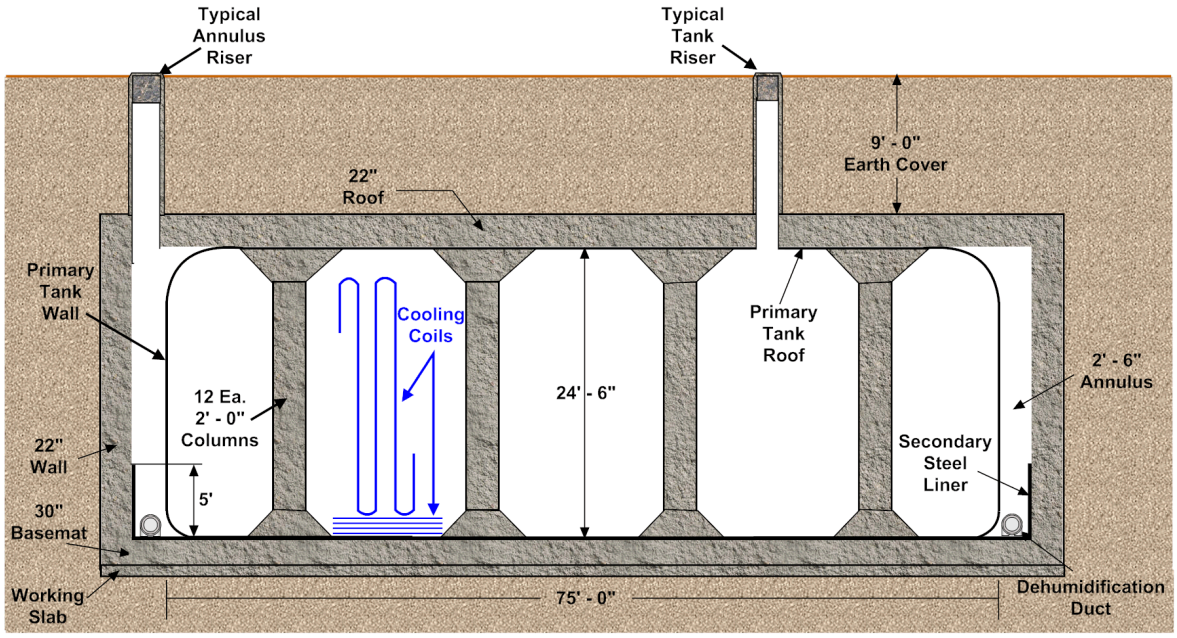

Figure 2.1: Typical Type I Tank

As designed and constructed, the roofs of Tank 5 and Tank 6 have nine primary tank access risers. Eight perimeter risers are 23 inches in diameter (opening to waste tank interior),

approximately 12 feet long, and approximately 24 feet six inches from the bottom of the riser to the waste tank bottom. The eight perimeter risers are on a 21 foot radius from the tank center and are not symmetrically located. The single center riser is approximately 42 inches in diameter (opening to waste tank interior) and approximately 12 feet long, and 24 feet six inches from the bottom of the riser to the bottom of the waste tank. The waste tank riser design configuration provides limited access to the waste tank interior.

The tank annular space is fitted with four access risers located 90 degrees apart at the North, South, East and West edges of the tank. These risers are 30 inches in diameter. The annular space is 30 inches wide and is fitted with a steel liner along the tank bottom and up to an elevation of 5 feet on the annular space outside wall. The bottom of the annulus is fitted with a ventilation duct, fed from the supply fan through ducting.

3.0 Grout Functions, Requirements, and Formulation

Liquid waste tanks undergoing closure are required to be filled with grout for the purpose of chemically stabilizing residual material, filling the tank void space, and discouraging future intrusion. Formulation LP#8-16 was used as the bulk fill grout in Tanks 18 and 19 [C-SPP-F-00055 Revision 2]. This mix was evaluated in 2011 [SRNL-STI-2011-00551]. Engineering requirements for the equipment fill grout(s) have been developed as the result of Phase 1 mock-up testing, documented in SRNL-STI-2011-00564 and demonstrated in Phase 2 mock-up testing [SRR-CES-2012-00031]. Experience with grouting Tanks 18 and 19 showed that high slump flow values were advantageous in minimizing mounding of the grout under the pour point, therefore, the grout formula used for Tanks 18 and 19 was adjusted to enhance flow in Tanks 5 and 6. Bulk fill grout procured for Tanks 5 and 6 will be provided by a vendor under specification C-SPP-F-00055 Revision 4.

