SUMMARY OF APRIL 28, 2022, U.S. Nuclear Regulatory Commission (NRC)/U.S. Department of Energy (DOE) Teleconference to Discuss Technical Review Report (TRR) Related to Tank 12H (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20296A550)

Date: 28 April 2022

Attendees (NRC): Chris McKenney, Cynthia Barr, George Alexander, Mathews George

Attendees (DOE): Charles Comeau

Attendees (SRMC): Mark Layton, Aaron Staub, Larry Romanowski, James Rush, Gregory Arthur, Christina Logan, Robert Voegtlen and Mike Harrell

Attendees (SCDHEC): N/A

Attendees (CNWRA): Cynthia Dinwiddie and Dave Pickett

General

During a January 11, 2022, meeting between U.S. Nuclear Regulatory Commission (NRC) and U.S. Department of Energy (DOE) to discuss the status of F-Area and H-Area tank farm facility (FTF and HTF) activities, NRC and DOE agreed to have follow-up meeting to discuss the following topics:

1. Type I and II Tank Special Analysis (SA) technical review report (TRR) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21231A202)
2. Tank 12H Grouting TRR (ML20296A550)

The Type I and II tank SA meeting was held on March 29, 2022. Tank12H grouting was the subject of this April 28, 2022, meeting. To prepare for the meeting, NRC recommended that DOE review Appendix B of the Tank12H grouting TRR, which listed a number of questions and requested references. Prior to the meeting, DOE provided NRC with the requested references via email on February 22, 2022, to facilitate the discussion.

To start the meeting, NRC staff provided a broad overview of the Tank 12H TRR findings. The NRC staff findings include the following:

- Tank 12H performance requirements were generally consistent with the performance assessment (PA) assumptions with respect to bulk chemical and hydraulic properties

- NRC still has concerns with the potential for shrinkage gaps, cracks and other preferential or bypassing pathways to form and the lack of consideration of bypassing pathways in the base case in DOE's tank farm PAs

- NRC is interested in groundwater in-leakage rates and pathways into submerged Tank 12H, and impact on curing and waste release

- NRC is interested in sources of standing water in the risers at the end of grouting and the riser over-fill event that resulted in a spill on the top of Tank 12H

Enclosure

- Uncertainty in hydraulic and chemical performance of grade 120 slag
- Cooling coil grouting lessons learned and potential modifications to cooling coil grouting

With regard to the Appendix B questions, the questions are listed alone with DOE's response, if provided. DOE agreed to provide follow-up responses to questions that were not discussed due to time limitations or provide additional information in the case that DOE sought additional clarification on the questions and the responses were incomplete. In the interest of time, the NRC staff suggested that the questions be broken down into groupings with higher priority items discussed first. All of the Appendix B questions are copied below for ease of reference, along with a response from DOE, if provided.

1. **Grout Specifications & Testing:** While the use of high-range water-reducer ADVA 575 has increased to achieve greater flowability, the viscosity modifying admixture (VMA), EXP 958 dosage has not changed, even though VMAs are used to counter-balance the use of high-range water-reducers, which at higher quantities can lead to excessive bleed water segregation. Why has EXP 958 dosage not changed with the increase in ADVA 575? Please provide the quantity or range of ADVA 575 and RECOVER in fluid ounces that were used to batch tank grout for Tank 12H (the 5 accepted and 5 rejected grout batch tickets for Tank 12H provided in SRR-CWDA-2020-00052 were illegible so the NRC could not determine the dosages).

DOE Response: ADVA 575 ranged 320 to 330 oz, and RECOVER ranged 50 to 70 oz in Tank 12H.

2. **Grout Specifications & Testing:** Tank 12H was grouted with two different types of grout. Lehigh Grade 120 slag cement was used in the mix to grout Tank 12H, after the second day and thereafter, however Holcim Grade 100 slag cement was used in the mix poured on the first day. Please explain the reasoning for using Grade 100 slag in the first 27 batches of tank grout that were placed into Tank 12H on the first and second grouting days. Also, was there a decision made to use all existing Grade 100 slag, even if it meant using two different types of slag in grout placed into one tank? Also, did DOE consider it important to use grout comprised of Grade 100 slag in immediate contact with the waste on the floor of Tank 12H? Please evaluate the differences in hydraulic conductivity between the Grade 100 and Grade 120 slag tank grout and any resulting performance impact. Please also consider using remaining untested samples of tank grout for late-term compressive strength testing.

