STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Remediation, Oak Ridge Office
761 Emory Valley Road
Oak Ridge, Tennessee 37830

January 7, 2025

Mr. Roger Petrie
Oak Ridge Office of Environmental Management
U.S. Department of Energy
Post Office Box 2001
Oak Ridge, Tennessee 37831

Dear Mr. Petrie

Re: Transmittal of the Remedial Investigation Report for the Molten Salt Reactor Experiment, Oak Ridge, Tennessee (DOE/OR/01-2956&D1)

The Tennessee Department of Environment and Conservation (TDEC), Division of Remediation-Oak Ridge Office, received the above referenced submittal on October 8, 2024. The document has been reviewed pursuant to the Federal Facility Agreement for the Oak Ridge Reservation. Review of this document meets the review cycle protocol of 90 days.

Please note TDEC's expectations for the U.S. Department of Energy (DOE) to complete the previous Molten Salt Reactor Experiment (MSRE) Record of Decision (ROD) for Interim Action (salts) and begin the planning for that activity as described in the 2013 Remediation Strategy Plan.

The following are the Remedial Investigation Report (RI report) comments:

General Comments

1. Several of the RODs discussed in this RI report are interim RODs and may not include final clean-up goals. Change ROD to IROD globally where appropriate.

2. The conceptual site model (CSM) presented in the RI report is incomplete and ignores certain exposure media (e.g., soil, remaining components) and exposure pathways. The CSM should be updated to include all media and exposure pathway such that a comprehensive baseline Human Health Risk Assessment (HHRA) can be completed. This is critical for evaluating remedial alternatives in the Feasibility Study (FS) and identifying what land use controls (LUCs) will be necessary to ensure the selected remedy is protective of human health and the environment.

3. Please attach frequently cited United Cleanup Oak Ridge, LLC (UCOR) documents (e.g., UCOR-5658, UCOR-5657, UCOR-5659) as appendices to this report. As written, this RIR relies heavily upon citations of these external documents. However, the public and regulators do not have easy accessibility to the most recent versions of these UCOR reports. Please include these reports as appendices to the main RI report.

4. Please include a better map illustrating well locations. As this report tends to rely heavily on external UCOR documents, essential information remains in references making this report difficult to read without the supporting documents.

5. While it is understandable to break up the facility into building units, please note that contributions to groundwater and risk should also be assessed holistically (i.e., from all BUs).

6. TDEC is in receipt of the applicable or relevant and appropriate requirement (ARAR) table which was informally submitted by DOE after the official transmittal of the RI Report. Tri-party agreement on anticipated ARARs is critical for identifying and evaluating remedial action alternatives in the Feasibility Study. Identification and agreement on ARARs early in the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) process is necessary for continued progress to finalize ARARs in a following decision document allowing for implementation of the selected remedy. TDEC is currently reviewing the draft ARAR table, anticipates providing comments to DOE soon, and requests DOE to schedule FFA tri-party discussion on the topic to ensure adequate consideration of stakeholder interests.

<u>Specific Comments</u>

1. Page ES-1, Executive Summary – Please clarify if the *updated Feasibility Study (FS)* will be an FS addendum.

2. Page 3, Section 1.2.1.1, 2nd paragraph – This paragraph references the 2013 Remediation Strategy Plan which identifies a tentative fuel and flush salts disposition date of 2032. Does DOE intend to implement the strategy described in this plan? Has a Defense and TRU waste determination been completed for the fuel and flush salts? Provide additional detail regarding the plan for fuel and flush salts disposition. Milestones should be added to Appendix E and J to support implementing the current IROD.

3. Page 3, Section 1.2.1.2, 3rd paragraph – The difference between the updated FS and the 1997 FS is discussed in this section. It is unclear if DOE intends to implement two separate remedies simultaneously at MSRE, the final ROD this RI supports and the 1998 IROD to remove fuel and flush salts, or if this final ROD will supersede the IROD with an inclusion of the fuel and flush salts removal. Provide clarification in the text on how the remedy under the IROD is incorporated into the final ROD.

4. Page 3, Section 1.2.1.2, No.2 – No. 2 states that the "*range of remedial alternatives for the updated FS will encompass ISD and/or removal and disposal of contaminated equipment from multiple MSRE BUs*." Will **all** the remedial alternatives evaluated in the updated FS assume that the fuel and flush salts have been removed? Please provide clarification in the text how the remedy under the IROD is incorporated into and consistent with the updated FS and final ROD.