The supplier selected to provide grout for Tanks 5 and 6 will be required to demonstrate the ability to batch and deliver the flowable, structural fill to F-Tank Farm. Samples of material batched at full-scale will be tested to qualify the ability of the grout subcontractor to produce and deliver the mix.

4.0 Pour Methodology

A supplier will deliver grout to an SRR installed and operated grout distribution and placement system. The grout will be delivered to FTF using cement mixer trucks. Front-end discharge cement mixer trucks are preferred due to their ability to off-load grout more quickly. The cement mixer trucks will empty grout into a hopper integral to the grout pumps. The grout will be pumped from the grout pump through slicklines to multiple primary tank and annulus risers on Tanks 5 and 6.

The grout distribution and placement system will be slicklines configured to support primary or annulus filling as required. The slickline routing to individual risers will be implemented using slickline fittings, e.g. tees and plugs. This will minimize or eliminate the need for slickline valves. The slicklines will be compliant with American Society of Mechanical Engineers (ASME) B30.27-2009, *Material Placement Systems*, and American

Concrete Institute (ACI) 304.2R-96, *Placing Concrete by Pumping Methods*. The slicklines shall be routed so as to minimize their length. It is anticipated the grout pumps will be located east of Tank 6 between the service road and Tank 6.

Bulk fill reducing grout will be used to fill the entire volume of Tanks 5 and 6 primary and annulus tank volumes, with the possible exception of the annulus ventilation duct volume. It is permissible to use equipment fill grout for grouting of the annulus ductwork. The reducing grout will flow and cover any residual material remaining in the tank and annulus. The ability of the grout to flow and cover any residual material remaining in the tank or annulus has been demonstrated during grouting of Tanks 18 and 19. However, internal tank obstructions and interferences in Tanks 5 and 6 increase the risk of uneven grout distribution. To reduce this risk, bulk fill grout with higher slump values will be introduced into the primary tanks through multiple risers. If additional pour locations are required to cover tank residual material, additional access points will be identified and slicklines installed to address the exact area requiring special effort. Figure 4.1 shows a conceptual grout equipment layout.