DOE Response: The batch plant used up what they had left before proceeding to the new slag.

3. **Grout Specifications & Testing:** Please clarify if all testing of Lehigh Grade 120 slag is described in VSL-15R3740-1. DOE indicated that additional testing information is provided in SRR-CWDA-2015-00088, but testing results do not appear to be included in this document. What testing, if any, has been completed for tank fill, equipment, cooling coil, and clean cap grout prepared with Grade 120 slag? Has DOE evaluated other reducing tank-closure grouts such as equipment, cooling coil, and clean cap grout? Are there any documents available that includes information about Grade 120 slag tank grout wet chemistry test, flow test, compressive strength, and bleed?

DOE Response: DOE indicated that there are no other test reports available for Lehigh Grade 120 slag.

4. **Grout Specifications & Testing:** The NRC requested the final specification for clean cap grout as a follow-up action to the May 17, 2016, teleconference. Could DOE clarify how it achieves the minimum flowability given that SRNL-STI-2012-00558 indicates that flowability would be compromised at a water-to-cement ratio of 0.51, and that the one most-relevant sample tested in SRNL-STI-2012-00558 (sample WP023 with a water-to-cement ratio of 0.51) had slump flow of only 18.6 cm (7.5 in) and no sample had greater slump flow than 29 cm? Could DOE clarify if any Daratard or any admixtures were used in the Tank 16H clean cap specification, or whether there is an option to use admixtures in the future?

DOE Response: Did not discuss.

D5. **Grout Specifications & Testing:** With respect to SDDR No. 13307, the document has two attachments documenting the two highest bleed results, which were 8.9 percent (June 18, 2015) and 3.3 percent (June 19, 2015), but the deviation description states that none of the bleed tests resulted in zero bleed. Please indicate if this statement was true over a limited time-range, or for every batch placed into Tank 16H. On page 4 of the SDDR, DOE states that bleed test results varied from 0.0 to 8.9 percent, which isn't consistent with page 1, that states none of the bleed tests resulted in 0.0 bleed. DOE also stated that the initial grout mix qualification test results for these two batch tickets show that these batches met the zero bleed requirement (initially, but not after 24 hours). Please clarify.

DOE Response: Did not discuss.

6. **Grout Placement:** The NRC recently reviewed DOE's Tank 16H grouting operations lessons learned document, which included the recommendation to devise grout placement sequence/lift height plans on real grout data for set-up time, specific gravity, etc., instead of on bounding values, to potentially provide more placement flexibility. Please indicate whether the Tank 12H lift height analysis was based on bounding values or realistic values, and if based on bounding values, will realistic values be utilized for Tank 15.

DOE Response: Did not discuss.

7. **Grout Transferability, Flowability & Mounding:** The DOE estimated that 3,928 cubic yards (793,411 gal) of grout would be required to fill a generic, empty Type I tank (U-CLC-G-00001), excluding riser volumes. For Tank 12H specifically, DOE conservatively estimated that the actual volume of the tank was 3010 cubic meters (3,937 cubic yards or 795,082 gal), and that the volume of residual material remaining on the floor of the primary (**Figure 1**) and on cooling coils (**Figure 2**) totaled 6.9 cubic meters (9 cubic yards or 1,900 gal) (SRR-LWE-2016-00036; U-ESR-H-00125; M-CLC-H-03256). Accounting for the residual material volume, the final estimated Tank 12H grout volume (excluding risers) was 3,002 cubic meters (3,927 cubic yards or 793,182 gal). Please indicate what accounts for the difference between the generic Type I tank and actual Tank 12H volume estimates. Please provide an estimate of uncertainty for these volumes. Please confirm that DOE calculates grout volumes in advance of grouting so that the values provided are not biased.

DOE Response: Did not discuss.

8. **Grout Transferability, Flowability & Mounding:** Please provide information about the volumetric capacity of the grout trucks and about the limitations on the amount they can reasonably discharge. Does the batch plant measure "exactly" 6.1 cubic meters (8 cubic yards) (and with what uncertainty) into each truck? When a truck has fully discharged its load of grout

into a tank, is there a certain amount of grout residue remaining on the interior of the truck, such that only approximately 6.04 cubic meters (7.9 cubic yards) are actually discharged per truck? Is it feasible for each grout truck to actually deliver its 6.1 cubic meters (8 cubic yards) of grout?

DOE Response: Did not discuss.

