REGION 4
ATLANTA, GA 30303

October 28, 2025

VIA ELECTRONIC MAIL

Mr. Roger B. Petrie
Federal Facility Agreement Manager
Oak Ridge Office for Environmental Management
Department of Energy
Post Office Box 2001
Oak Ridge, Tennessee 37831

Dear Mr. Petrie:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Department of Energy's (DOE) *Supplemental Analysis* (SA) *for the Environmental Management Disposal Facility* (UCOR-5843), received on July 28, 2025. The document is a requirement of the Environmental Management Disposal Facility (EMDF) Record of Decision (ROD) (DOE/OR/01-2794&D2/R2) and is intended to demonstrate EMDF's protectiveness using Comprehensive Environmental Risk and Liability Act (CERCLA) methodology and inform development of the EMDF's Waste Acceptance Criteria Compliance Plan, a Federal Facility Agreement primary document.

The EPA has the following comments on the SA. If you have any questions or comments, please contact me at (943) 212-7256, or electronically at sayer.john@epa.gov.

Sincerely,
JOHN SAYER
Digitally signed by JOHN SAYER
Date: 2025.10.28 16:31:22 -04'00'
John W.W. Sayer
Remedial Project Manager
Superfund and Emergency Management Division

cc: Joanna Hardin, DOE
Melyssa Noe, DOE
Dennis Mayton, DOE
Erin Sutton, DOE
Samantha Urquhart-Foster, EPA
Brad Stephenson, TDEC
Eileen Marcillo, TDEC
Ethan Sweet, TDEC
Sid Garland, UCOR
Tanya Salamacha, UCOR
Jennifer Linton, UCOR
Mary Magleby, UCOR
Annette Primrose, UCOR
ORSSAB@orem.doe.gov
OROEMMailroom@orem.doe.gov

The following represents EPA comments on the Supplemental Analysis (SA) for the Environmental Management Disposal Facility (EMDF) (UCOR-5843):

General Comment

1. Please include in-text citation references throughout the SA that point the reader to the reference where specific values were obtained. For example, it is not apparent which reference was accessed to provide the Table 3 partition coefficient values for waste and leachate.

Specific Comments

1. **Section 1, Introduction, page 1** - In the third paragraph please remove "25 millirem in a year" and replace with "an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort will be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable". The NRC Low Level Waste Standard is 25/75/25 per 10 CFR part 061-0041 which is also an EMDF Record of Decision (ROD) Applicable or Relevant and Appropriate Requirement (ARAR).

2. **Section 1, Introduction, Page 2** – This section states, "The SA assumes a residential exposure scenario that is developed in Sect 0 along with the required inputs (exposure factors) and contaminant toxicity information." However, there is no Section 0 in the report. It is unclear whether this text was referring to a section in the EMDF ROD. Please verify and revise as needed.

3. **Section 2.3.1, Long-term EMDF Cover System Performance, Page 6** – The second paragraph mentions that the probabilistic modeling of the Savannah River Superfund Site's composite barrier performance in closure cap systems for grouted tanks and solidified liquid waste, credits partial geomembrane function for durations exceeding 1,000 years (SRMC 2021, 2022). It later states, "This work suggests that cover system infiltration rates below 1 inch per year could be maintained for durations as long as 10,000 years, even under wetter future climatic conditions." It is unclear how the extrapolation from 1,000+ years to 10,000 years was determined (e.g., probabilistic forecasting based on some form of correlation). Please explain how the 10,000-year ceiling limit was computationally projected from the Savannah River Superfund Site.

4. **Section 2.3.1, Long-term EMDF Cover System Performance, Page 6 –** Additionally, there is no discussion of the potential for subsidence of the disposal facility from events such as waste decomposition and settling and/or seismic activities given Oak Ridge lies within the East Tennessee Seismic Zone (ETSZ) and is in proximity to Bear Creek. Please elaborate on whether the probabilistic model or structural engineering analysis would account for subsidence from

waste settling over time, increased mass of waste disposed coupled with increased fluid pressure on the liner system that could aid in subsidence resulting in leachate leakage into Bear Creek and its tributaries.