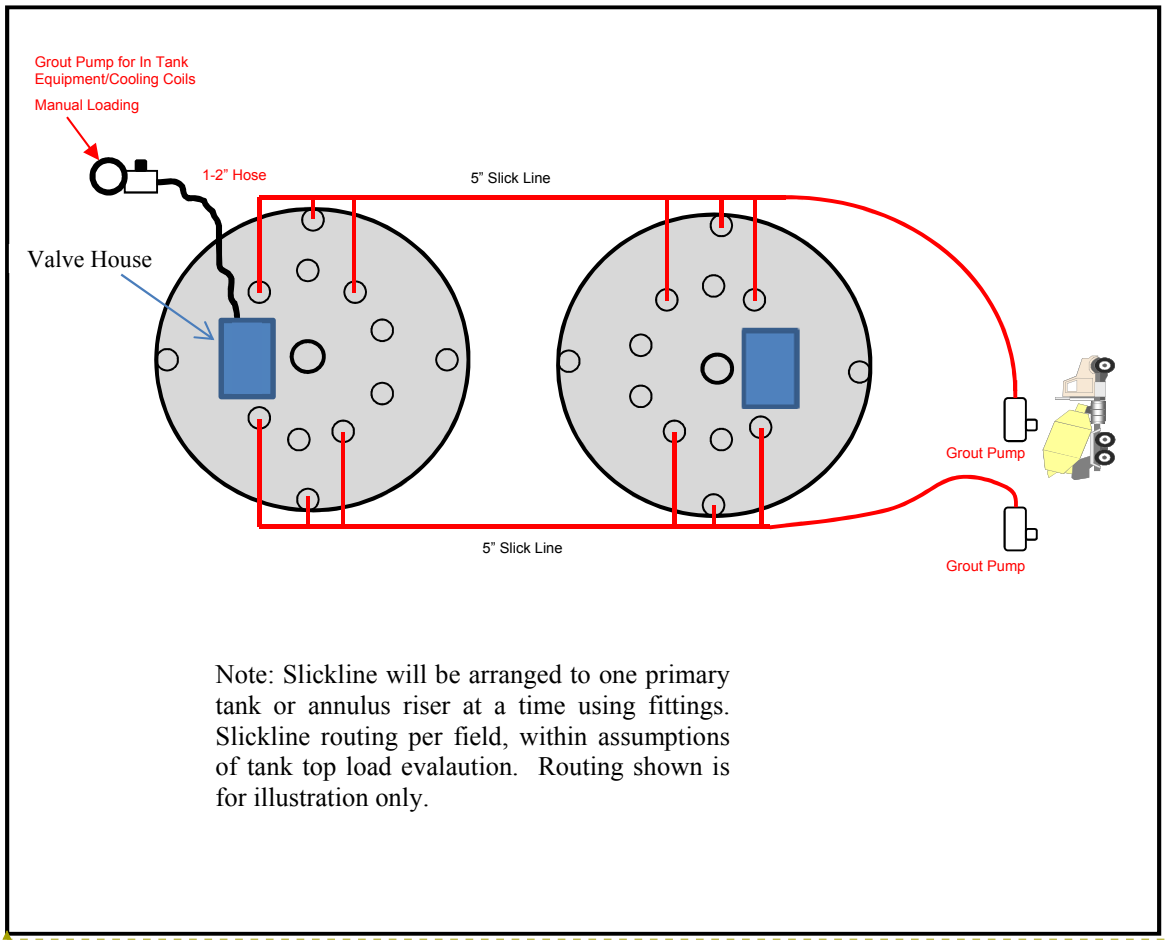

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Figure 4.1: Tank 5 and 6 Conceptual Grout Equipment Layout

5.0 In-Tank Equipment

Various types of equipment from the bulk waste removal and heel removal campaigns remain in Tanks 5 and 6.The goal is to eliminate vertical fast flow paths down through the grout to the residual material on the tank floor. A vertical fast flow path negates two of the primary purposes of the entire grouted tank:

1.) Slow water infiltration and

2.) Chemically treat the infiltrating water to retard contaminant migration.

Open vertical pathways (pump discharge lines, thermowells, etc.) in the tank will be filled with grout to the extent practical. The equipment fill grout mix is recommended for the filling of abandoned equipment [SRNL-STI-2011-00592]. Tables 5.0-1 and 5.0-2 show the equipment remaining at the start of grouting in Tanks 5 and 6, respectively, and the locations. It is assumed that all submersible mixing pumps (SMPs) will be removed from Tank 6 prior to the start of grouting. Both Tanks 5 and 6 contain a submersible transfer pump, caisson and thermowell in Riser 6 and a partially disassembled fixed length transfer jet suspended in Riser 4**.** A pneumatically powered Wilden pump is located in the Tank 6 south annulus riser. To ensure the grouting will meet the Performance Assessment (PA) assumptions, sequencing of the grouting activities for Tanks 5 and 6 are required to accomplish grouting of the internals of the dip tubes and other opened ended equipment. Vertical pipes closed at the bottom, such as thermowells, may be grouted at any time. Vertical pipes open at the bottom, such as dip tubes, must have the bottom open end of the pipe covered by bulk fill grout before they are grouted. The Submersible Transfer Pumps (STP) in Tanks 5 and 6 will be grouted internally through the vent/flush connection in the upper riser. The bottom of the pump must be covered in bulk fill grout prior to the introduction of grout into the pump. The STP caisson may be grouted last with bulk fill grout.