9. **Grout Transferability, Flowability & Mounding:** The Tank 16H lessons learned document addressed needs to (i) remove diversion valves from the grout slickline, because such use resulted in grout plugging and ineffective cleaning of the slickline, and (ii) develop a better method to ensure that the grout slickline is fully wetted/lubricated prior to grout introduction to minimize grout plugging (SRR-TCR-2015-00024). Please provide insight into whether this lesson learned represents a long-term issue that DOE has been tracking through multiple tank grouting operations.

DOE Response: DOE will not use the diversion valves for grout slick lines in the future.

10. **Grout Transferability, Flowability & Mounding:** The Tank 16H grout strategy indicated that having 8 to 10 cement mixer trucks in rotation was ideal (SRR-LWE-2014-00013), whereas the Tank 12H grout strategy later clarified that a grout delivery rate of 8 to 10 trucks per hour (SRR-LWE-2014-00147) was ideal. Which of these two statements is correct?

DOE Response: A truck takes about an hour per rotation, so both statements are correct (8-10 cement trucks in rotation is ideal, and 8-10 trucks per hour is ideal).

11. **Grout Transferability, Flowability & Mounding:** Has DOE made an effort to establish a causative relationship or correlate ambient temperatures or grout placement rates with the Tank 16H mounding phenomenon (ML16167A237), which, if undertaken, would improve understanding of contributing factors or has DOE taken steps to study this phenomenon in the future? For example, DOE could monitor in-tank temperatures (ML16167A237), which are expected to be dominated by the heat of hydration during grouting operations. While the tanks are located underground and are insulated from surface temperature fluctuations, DOE indicates that ventilation of the tanks introduces ambient air into the tanks and could influence in-tank temperatures during grout hydration.

DOE Response: DOE has no plans to monitor in-tank temperatures

12. **Bleed Water Segregation:** Residual pools of flush water present on the floor of Tank 12H before grouting began were mapped by DOE contractors so that those areas could be purposefully avoided during initial grouting of Tank 12H (ML16111B174). Does DOE have such maps or further information available about where residual water remained in the tank for NRC review? DOE should provide additional information regarding the quantity and performance impact of the standing water that was present in Tank 12H during grouting. DOE to follow-up.

DOE Response: The standing water in Tank 12H at the start of grouting was left over from waste retrieval operations. DOE will check and see if they have maps of standing water at the start of grouting. Also, the NRC requested that the DOE indicate how did went about grouting around the pools of water and indicate any potential negative impacts associated with grouting in standing water. DOE will follow-up with additional information on this question.

13. **Groundwater In-Leakage:** As tank grout placed into Tank 12H primary approached the tank roof and risers, liquid perched on the grout surface was observed from several of the risers

(SRR-CWDA-2016-00068; SRR-LWE-2016-00036). Has DOE considered that the rising liquid level could have been comprised, in part, of bleed water that was segregated from grout flow lobes, flowing to low spots near the tank wall? Tank grout comprised of Grade 120 slag may produce more bleed water than tank grout comprised of Grade 100 slag (VSL-15R3740-1). The NRC recalls a water/liquid removal procedure being in place for Tanks 5F and 6F, but that it was not implemented for those tanks. When rising liquid levels were observed approaching the roof of Tank 5 or 6 (perhaps 1 ft of water), why was it unnecessary to pump out the excess (follow-up question from discussion during August 2018 OOV)? Was dry grout mix added to absorb the liquid, as mentioned in a recent work order? Is Tank 12H the first tank for which water was pumped out late in the process of grouting?

DOE Response: DOE indicated that the standing water that needed to be pumped out of the risers toward the end of grouting could have also been due to bleed water segregation, in addition to groundwater in-leakage due to a crack in riser 8, rainwater entering the riser openings, and use of slick line lubricant. DOE indicated that no dry grout has been added to any FTF or HTF tank to date. DOE also indicated that Tank 12H was the first tank where water had to pumped out of a riser with excess water not being re-absorbed into the grout prior to the grout reaching the top of the tank.

14. **Groundwater In-Leakage:** During the May 17, 2016, teleconference, DOE indicated that it is working with SCDHEC to enable original, operational ventilation systems to remain in place during future grouting operations (ML16167A237) to better manage water ingress. Would DOE please provide an update on the status of these discussions and plans?