5. **Section 3.1.1, Waste Concentrations, Page 9** – The first paragraph states, “This SA evaluates risk for 53 radionuclides identified in Table 2.5 of the EMDF ROD, with the exception of Th-228 (U-232 progeny with short half-life) and the addition of Se-79.” It is unclear why Se-79 was not presented in the EMDF ROD but is being considered in the SA. This alludes to the possibility for other radionuclides in waste lots being identified post-ROD. If so, please address how the process laid out in the SA will ensue and discuss the likelihood for other radionuclides to be identified that are not listed in the EMDF ROD or Table 1 of the SA.

6. **Section 3.1.1, Waste Concentrations, Page 9** - The second paragraph states, "The non-radioactive contaminants evaluated include 14 metals from Appendix A, Table A.1 of the Attainment Plan for Risk/Toxicity-Based Waste Acceptance Criteria at the Oak Ridge Reservation, Oak Ridge, Tennessee (EMWMF WAC Attainment Plan, DOE/OR/01-1909&D3), including uranium evaluated for noncarcinogenic toxicity." Please add language to the SA that explains why only these contaminants were evaluated for noncarcinogenic toxicity, and why other metals and other groups of contaminants (such as volatiles and semi-volatiles) were omitted from the analysis.

7. **Section 3.1.1, Waste Concentrations, Page 9 -** Several sources of information were used to inform the average waste concentrations. These included 1) EMWMF waste characterization data for previously generated and historical Y-12 National Security Complex (Y-12) and Oak Ridge National Laboratory (ORNL) waste lots; 2) data from other detailed facility and environmental characterization studies; and 3) data from the targeted D&D facilities, which included radionuclide quantities derived from various types of facility safety analyses and other sources. However, no specific information on how these various sources were weighted to derive the average waste concentration (e.g., statistical weighting, kriging, sums of fraction). Please describe and provide an example calculation of how the “average” waste concentrations were determined for the EMDF facility.

8. **Section 3.1.1, Waste Concentrations, Page 10** - states, “For purposes of the EMDF SA a total EMDF facility average uranium concentration of 400 mg/kg was assigned for evaluation of uranium toxicity. For consistency, the U-238 waste activity concentration used to estimate leachate activity concentrations and carcinogenic risk was set to the U-238 equivalent of 400 mg/kg, or 134 pCi/g [picocuries per gram].” Please explain how the average uranium concentration for the EMDF SA was specifically derived and why the stated average of 1,130 mg/kg used in the EMDF Performance Assessment[1] was not used as a conservative measure for

[1] Performance Assessment for the Environmental Management Disposal Facility at the Y-12 National Security Complex, Oak Ridge, Tennessee, 2020 (UCOR-5094/R2).

the SA?

9. **Section 3.1.1, Waste Concentrations, Page 10 –** The average uranium concentration of 400 mg/kg assigned for evaluation of uranium toxicity evaluation (referenced in the comment above evaluation) is used as a "*trigger level facility average concentration*" in the EMDF's Waste Acceptance Criteria Compliance Plan (WACCP)[2]. These "trigger levels" are proposed to provide a basis for initiating an evaluation of additional risk management activities in the event that actual or forecast average concentrations of the total EMDF waste disposed to date approach the trigger level. As the 400 mg/kg does not represent an inventory limit for uranium, but rather a means for initiating additional risk evaluation, how is it representative as an average uranium concentration in the SA?

10. **Section 3.1.2, Leachate Concentrations, Page 10** – The first paragraph states that a range of solid-aqueous partition coefficients (Kd) values were assembled in Table 1 for application to the EMDF SA. EPA policy on the Kd for radionuclides is discussed on page 5.3 of the Soil Screening Guidance for Radionuclides Technical Background Document[3]. The number of significant influencing parameters, their variability in the field, and differences in experimental methods result in as much as seven orders of magnitude variability in measured metal Kd values reported in the literature. This variability makes it much more difficult to derive generic Kd values for metals (including radionuclides) than for organics. Therefore, it is recommended that Kd values be measured for site-specific conditions. In the event site-specific Kd values are not available, the International Atomic Energy Agency (IAEA) and EPA have peer-reviewed and compiled Kd data for radionuclides (e.g. IAEA [2010][4], EPA[2004][5]). In addition, EPA's PRG calculator uses the most conservative literature values when the above sources have been exhausted. These sources should be used instead of other non-consensus-based references.