There is equipment in Tanks 5 and 6 that will not be grouted: The transfer jets will not be grouted due to the equipment's configuration. The transfer jets in both Tanks 5 and 6 are suspended in the riser approximately 24 feet above the tank floor. Two electrically powered sampling crawlers are located in each tank. The robotic sampling crawlers will not be grouted due to their lack of internal voids. Cabling attached to the sampling robot has been cut and dropped to the tank floor. The cabling will not to be moved from its current arrangement in the tank. The sampling robots will be entombed in place on the tank floor. The potential for galvanic corrosion of the carbon steel tank floor due to the presence of stainless steel equipment was evaluated [SRNL-L4440-2011-00004] and found to have no adverse impact. The Tank 6 annulus transfer pump will not be grouted because the positive displacement pump cannot be vented to allow filling of the pump internals through the pump discharge hose. The hoses currently connected to the annulus transfer pump may be cut at the riser level and dropped into the annulus. The Tank 6 annulus transfer pump will be entombed in similar fashion to the robotic crawlers. In Tank 6 Riser 5 a thermowell assembly consisting of a 1" Schedule 40 thermowell tube sealed at the bottom end and two ½" Schedule 40 pipes will be entombed. The two 1/2" pipes are fitted with spray nozzles to allow mining of the assembly into the tank. The assembly has been shortened and lowered back into the tank. The cut length of the assembly is such that he top of the assembly is approximately 3 feet below the plane of the riser opening and the bottom of the

assembly is suspended above the tank floor. Thus the assembly will have an approximate 3 foot layer of bulk fill grout above and below the assembly.

Due diligence should be put forth to add the equipment fill grout into the equipment to ensure that voids are filled to the extent practical. All efforts should be made to vent equipment being filled with grout.

Table 5.0-1 – Remaining Tank 5 Equipment at Start of Grouting

Riser Location	Equipment	Grout Plan
Center	Robotic sampling crawler and cabling located on floor approximately 5 feet east of riser. Umbilical cables abandoned in tank.	Not accessible to grout. Minimal void space. Crawler will be encapsulated.
Riser 1	None	N/A
Riser 2	None	N/A
Riser 3	None	N/A
Riser 4	Disassembled fixed length transfer jet suspended in riser approximately 24 feet above the tank floor	Not accessible to grout. Will not be grouted internally but encapsulated during riser filling.
Riser 5	Robotic sampling crawler and cabling located on floor at tank wall southeast of riser 5. Umbilical cables abandoned in tank.	Not accessible to grout. Minimal void space. Crawler will be encapsulated.
Riser 6	Submersible Transfer Pump and caisson, Per P-PA-F-3480-3482 1 inch, 33 feet 10 inch long Thermocouple well	Pump and discharge line will be grouted. Caisson will be grouted Thermowell will be grouted
Riser 7	None	N/A
Riser 8	None	N/A
North Annulus	Alarm Junction Box-Approx. 6 feet above annulus floor on outer annulus wall	Not accessible to grout. Minimal void space.
East Annulus	None	N/A
South Annulus	None	N/A
West Annulus	None	N/A

Table 5.0-2: Equipment to Remain in Tank 6 at Start of Grouting

Riser Location	Equipment	Grout Plan
Center	None	N/A
Riser 1	None	N/A
Riser 2	None	N/A
Riser 3	None	N/A
Riser 4	Disassembled fixed length transfer jet suspended in riser approximately 24 feet above the tank floor	Not accessible to grout. Will not be grouted internally but encapsulated during riser filling.
Riser 5	Shortened and suspended thermowell assembly	Not accessible to grout. Will not be grouted internally but encapsulated during riser filling.
Riser 6	Submersible Transfer Pump and caisson, Per P-PA-F-3546-3548 1 inch, 33 feet 10 inch long Thermocouple well	Pump and discharge line will be grout internally. Caisson will be grout Thermowell will be grouted
Riser 7	Robotic sampling crawler and cabling located on floor approx. 5 feet north of riser 7. Umbilical cables abandoned in tank. Robotic sampling crawler and cabling located on floor at tank wall south of riser 7. Umbilical cables abandoned in tank.	Not accessible to grout. Minimal void space. Crawlers will be encapsulated.
Riser 8	None	N/A
North Annulus	None	N/A
East Annulus	None	N/A
South Annulus	Wilden Transfer Pump per M-PA-F-00050 Alarm Junction Box-Approx. 6 feet above annulus floor on outer annulus wall	Transfer hose not accessible to grout. Will not be grouted internally Transfer pump, discharge hose and air supply hose will be encapsulated. Not accessible to grout. Minimal void space.
West Annulus	None	N/A