DOE Response:. DOE was previously required to completely isolate supporting systems prior to grouting. Currently, DOE has increased flexibility with respect to isolation of systems from service. The primary concern is isolation of systems is to ensure that no additional chemicals are added to the tanks (e.g., transfer lines that send waste from the canyons to the high-level waste tanks). But supporting utilities (power, water, ventilation) can now be left in place and used during grouting with isolation occurring later. This flexibility is captured in the Consolidated General Closure Plan (GCP). Diversion boxes 5/6 are the first structures closed under the new or revised GCP. This capability will apply to closure of Tank 15H in the future.

15. **Groundwater In-Leakage:** It is the NRC's understanding that DOE stopped work twice during Tank 12H grouting due to groundwater in-leakage into the annulus through clay pipe ductwork. First, initial planned grouting of the first annulus lift was delayed due to groundwater ingress and required pumping of 3785 L (1000 gal) of water. Then, water was also observed flowing into the vertical ventilation inlet duct of the Tank 12H annulus (SRR-CWDA-2020-00058) through a crack in the duct wall of the Tank 12H annulus (SRR-CWDA-2016-00068). The DOE described that a clay ventilation pipe was a source of groundwater leaking into the annulus (August 2018 OOV). DOE contractors indicated that a vertical leg of the annulus ventilation duct required 1893 L (500 gal) of groundwater to be pumped out. Did this second event all occur on one day, from discovery to resolution of the issue and completion of ductwork grouting? On what date(s)/during which lifts did this second water ingress and pumping of another 1893 L (500 gal) of water occur?

DOE Response: The discovery of the leak occurred on March 2, 2016. DOE began pumping water out on April 14 and completed April 15. Proceeded to begin grouting inlet duct within hours on the same day. The estimated groundwater in-leakage rate was 6 gal/hr.

16. **Groundwater In-Leakage:** Tank 12H is susceptible to groundwater intrusion due to its location below the water table. DOE should provide additional information about the anticipated performance impact on grout in Tank 12H of groundwater saturation. Will DOE undertake modeling to estimate the rate at which the grout monolith of Tank 12H will wet up due to in-leakage?

DOE Response: The DOE indicated that the grout monolith is assumed in the modeling to be fully saturated from the start and inquired if the NRC could provide additional information about its information request. The NRC staff clarified that the question was raised along the same lines of other questions regarding the impact of excess water on the quality of grout placed in the tank, or the impact of differences in grout hydraulic properties on performance due to differences in water-to-cement ratios of grout. The NRC's contractor further clarified if there would be an expected difference in grout performance for submerged versus unsubmerged tanks due to excess water in submerged tanks.

17. **Annulus & Ventilation Duct Grouting:** The Tank 12H closure module (SRR-CWDA-2014-00086) suggested that a more flowable grout might be used to grout future ventilation ducts, and DOE reiterated the potential use of a more flowable grout for ductwork during the February 2–3, 2016, OOV. The Tank 12H grout strategy document (SRR-LWE-2014-00147) did not address use of a more flowable grout for this purpose (ML16111B174). Work order WO 01337683-33 indicates that Lifts 5, 7, and 9 partially consisted of placement of cooling coil grout inside the annulus ventilation duct, addressing the issue of grout flowability within the ductwork. It is the NRC staff's understanding that this is the first tank for which flowable cooling coil grout was placed into the annulus ventilation duct. Please indicate if the DOE had a concern about filling the ductwork using the annulus grout that led to this new use of a more flowable grout. If there was a concern, please provide data or evidence from relevant grouted tanks that supports why this was a concern.

DOE Response: For Tank 12, DOE had allowed within the work packages the capability to use more flowable cooling coil grout in the ventilation ducts. The annulus grout lifts for Tank 12H include Lifts 2, 3, 5, 7, and 9. At the beginning of Lift 5, DOE used 2 supersacks of cooling coil grout to fill a portion of vertical section of the annulus ductwork. The remainder of Lift 5 used regular tank fill grout to fill a portion of the annulus area outside of the ductwork. When water was discovered to be collecting on top of the grout in the annulus ductwork, DOE combined Lifts 7 and 9 into a single lift to fill the remainder of the annulus outside of the duct and then, after removing the water, finished internally grouting the duct. No cooling coil grout was used in Lifts 2, 3, 7 and 9. Lift 5 was about a third of the annulus volume, above the horizontal ductwork. DOE stated that there was no distinct concern that led to the use of the more flowable grout inside the Tank 12H duct work during Lift 5.