5. Page 5, Section 1.2.2, last paragraph – The last paragraph states, "*In addition to the MSRE characterization activities, the RI includes a baseline human health risk assessment (HHRA) based on modeled future releases and assuming a residential exposure scenario and no remedial action* ***other than removal of the fuel and flush salts in the DTC.*** *The release and transport results and risk assessment for this no-action scenario are presented in Sect. 3.2 and Chap. 4 of this RIR*." However, in Section 3.2 it states that "*for purposes of release simulation presented in this RI and the baseline (no-action) HHRA presented in Chap 4,* ***the Drain Tank Cell salt is assumed to be left in place.***" These two statements contradict each other, please clarify the assumptions used for the simulations and baseline HHRA in this RI. It may be beneficial to clearly state up front in the document the strategy for salt removal and what assumptions will be used in what document.

6. Page 47, Hydrogeologic conditions – Please revise list to include borehole field testing of hydraulic conductivity.

7. Page 63, Section 3.1.1 – Please provide additional details on the fuel and flush salts disposition assumptions included in the no-action alternative. Does the release and transport modeling assume that the fuel and flush salt are removed by year 100?

8. Page 67, Figure 23 – CSM - While this figure is helpful in illustrating the water table, it would be beneficial to also include a discussion and a table within the text of the document which describes the location of each building unit relative to the fluctuating groundwater table. In addition, it would be beneficial to discuss water level depths relative to building units with the pump on and off. From the figure, it is obvious that some of the building units extend below the water table, but it is difficult to determine to what extent.

9. Page 69, Section 3.1.3 – The residential scenario should not exclude the dermal contact, external exposure, and inhalation exposure pathways. Under a residential scenario these exposure pathways are complete. Please revise the text, recalculate the PRGs, and update the tables as needed.

10. Page 69, Section 3.1.3 – The last paragraph states, "*Adoption of this simplified (and unlikely) residential human exposure scenario is consistent with the FS objective to evaluate the effectiveness of remedial alternatives for individual BUs and for the MSRE as a whole according to the CERCLA threshold criterion for protection of human health and the*

environment." Were the remedial alternatives evaluated for MSRE as a whole, and if yes, where are the results reported?

11. Page 70, Section 3.1.3, last paragraph – As discussed in numerous meetings, groundwater immediately below the building units must be evaluated against PRGs and MCLs. Include a discussion of receptor location $C_{gw, WT}$ in this section.

12. Page 71, Section 3.1.4 – Consider using consistent nomenclature for non-radionuclides screening values. This section references non-radionuclides screening values as PRGs which are references as RSLs in Section 4.1.2.

13. Page 72, Table 28 – Please explain what is meant by **adjusted** ingestion PRG.

14. Page 72, Table 28 – Confirm if a Chromium VI carcinogenic value needs to be listed.

15. Page 72, Section 3.1.4.1, 2nd paragraph – I-129 was removed as an ROPC because it was determined that it would not impact drinking water at any receptor location. Confirm that location $C_{gw, WT}$ was included as receptor location. Furthermore, confirm that receptor location $C_{gw, WT}$ was evaluated when generating the list of COPCs and ROPC. See comment #25.

16. Page 80, Table 39 – Confirm where the MCL values for Pu-239, Pu-238, Pu-240, Np-237, Am-241, and Cm-244 were obtained. These radionuclides are not listed in NBS Handbook 69.

17. Page 80, Section 3.1.4.2 Maximum Contaminant Levels, Table 39 and associated text. Please add clarifying text regarding the beta and photon MCL of 4mrem/year. The individual MCLs listed in Table 39 are calculated to be a 4 mrem/year dose, individually. Thus, each individual value in that table assumes that if no other beta or photon emitter is present, that activity per liter would cause a 4mrem/year dose. As clarified in CFR 141.16 and in the *Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure, NBS Handbook 69*, if two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 millirem/year. While the individual activity per liter for each beta and photon emitter as shown in Table 39 is useful, evaluation of the MCL includes the sum of fractions of all beta and photon emitters that exceed 4 mrem/year dose collectively.