6.0 Grout Strategy

6.1 Pre-Grout Activities

The preferred risers for Tank 5 and 6 grout additions are Risers 1, 3, 5 and 8. The risers are at an equal radius from the tank center and roughly equidistant from each other. These risers will be modified to permit grout to be placed into the tank. These risers have no known internal obstructions. The SMP currently in Tank 6 Riser 3 will be removed prior to the start of grouting preparations. For Tank 5, it is assumed that Risers 1, 2, 3, 4, 5, 7, 8, Center, East, West and South riser plugs will be replaced with new riser covers to facilitate grout placement. For Tank 6, it is assumed that Riser 1, 2, 3, 4, 5, 7, 8 North, East and West riser plugs will be replaced with riser covers to support grouting.

Provisions will be made to provide grout delivery point(s) into the tank. Camera and lighting access into the tank will be provided through the riser covers. Radiological containment will be provided at each riser opened. The radiological containment will allow air displacement venting and allow ventilation condensate to be managed. During the actual grouting of the tank and equipment measures will be taken to handle any overflow while filling equipment or risers. Figure 4.1 shows a proposed slickline path and riser installation concept. It is assumed that Risers 1, 3, 5, 7, 8 and Center Riser will be configured to support video operations. Previous experience gained during robotic sampling in Tanks 5 and 6 indicates the need to have at least 3 video cameras at a time to see the majority of the primary tank at the same time. The use of additional installed cameras is anticipated to reduce potential downtime when the riser location being filled is changed. It is anticipated that 4 cameras will be used simultaneously to support annulus grouting. However, based on field experience the number of annulus cameras maybe reduced. [SRR-LWE-2013-00008]

Prior to grouting a CLOSURE tank is unable to achieve hydrogen levels sufficient to allow the tank or annulus vapor space to reach 100% of LFL. However, as the primary tank and annulus are filled with grout the vapor space becomes small enough for hydrogen levels to increase. By this time the Material at Risk in the primary tank or annulus has been covered by grout and is immobilized. Thus the ventilation is not credited in the DSA for tanks in this mode. As a best management practice prior to the start of grouting the Tanks 5 and 6 shall undergo quarterly ventilation operation using an installed or portable ventilation system (i.e., for a duration of 12 vapor space turnovers with downtime not exceeding 12 cumulative hours from start to completion). As an alternative to ventilation operation, the tank vapor space may be verified to be less than 25% of the LFL.

Prior to initiating grouting operations, Engineering shall perform an evaluation to determine the following (not applicable to riser grouting):

a. minimum purge flow required to maintain a flammable vapor concentration below 25% CLFL during grouting
b. required time for response to a loss of ventilation (e.g. restoration of ventilation or periodic flammable vapor sampling)

Grout distribution piping, slickline and tremie details will be included in the installation work packages. All equipment modifications inside the tank isolation boundary will be detailed accordingly via field sketches that will be utilized during pre-grout and grouting activities [U-ESR-F-00051]. The distribution piping will be inserted through a riser access port(s) to allow introduction of the bulk fill grout into the tank. The distribution pipe outlet may have the ability to traverse allowing limited directional control of the grout leaving the distribution piping.

The project team will develop detailed grout modification work packages for each riser and piece of equipment. The Tank 5 purge ventilation system has been removed and cannot be used. The installed Tank 6 ventilation system will not be used due to its condition. Two primary tank and annulus risers in each tank will be modified to provide connection to a portable ventilation system. In this way, no adverse impact to grouting operations will occur if the HEPA filters need replacing. The ventilation system will have provisions for dealing with moisture in the vapor. One primary tank and annulus riser will be fitted with a purge air inlet suitably fitted with a HEPA filter. When the entire primary tank is filled, containment of the individual risers will be maintained during filling.

Bulk fill grout will be introduced into the annulus space of the tanks using two of the four annulus risers. The two annulus risers used to place grout will be 180 degrees apart. All four annulus risers shall be configured to support simultaneous camera operation. One annulus riser shall be configured to support a portable ventilation system configured similarly to the tank primary portable ventilation. The Tank 6 annulus transfer pump will be entombed in place. The ¾" supply air hose and the 1" discharge hose will be cut at the South Riser cover and dropped into the annulus.