11. **Section 3.2.2, Surface Water Concentrations, Table 1, *Estimated average EMDF waste concentrations, waste partition coefficient (Kd) values*, and *estimated leachate concentrations*, Page 12** - There is no discussion of how the values in the table account for the range of variables that may affect Kd values, such as: the oxidative state/form of each metal and radionuclide, pH, temperature, availability of oxygen and potential for redox reactions to occur, complex geochemistry reactions with mineral components present in naturally occuring medial, reactions with other chemicals in the waste, the amount of time waste is in contact with groundwater or leachate. For completeness, please consider listing the factors that affect

[2] Waste Acceptance Criteria Compliance Plan for the Environmental Management Disposal Facility at the Oak Ridge Reservation, Oak Ridge, Tennessee, July,2025 (DOE/OR/01-3012&D1)

[3] Soil Screening Guidance for Radionuclides: Technical Background Document, EPA Office of Radiation and Indoor Air, Office of Solid Waste and Emergency Response, Washington, DC 20460, 9355.4-16, EPA/540-R-00-006, October 2000.

[4] Technical Report Series no. 472, Handbook of Parameter Values for the Prediction of Radionuclide Transfer in Terrestrial and Freshwater Environments, IAEA, 2010.

[5] Understanding Variation in Partition Coefficient, Kd, Values, Volume III, EPA 402-R-04-002C, July 2004.

the Kd values and how the listed ranges of Kd values consider such factors.

12. **Section 3.2.2, Table 1, Estimated Average EMDF Waste Concentrations, Waste Partition Coefficient (Kd) Values, Estimated Leachate Concentrations, Page 12-14** – The low-end Kd values substantially affect the estimated leachate concentrations for multiple radionuclides (e.g., 50-fold increase for Thorium isotopes). Also, please see previous comment on recommended Kd values for use in estimating leachate concentrations. Additionally, please include a table note indicating that Th-234 was excluded because it should be in secular equilibrium with U-238 and Th-228 (progeny of U-232) was excluded due to its short half-life.

13. **Section 3.2.2, Surface Water Concentrations, Page 19** – states, "The approach to estimate surface water concentrations for the risk assessment is simplified and intended to conservatively over-estimate surface water pathway risk. The basic assumption is that all leachate generated for the selected cover performance scenario (0.43 in./yr or 0.53 gpm) is discharged to and uniformly mixed with the flow in Bear Creek immediately downstream of the confluence with NT-10. For this calculation daily estimated stream flow data from the flow monitoring station at Bear Creek Kilometer 9.2 (BCK 9.2) from 2001 through 2018 was utilized." Surface Water flow in Bear Creek is highly seasonal and varies significantly based on the season and precipitation events. It is stated that flow data were scaled up by the ratio of the contributing drainage areas at BCK 9.2 and NT-10. Please state how the surface water flow in Bear Creek was determined for each location?

14. **Section 3.2.2, Surface Water Concentrations, Page 19** – with reference to the above question, please also specify whether days where no surface water flow (i.e. value of 0) was observed in Bear Creek was included in the calculation of average estimated stream flow.

15. **Section 3.2.2, Surface Water Concentrations, Page 19** - it appears a daily flow for Bear Creek at NT-10 of 598.9 gallons per minute (gpm) was used (1130 mixing ratio x 0.53 gpm leachate release rate). Please confirm if this number is accurate and if so, why this number is the most representative to use for Table 3?

16. **Section 3.2.2, Surface Water Concentrations, Page 19 -** please provide the dates that were used to calculate the median of the daily calculated values of surface water mixing ratio of 1130.

17. **Section 3.2.2, Surface Water Concentrations, Page 19 -** to provide a reasonable worst-case scenario, it seems it would be appropriate to provide surface water concentrations in Bear Creek for the lowest flow (or non-existent flow as appropriate). Please provide such a calculation for the SA.

18. **Section 3.2.2, Surface Water Concentrations, Page 19** – The second paragraph states, "For

elements expected to have relatively large Kd values, release timing and contaminant concentrations discharged to surface water would vary for leachate percolating through the liner versus bathtub leachate release pathway. This difference would have the largest impact for the 50% liner performance condition." Please revise this sentence for clarity. Specifically, it would benefit the reader to understand how this difference in mobilization of leachate with high Kd values (tightly bound to soil so low mobility in water) percolating through the liner and the bathtub release, affects the 50% liner performance condition.