18. Page 81, 1st paragraph, Section 3.1.4.2 Maximum Contaminant Levels– This paragraph references two documents (See EPA [2001], Directive No. 9283.1-14; also see LLNL-TR-812351 for discussion) and indicates that a 15 pCi/g limit is to be applied to all alpha emitters. Through reading the referenced documents, this 15 pCi/g was not to be found. Please review and clarify the meaning of this text. Was this perhaps meant to be 15

pCi/L instead of 15 pCi/g? Please clarify application of the MCL limit of 15 pCi/L for alpha emitters.

19. Page 81, Tables 40, 41, 42, and 43 – The alpha activity MCL is 15 pCi/L. TDEC's understanding is that these tables present the decay chain activity fractions for several Uranium isotopes at the representative times based on the initial assumed activity of 15 pCi/L. That is, there is only one MCL value that doesn't change, and the combined activities presented in these tables at 60, 1,055, and 30,055 years are what remains from that initial activity and not the MCL values. Please make necessary changes to tables and the text on pages 80 and 81.

Radionuclide Maximum Contaminant Levels	
Beta/photon emitters*	4 mrem/year
Gross alpha particle	15 pCi/L
Radium-226 and Radium-228	5 pCi/L
Uranium	30 µg/L
*A total of 179 individual beta particle and photon emitters may be used to calculate compliance with the MCL.	

20. Page 100, Section 3.2.3, Preliminary Baseline (no-action) Modeling Results, All Tables - Each table within this section (e.g., Table 45 through Table 53) shows individual MCL exceedances marked with a yes or a no. While it is useful to understand which beta and photon emitters cause greater than 4 mrem/year dose individually, it is crucial that the total sum of fractions be calculated for all beta and photon emitters. Please include in the table a calculation of the total sum of fractions for beta and photon emitters and compare to the 4 mrem/year MCL.

21. Page 100, Section 3.2.3, Preliminary Baseline (no-action) Modeling Results, All Tables - Chemical specific MCLs are listed in Table 38 which includes contaminants such as beryllium, chromium, fluoride, PCBs, and uranium metal. In the preliminary (no action) modeling result section, it appears that only radionuclides were modeled. The other chemical specific MCLs must be evaluated. Please include tables showing results of these contaminants in addition to radionuclides.

22. Page 101, Table 45 – Please correct the typo for the tritium MCL from 2,0000 to 20,000 pCi/L. Also, remove X12 from the footnotes. Confirm the footnote that states yellow highlights indicate exceedances of either MCL and/or PRG, text in Section 3.2.3 states yellow highlights indicate exceedance of PRG only.

23. Tables 45 through 53 – Please remove all MCLs that were calculated. The MCL is for gross alpha particle activity.

24. Page 119, Section 4.1.1 – Please confirm if the assumption also assumes the salts have been removed.

25. Page 119, Section 4.1.1 – The last paragraph states, "*Residential risk will be evaluated using an SOF approach where the concentration of each radionuclide in groundwater is divided by its PRG for a given time period and summed. Other potential receptor locations were not evaluated in this HHRA, because R0 is the most conservative location (i.e., has the highest predicted groundwater concentrations).*" In addition, Page 12, Section 1.3.4 - The last paragraph states, "*No contaminant release to groundwater from the MSRE facilities was documented in the MV RI (DOE/OR/01-1546/V1&D2), and recent groundwater sampling for the RI (RIR Sect. 2.3.1) appears to confirm this assessment.*" Considering no documented or confirmed releases, the location Cgw, $_{WT}$ immediately below the building units should also be evaluated in addition to R0, based on general use groundwater classification.

26. Page 120, Figure 36 and Page 121, Table 36 – As stated above in the general comments the CSM is incomplete and ignores certain exposure media (e.g., soil, remaining components) and exposure pathways. The CSM should be updated to include all media and exposure pathway such that a comprehensive baseline Human Health Risk Assessment (HHRA) can be completed. This is critical for evaluating remedial alternatives in the FS and identifying what LUCs are necessary to ensure the selected remedy is protective of human health and the environment.

27. Page 123, Exposure Assessment – A review of the Melton Valley LUCIP did not identify specific LUCs for MSRE. LUCs will need to be established within the decision document tied to MSRE.