Intact cooling coils will be flushed with water prior to the introduction of grout. The chromate water flushed from intact cooling coils shall be collected and returned to a waste tank.

6.2 Grout Sequencing Activities

The sequence of primary tank and annulus filling is subject to the restrictions imposed by Structural Integrity requirements. [T-CLC-F-00496]

Each day of grout placement in the primary tank or the annulus, a camera inspection shall be performed prior to start of pouring grout. These inspections will look for voids or anomalies in the grout placed the previous day. Additional camera inspections are recommended during grout pouring at approximately midday and at the end of the day when grout pouring is complete for the day. These inspections shall be recorded if performed. However, grout filling may proceed without an operating video camera, as long as the initial camera inspection of the day is met. The grout level will be calculated based on the volume of grout added and verified using visual reference markings, as possible. [SRR-LWE-2013-00008]

6.2.1 Annulus Bulk Fill Grouting

Bulk fill grout will be introduced into the annulus, between the outside radius of the annulus ventilation duct and the annulus space steel wall. A bed of grout will be poured approximately 6 to 12 inches deep to support the annulus ventilation duct. This bed of grout will serve to support the annulus ventilation ducting from collapse during grouting of the ducting interior. Annulus filling is subject to the restrictions imposed by Structural Integrity requirements. [T-CLC-F-00496]

The addition of bulk fill grout inside the duct will be performed through the tank annulus ventilation inlet piping. The annulus ventilation inlet fan casing will be removed to allow clear access to the inlet ducting. A plate will be installed with penetrations to allow grout introduction through the plate and the venting of inlet ducting during filling. The venting penetration will be connected to a suitable HEPA filter. The bulk fill grout will flow through the ventilation inlet ducting to the bottom of the annulus where it will fill the horizontal ventilation ducting. There are two legs of the horizontal ventilation ducting. Filling of one leg shall continue until that leg is filled to the extent practical. Additional grout will then flow into the second leg and the process repeated. The ducting at the bottom of the annulus decreases in size, in step-wise fashion, as it progresses around the annulus. Distribution holes are located in the top of the ducting at various points. Grout filling should continue until grout is observed exiting the all horizontal ducting distribution holes. Flexible hose may be used to introduce the grout into the duct work.

Once the horizontal ventilation ducting is grouted, the addition of bulk fill grout may then resume into the rest of the annular space subject to the restrictions imposed by Structural Integrity requirements, up to the annulus riser openings. In parallel with filling of the annulus, the vertical section of annulus ventilation inlet ducting may be filled all the way back to grade level with either equipment fill or bulk fill grout. In a similar fashion, the annulus ventilation exhaust ducting will be filled to grade level. The annulus ventilation exhaust should not be filled until the rest of the annulus filling is completed. To allow the introduction of grout into the annulus ventilation exhaust ducting, a penetration will be made in the exhaust hood base. The grout fill hose will be connected to this penetration. Venting of the annulus exhaust ducting during grouting will be through the exhaust HEPA filter located in the exhaust hood. There is no requirement to cap the annulus ventilation ducting at grade level. The annulus risers will be filled up to the level of the riser opening planes. Riser capping will be completed on annulus risers in similar fashion to primary tank risers.

Prior to initiating annulus grouting, monitor the vapor space to ensure that the flammable vapor concentration is less than 25% CLFL. If the result is equal to or greater than 25% CLFL, operate forced ventilation until the flammable vapor concentration is less than 25% CLFL.

When grouting is initiated, the following shall be performed for the primary tank and its annulus until each of these locations is completely filled to ensure that flammable vapor concentration remains below 25% CLFL:

a. Ventilate the location with forced ventilation

OR

b. Perform periodic flammable vapor sampling

If ventilation is being used to satisfy this attribute and ventilation flow is lost, initiate periodic flammable vapor sampling until forced ventilation is restored.