19. **Section 3.2.2, Surface Water Concentrations, Page 19** – the third paragraph states "The calculated Bear Creek water concentrations based on the estimated median daily surface water to leachate flow ratio (1130) is provided in Table 3 for the leachate concentrations based on the lower Kd values and the higher but reasonable Kd values." Please explain what "higher but reasonable Kd values" indicates about how these values were selected, and state whether this means some percentage of the highest Kd value was selected rather than the highest Kd value. Please provide this information, as appropriate, in the SA.

20. **Section 4.2, Exposure Assessment, Table 4, Receptor populations and exposure Pathways evaluated for the EMDF Supplemental Analysis, and Figure 12, Human Health Conceptual Exposure Model for the EMDF Supplemental Analysis, Page 22-23** – The residential receptor populations and complete exposure pathways listed in Table 4 and the human health conceptual site model (Figure 12) do not adequately capture the potential for land adjacent to the landfill to be developed into a conventional farmer scenario (RME [reasonable maximum exposure] scenario) where potentially impacted livestock (biota) may be bred and raised for human consumption as a primary protein source. These farm-raised livestock may encounter contaminants in EMDF wastewater in the event of a degraded facility condition and in the absence of long-term institutional controls. The consumption of produce and biota provided in Table 4 include fruits, vegetables, poultry, and eggs only. Given the physical characteristics of the surrounding area and current and planned recreational areas surrounding the future EMDF, please provide adequate justification for excluding from the SA the potential for consumption of farm-raised livestock with limited or confined home ranges in addition to poultry (e.g., rabbits, squirrels, goats, sheep, swine, cows, etc.). Consumption of milk from goats, sheep, and cows may also be a potential exposure pathway.

21. **Figure 12, Human Health Conceptual Exposure Model for the EMDF Supplemental Analysis, Page 23** – The bathtub release pathway post-closure that results in the discharge of wastewater from the cell over land and into Bear Creek could potentially contaminate sediments along the banks of Bear Creek prior to entering surface water. It is reasonable to assume that contaminants with high Kd values that are forced upwards from an increase in fluid pressure could exit the cell and sorb to sediments along the banks of Bear Creek. Therefore, bank sediment is a viable exposure pathway in addition to surface water in Bear Creek. Please provide justification for excluding bank and creek sediments as a potentially complete exposure

pathway for nearby future residents or farmers who fish in Bear Creek.

22. **Section 4.2.1, Exposure of Adult and Child Residents, Page 24** – The second paragraph states, "The risk assessment evaluated a combined child residential exposure period of 6 years and 20-year adult exposure period for the evaluation of potential cancer risks..." For a conventional farmer RME scenario, a 30-year exposure duration is assumed in the EPA's Radionuclide Preliminary Remediation Goal online calculator as farmers are expected to live in their homes longer than a typical urban or rural resident.

23. **Section 4.2.1, Exposure of Adult and Child Residents, Page 24** – The third paragraph states, "A Fraction Ingested parameter value of 50 percent is based on a 10 ft x 30 ft residential garden relative to the minimum garden size (600 ft2 i.e., a 20 ft by 30 ft residential garden) required to feed a family of 4 year-round." Please provide adequate justification for not assuming the minimum garden size in the risk calculations as this is representative of the RME garden scenario.

24. **Section 4.2.1, Exposure of Adult and Child Residents, Page 24** – The third paragraph states, "Input parameters for the consumption of fruits and vegetables are for a limited number of fruit and vegetable types. The selection of the types of fruits and vegetables represents tree, shrub, and herbaceous fruits as well as both root and above-ground vegetables." Please provide the basis for the selected fruits and vegetables. It is recommended that these be based on commonly grown fruits and vegetables in the Oak Ridge area as determined by climactic factors, soil characteristics, and preference. The TN Agricultural Services Program or University of Tennessee may have information to inform the selection of currently grown agricultural crops.

25. **Section 4.2.1, Exposure of Adult and Child Residents, Page 24** – The SA conservatively assumed that a residential garden would be irrigated annually for only 25% of the growing season. Please provide additional justification for the 25% annual irrigation rate. Please note that possible drought conditions extending longer than expected should be considered under an RME scenario. Irrigation rates during historic drought conditions for farmers during the growing season could inform the selection of an appropriate value.