28. Page 123, BASELINE (NO-ACTION) FUTURE RISK ESTIMATES – This section provides the maximum estimated risk for several building units. However, there is no calculation or illustration of the cumulative estimated risk to the whole MSRE under this scenario. As stated earlier, cumulative risk should be calculated.

29. Page 94, Section 3.2.2.2, 1st paragraph – Please clarify the following RI report text:
    a. *A network of French drains is installed around the base of the Bldg. 7503 foundation walls and around BUs that extend into the uppermost bedrock* – Are construction plans or as-builts on the French drain network available including construction details and inverts? Is the French drain still functioning as intended?
    b. *This network drains water from around the building into an open sump pit below the MSRE building* – Does this network completely dewater the footprint of the BUs? Could the French drain dewater the subsurface in the immediate proximity surrounding French drain backfill but not at distance from the network. If a hole was drilled through the BU concrete, would water be present?
    c. *However, on an average, the pump discharges approximately 1 gallon per minute (gpm)* – Is this believed to be more attributable to the flat gradient caused by widespread dewatering or the thin saturated thickness? Do we know if historical flow rates were higher?
    d. *To represent the sump pump operation in the model, constant head boundary condition cells were added to Layer 78 (bedrock below the MSRE building) in the area*

where the water elevation is maintained at 812 ft AMSL with the network of French drains in connection to the sump pit – Why was a constant head boundary condition for the sump pump selected versus the use of a pumping well with a set Q for the known extraction? What would happen if a pumping well was simulated in place of a constant head boundary condition?

e. *The combination of HFB cells to simulate the foundation walls of the MSRE building and the constant head cells to simulate the water table suppression maintained by the French drain network and sump pump replicates the piezometric surface around the MSRE building* – Is this combination artificially suppressing water levels versus using the other model boundary conditions and parameterization to simulate the suppressed water levels?

30. Page 94, Section 3.2.2.3, 4th paragraph – The text states *"the groundwater flow mass balance was checked to ensure the modeled input reasonably matched the modeled output throughout the modeling and calibration process."* What are the units on the mass balance?

31. Page 95, Figure 32 – Does this figure demonstrate that the model calibrated? If so, what were the calibration targets for the residual statistics? Provide additional insight on how the calibration targets were selected and how they were met?

32. Page 95, Figure 32 – The Number of Observations (n) is listed as 153. Please provide additional detail on the Number of Observations (n) within the grid refinement area? Are there sufficient data points between R2 and R3 to adequately model flow from R0 to these potential receptor locations?

33. Page 95, Figure 32 – The Scaled RS and Scaled RSME were greater than 10%. Do these scaled values support full calibration?

34. Page 96, Section 3.2.2.4, 2nd paragraph – The text states, *"this gradient configuration is not conducive to groundwater migration to the east from MSRE BUs within the facility."* The January 24, 2024, response to Comment 12 for the MSRE Model DQA Sept 22 2023 (presentation delivered Sept 25, 2023) states, "The topography of the site dictates that a saddle geometry will likely be present in the groundwater elevations under non-pumping conditions." Under non-pumping conditions, will the direction of groundwater flow under the BUs flow to both the east and west. If so, which BUs have the potential to be in contact with groundwater migrating to the east?

35. Page 96, Section 3.2.2.6, 2nd paragraph – The text states, *"hydrogeologic parameters relevant to contaminant fate and transport in the MSRE GFM were as follows. Longitudinal dispersivity was set to 30 ft, transverse dispersivity was set to 3 ft, and vertical dispersivity was set to 3 ft. The distribution coefficient and contaminant half-life variables were chemical-specific as a variety of constituents were modeled for each BU."* Please provide a source or a rationale for these parameters. What effect does the ratio between the longitudinal and

transverse dispersivities and hydraulic conductivity anisotropy have on constituent fate and transport?

36. Page 97, Figure 33 – Please add the simulated particle flow paths with directional arrows indicating time.

37. Page 98, Figure 34 – The peach-colored cells are not identified in the figure as pinched out (UCOR-5659/R0 Figure 24). In the figure, the modeled potentiometric contours under the building footprint are not present. Are the modeled potentiometric contours discontinuous under the BU footprints due to BU foundation walls modeled as a horizontal flow barrier condition?

Questions or comments concerning the contents of this letter should be directed to Kristof Czartoryski at the above address or by phone at (865) 250-9705.

Sincerely

Randy Young Digitally signed by Randy Young
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