6.2.2 Primary Bulk Fill Grouting

Grout should be placed in the primary tank prior to the grouting of vertical cooling coils. Primary tank grouting may be completed prior to the grouting of any cooling coils. This will mitigate the risk of chromate water leaking into the tank during cooling coil grouting. Primary tank filling is subject to the restrictions imposed by Structural Integrity requirements. [T-CLC-F-00496]

Multiple risers may be used to place grout into the primary tank. Field experience and engineering judgment shall dictate which riser to fill from and the frequency of switching risers.

When indicated by visual surveillance, the in-tank equipment may be filled with grout when the bottom open sections of the individual pieces of in-tank equipment are covered by bulk tank fill grout. During the bulk fill grouting activities of the tank, the tank will be ventilated utilizing a portable ventilation system.

Prior to initiating primary tank grouting, monitor the vapor space to ensure that the flammable vapor concentration is less than 25% CLFL. If the result is equal to or greater than 25% CLFL, operate forced ventilation until the flammable vapor concentration is less than 25% CLFL.

When grouting is initiated, the following shall be performed for the primary tank and its annulus until each of these locations is completely filled to ensure that flammable vapor concentration remains below 25% CLFL:

a. Ventilate the location with forced ventilation

OR

b. Perform periodic flammable vapor sampling

If ventilation is being used to satisfy this attribute and ventilation flow is lost, initiate periodic flammable vapor sampling until forced ventilation is restored.

6.2.3 Cooling Coil Grouting

Known leaking or failed coils have been previously flushed [M-M6-F-3161, M-M6-F-3162, M-M6-G-0669]. Cooling coils indicated to be leak free have yet to be flushed. All intact cooling coils require flushing prior to the introduction of grout into the cooling coils. A leak check of existing intact, operable coils should be performed to determine if the cooling coil leak status has changed. The chromate water flushed from intact cooling coils shall be collected and returned to an active waste tank. The flush water will remove chromate cooling water from the coils and will ensure a uniformly wetted path exists for the grout to follow. This will also reduce the possibility of chromate cooling water entering the tank during grouting of the coils. Previously identified intact cooling coils identified to have large or guillotine-type leaks shall be flushed from each coil end back into the primary tank, while minimizing the addition of water to the tank. Video camera support of the coil flushing shall utilize several risers simultaneously to allow the greatest opportunity to identify leaking coils. [SRR-LWE-2013-00008] Cooling coils will be grouted with a grout formulation conforming to the latest revision of C-SPP-F-00057 and blended per SRNL-L3100-2012-00205. This formulation was demonstrated in lab and field testing. [WSRC-STI-2008-00298, WSRC-STI-2008-00172]

A minimum of 20 inches of grout will be placed into the tank prior to the grouting of the any cooling coils. All known failed or guillotined cooling coils are vertical coils. The 20 inch bed of grout will support the vertical cooling coils and help prevent vertical coil failure during grouting. Engineering judgment shall be used in determining when the 20 inch grout depth has been reached. Limiting the grout level to approximately 20 inches will allow the greatest opportunity for guillotined cooling coils to vent during grouting, and provide adequate structural support.

Coils having a guillotine failure shall be grouted from each end until indicated to be full. It will not be possible to collect any residual water from these types of coils during the grouting. There may be sections of coils with guillotined breaks not connected to the coil inlets and/or outlets. These intermediate sections of coils with guillotined breaks may not be filled with grout internally due to their configuration. It is also possible for portions of guillotined coils connected to the coil inlet or outlet, to not be completely filled with grout due to their configuration. Efforts will be made to minimize drainage from guillotined coils during grouting of these coils.

The two horizontal cooling coils, Coils 18 and 36, and all remaining vertical cooling coils shall be grouted after the primary tank bulk grout level has reached approximately 20 inches or greater. The higher the bulk fill grout level achieved before the grouting of coils begins, the lower the risk of water entering the tank due to cooling coil leakage. This is due to the coil being encapsulated by grout and limiting the volume a leak may occupy.

Intact cooling coils and cooling coils with pinhole leaks shall be grouted from the inlet and the volume of flush water displaced from the coils by grout shall be returned to another waste tank. This volume will be determined visually. When grout is visually detected at the cooling coil outlet, additional grout shall be introduced into the cooling coils. At a grout fill rate of 7 gallons per minute, testing indicated a volume of 35 gallons was required to

transition from water to 100 % grout. Higher grout flow rates were stated to have smaller interface volumes; however the amount was not quantified [WSRC-STI-2008-00298]. The grout/flush water interface volume will be collected and disposed of separately.