18. **Cooling Coil Flushing & Grouting:** Intact cooling coils of Tank 12H were flushed once prior to grouting to remove chromate water, which was sent through a hose to Tank 10H, Riser 3 (SRR-CWDA-2020-00052; WO 01337683-31-A; HTF-SKM-2015-00010). Intact cooling coils remained full of water at the conclusion of flushing (SRR-CWDA-2020-00052). After Lift 8 was complete and the primary had been filled with bulk grout (ML18247A080, Slide 21), flushwater remaining in the coils was flushed again on March 17 and 21, 2016, through hoses into stand-alone, 1135-L (300-gal) gray-water collection totes by grout pumped into the coils (HTF-SKM-2015-00010); this process minimized air entrainment and helped maintain the water-to-grout interface inside the coils (ML16167A237). Please indicate if chromate flushing

into Tank 10 also occurred on these intact coil grouting dates, or beforehand, and when it occurred.

DOE Response: On March 16, 2016, flushing of cooling coils into Tank 10 took place. On March 17 and 21 they grouted the cooling coils. There are no plans to terminate cooling coil grouting.

19. **Cooling Coil Flushing & Grouting:** The 8 intact cooling coils of Tank 12H were grouted only from the coil inlet (SRR-LWE-2016-00036). When a solid stream of grout was visually detected at the coil outlet, a minimum surplus of 38 L (10 gal) of grout was introduced to the coil to ensure complete filling (ML15239A612; SRR-CWDA-2015-00159; SRR-LWE-2016-00036; WO 01337683-31-F). Does the DOE measure the discharged grout volume to determine if more than 37.9 L (10 gal) was introduced to a coil, or does DOE know the coil capacity ahead of time (coil volume) and add 37.9 L (10 gal) to determine the volume of grout to be injected into the coil?

DOE Response: DOE will provide at a later time.

20. **Cooling Coil Flushing & Grouting:** With regard to work order WO 01337683-31-A (Tank 12H coil flushing spreadsheet), please explain the term “water buffalo level” and the disconnect between the water levels recorded before, after, and the volumes required (which do not appear to add up, even with adding a minimum of 37.9 L (10 gal) extra).

DOE Response: DOE will advise what a water buffalo is.

21. **Cooling Coil Flushing & Grouting:** With regard to work order WO 01337683-31-F (Coil Grout Spreadsheet), please explain why this spreadsheet addresses only 5 of 8 intact coils, and why the coil capacity noted here differs from the required flush volumes per coil (WO 01337683-31-A).

DOE Response: There was a missing second page that the DOE will send to the NRC.

22. **Riser Grouting:** It was pre-estimated that 34 cubic meters (45 cubic yards or 9,089 gal) of tank grout would be required to fill the risers, including four spray chambers (SRR-LWE-2016-00036). However, only approximately 20 cubic meters (26 cubic yards of tank grout or 5,241 gal) were used to fill the risers and spray chambers and this is consistent with the grouting operation work order’s description of the estimated riser fill volumes, which total 20 cubic meters (26.2 cubic yards) (WO 01337683-33). Please explain how explain how the total riser volume in SRR-LWE-2016-00036 was mis-estimated, when the total riser volume was accurately estimated in the WO.

DOE Response: The riser volume in SRR-LWE-2016-00036 was mis-estimated.

23. **Riser Grouting:** During the final stages of riser grouting in the Tank 12H primary, a liquid spill onto the tank top occurred when liquid that had accumulated in the tank primary overtopped a riser. DOE thinks the liquid spill was from a riser that was not being monitored by a camera, but the specific riser that was overtopped was not identified in the lessons learned document (SRR-TCR-2016-00007). Please identify the specific riser involved in this liquid spill, and additional reports or documentation of the incident, as well as any video footage.

DOE Response: The spill occurred on 3/7/2016. Spray chambers 6-8 ft in height were left in place during Tank 12H grouting making it more difficult to observe rising grout levels in Tank 12H risers. While filling in Riser 3, the grout backed-up into the Riser 3 spray chamber above the tank level. This was realized when a pipe cleaning “pig” had floated up into the riser and was seen moving around at the elevation of the spray chamber flush ring. Riser 7 was not as sealed as other risers. The grout exited from Riser 7 through the path of least resistance onto the tank top. The NRC staff inquired about the volume of grout that spilled on to the tank top. When recalling the incident during the meeting, the DOE estimated that it was approximately 200 sq feet. The DOE contained the over-flow grout with spill kits and cleaned up the area. The DOE capped the area with grout.