26. **Section 4.2.1, Exposure of Adult and Child Residents, Page 24 –** The last paragraph states, "Additionally, the fence excludes potentially hunted deer and other large animals from consuming the contaminated produce and soil." This exclusion of the wild animal consumption of homegrown produce due to assuming the garden would be fenced was also discussed in Section 4.2.2 Media Eliminated from the Exposure Assessment. To best represent the RME scenario, the consumption of game animals consuming homegrown produce/crops should be evaluated assuming no institutional controls such as a fence. Fencing is ineffective at eradicating wildlife from gardens, and the consumption of game animals should be taken into

consideration when estimating human exposure.

27. **Section 4.2.3, Estimation of Exposure Concentration, Page 25** – The exposure point concentrations (EPCs) used to derive the cancer risk from radionuclides were based on the modeled leachate concentrations from the EMDF under a future bathtub release scenario. The low-end Kd values for some radionuclides greatly impact the EPCs. See previous comments and recommendations on Section 3.1.2 and Table 1.

28. **Section 4.2.4, Quantification of Intake and Dose, Page 26** – This section states, "Consumption of Bear Creek fish for the RME is assumed to be 11 meals of 227 grams per meal, for a total annual ingestion rate of 2,497 g." While EPA recognizes the basis for the proposed fish ingestion rate (FIR), the FIR is inconsistent with the value assumed in the EMDF ROD. Please revise risk estimates for the fish ingestion pathway using the FFA party-agreed upon default FIR of 17.5 grams per day consistent with the EMDF ROD.

29. **Section 4.2.4 (Quantification of Dose), page 27, Table 5** – this section details the human health Risk assessment parameters for the EMDF Supplemental Analysis. The table states that "Sum of individual fruit and vegetable intake values from the radionuclide calculator (refer to Appendix A) used for metals." Was every fruit and vegetable run in the PRG calculator?

30. **Section 4.2.4, Quantification of Dose, page 27, Table 5** - details the human health Risk assessment parameters for the EMDF Supplemental Analysis. The table states that "the exposure duration used is 20 years for carcinogens and 26 years for non-carcinogenic risk." However, the default for the adult farmer is 34 years and the total exposure duration is 40 years for farmers in the PRG calculator.

31. **Section 5.3.2, In-Stream Water Quality Criteria, Page 46** – states, "The estimated Bear Creek average concentrations for 20 of the 24 radionuclides are less than the calculated in-stream criteria and the cumulative risk for those 20 radionuclides is less than 2.0E-06 ELCR. The estimated Bear Creek concentrations for C-14, Pu-238, Pu-239, and Pu-240 are a factor of five to ten times higher than the corresponding in-stream criteria in Table 12." Please note that based on prior comments regarding the input parameter values (e.g., EPC derivation) that additional radionuclides may individually contribute a cancer risk above 2.0E-06. In addition, while it is acknowledged that the bioconcentration factors (BCFs) for the four radionuclides that exceed the calculated in-stream water quality concentrations may be conservative, the SA does not acknowledge that there may be times where the release of contact water into Bear creek may not actually be diluted by surface water flow in Bear Creek, such as during dry spells in the summer or fall. Please consider providing a calculation of radionuclide concentrations assuming no surface water flow/dilution in Bear Creek.

32. **Section 5.3.2, In-Stream Water Quality Criteria, Page 46** – states, "The estimated Bear Creek

concentrations for C-14, Pu-238, Pu-239, and Pu-240 are a factor of five to ten times higher than the corresponding in-stream criteria in Table 12. The calculated in-stream criteria for these four radionuclides are very low because of the very large default values for the fish BCF applied in UCOR-5055. There are credible, much lower values of BCF for carbon and plutonium documented in the literature *(PNNL-13421; Fesenko et al., 2011; Yankovich et al., 2013)* that would yield much higher surface water concentrations corresponding to 1.0E-5 ELCR." BCFs from authoritative sources were agreed by triparty members and were used in the *Development of Fish Tissue and Surface Water Preliminary Remediation Goals for Radionuclides of Interest for the Proposed Environmental Management Disposal Facility, Oak Ridge, Tennessee* (UCOR-5055; DOE/OR/01-26664&D4/R1). These should be used in the absence of site specific BCFs.

33. **Appendix A, Radionuclides - Input Parameters Homegrown Produce** - the Form-input value of 0.5 is used for fruit and vegetables. How was the decision made to deviate from the default contaminated plant fraction?