The cooling coil grouting methodology described above will demonstrate a prudent effort to grout cooling coils to the extent practical. In a manner similar to that of grouting equipment, the internal configuration of the cooling coils is not known with any degree of certainty. Cooling coils indicated to be intact in leak tests may be fouled to the point of not passing liquid. Cooling coils will be filled to the extent practical. If field conditions indicate that a cooling coil is not yet full but will not accept any additional grout, the grout filling of that cooling coil will be declared complete. No further evaluation will be required prior to proceeding. Discrepancies identified between the amount of grout added to a particular cooling coil and the amount estimated to be needed to fill that coil will be documented in the implementing work document.

6.2.4 Riser Grouting

The nine primary tank and four annulus risers for each tank to be filled are listed in Tables 5.0-1 and 5.0-2. All risers have a cube shaped upper portion, capped by a riser cover. The lower riser is a cylindrical tube connecting the upper riser and the tank proper. Riser containment, e.g. a hut or other approved method, and venting will be maintained during grouting of the risers. Individual risers may be capped following grouting of the tank, in-tank equipment and risers. Risers or other tank penetrations extending to above the grade level will not require capping if the grout level in the riser or penetration also extends above the grade level. The grout level in these risers or penetrations will be brought to the level of the riser opening. This level of grout combined with the riser cover will minimize potential water intrusion. In those risers or tank penetrations where bringing the grout level to above the grade level is not achievable, a grout cap shall be placed surrounding the riser or penetration at the grade level. Individual risers may be capped with bulk fill grout, 5000 psi concrete, or other suitable material.

The requirements of NFPA 69 shall be met during tank and annulus riser grouting:

1. Upon completion of bulk (non-riser) grouting perform the following for unfilled risers:
   a. Sample one primary and one annulus riser for flammable vapor concentration weekly. If riser grouting is to be performed, the riser to be grouted may count as one of the risers sampled (annulus or primary)

      - If measured vapor concentration is less than 25% of the CLFL, no action is required.
      - If vapor concentration is greater than 25% of the CLFL, a compensatory measure, as defined in an engineering evaluation, shall be performed to bring the concentration below 25%.
      - Additionally, other unfilled risers in that location (primary or annulus) shall be sampled to determine flammable vapor concentration. Compensatory

measures shall be performed for each riser found with a concentration above 25% CLFL.

b. If data shows the flammable vapor concentration remains below 10% CLFL, the frequency of sampling may be decreased based on an engineering evaluation.

2. For riser grouting, perform the following:

a. Prior to grouting of a riser, sample the flammable vapor concentration.

- If the concentration is less than 25% CLFL, no action is required and grouting may proceed.
- If the concentration is greater than 25% LFL but less than 60%, perform an engineering evaluation to determine compensatory actions to reduce flammable vapor concentration.
- If the measured flammable vapor concentration is equal to or greater than 60% LFL, perform the following:
- Ventilate riser with forced ventilation. Perform a follow-up sample of that riser after ventilating to ensure LFL <25%.
- Sample all other unfilled risers for that location (primary or annulus) and perform required actions defined above for any riser with a measured concentration >25% LFL

b. If grouting is interrupted prior to filling the riser perform the following actions:

- If interruption duration is less than 8 hours, no action is required and grouting may proceed.
- If interruption duration is greater than 8 hours, monitoring of vapor space concentration shall be completed and actions performed as stated in (a) to ensure the flammable vapor concentration is < 25% CLFL before grout pouring can continue.

7.0 Conclusion

The current closure concept for Tanks 5 and 6 is to fill the tanks with a chemically reducing cementitious grout that has the capabilities to protect against inadvertent intrusion after closure. The Tanks 5 and 6 project team has designed the Tank 5 and Tank 6 grouting strategy for planning purposes and to support the grout formulation design and testing. This Strategy may be revised as detailed planning of the specific grouting implementation activities progress.

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