# Request for Additional Information (RAI)
on the
# Draft Waste Incidental to Reprocessing Evaluation for Vitrified Low-Activity Waste Disposed Onsite at the Hanford Site, Washington

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# NRC's Role at the Hanford Site

- NRC provides independent technical consultation in an advisory manner based on an interagency agreement with DOE.
- NRC is not part of the Tri-Party Agreement (DOE, EPA, and the State of Washington).
- NRC's consultation typically includes:
  - Scoping meetings or technical exchanges
  - Document Review (WIR Evaluation, Performance Assessment (PA), etc.)
  - Requests for Additional Information (RAI)
  - NRC Technical Evaluation Report (TER)
- NRC does not have a regulatory or a monitoring role at the Hanford Site.

# Criteria for Determining Reprocessing Waste is WIR (i.e., not High-Level Waste)

## From DOE Manual 435.1-1

- Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
- Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*
- Waste will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste

# Other Considerations for the Review

- DOE indicated that although the entire draft WIR evaluation is subject to consultation, DOE requested emphasis on criteria 2 (performance objectives) over criteria 1 (removal of key radionuclides).
- DOE requested that NRC determine if DOE demonstrated a reasonable expectation of compliance with the performance objectives for 1,000 years.
- DOE provided model results to 10,000 years to support NRC's risk-informed decision-making.

# Review of VLAW WIR Evaluation

- Review addresses the disposal of low-activity waste in the Integrated Disposal Facility (IDF) at Hanford.
- Does not address the disposal of high-level waste (HLW).
- NRC included secondary wastes generated as the result of processing that would contain significant fractions of key radionuclides.

# Review of VLAW WIR Evaluation

- Staff developed an independent model to develop risk insights.
- Risk is broadly defined by the risk triplet (quadruplet):
  - What can happen?
  - How likely is it?
  - What are the consequences?
  - What are the uncertainties?
- NRC's review is risk-informed.
  - Non-risk significant comments will be included in the TER
  - Risk is specific to VLAW
- Basis for requests for additional information is provided.
- NRC will publish a final document of the review with our recommendations.

# Summary of NRC's Role

- NRC is an independent federal agency whose decision is based solely on the merits of the materials provided.
- NRC strives to provide a clear and technically-sound basis for findings.
- Documents can be accessed through ADAMS, enter docket number PROJ0736 in the search box.

https://www.nrc.gov/reading-rm/adams.html

# Removal of Key Radionuclides to the Maximum Extent Practicable

**RAI 1-1** Comment: Additional information is needed on the amount of soluble $^{90}Sr$ expected to be in the waste processed for DFLAW and the technologies that may be used to remove it to the maximum extent practical.

- Sr-90 is an important contributor to chronic intruder doses.
- Deployment of select technologies or processes could reduce soluble Sr in the waste.
- The basis for the amount of soluble $^{90}Sr$ in the waste was not clear.

# Removal of Key Radionuclides to the Maximum Extent Practicable

**RAI 1-2** Comment: Additional information is needed on the percentage of key radionuclides removed from the waste that will be disposed in the integrated disposal facility.

- The percentage of all key radionuclides present in various wasteforms disposed at IDF and removed by processing was unclear.

# Removal of Key Radionuclides to the Maximum Extent Practicable

**RAI 1-3** Comment: Additional information is needed on the percent of the $^{99}Tc$ and $^{129}I$ that could potentially be removed from the waste versus remaining in either the VLAW or the SSW. (See also RAI 2-10).

- Tc-99 and $^{129}I$ are two of the most important radionuclides with respect to demonstration that the requirements for the protection of public health and safety will be met.
- Staff would like to determine the percentages of $^{99}Tc$ and $^{129}I$ removed and remaining in all waste streams.

# Removal of Key Radionuclides to the Maximum Extent Practicable

**RAI 1-4** Comment: Additional information is needed on the alternative technologies considered for removal of $^{129}I$ and $^{99}Tc$.

- It wasn't clear what technologies were considered for removal of $^{129}I$ and $^{99}Tc$.
- Vitrification results in significant separation of these radionuclides from the waste.
- Selective treatment of the off gas waste streams was not discussed.

# Removal of Key Radionuclides to the Maximum Extent Practicable

**RAI 1-5** Comment: In the draft WIR evaluation, DOE indicated that they did not identify a technology that could practically remove $^{129}I$ from tank wastes. It isn't clear why the $^{129}I$ that is separated very efficiently by the vitrification process could not be disposed as HLW.

- DOE didn't identify technologies that could be applied to $^{129}I$ in tank waste prior to vitrification, but it wasn't clear why the volatized $^{129}I$ couldn't be collected and sent to HLW processing.

# WIR Scope and PA Results

**RAI 2-1** Comment: The results from the PA that are directly applicable to the scope of the draft WIR evaluation are not clear. One factor could have been the timing of the completion of the PA and draft WIR evaluation.

- The PA was completed prior to the draft WIR evaluation and therefore examined different inventory cases.
- Though scaling can be performed, in order to risk-inform the review and conclusions the NRC needs the impacts associated with the primary and secondary wastes consistent with the scope of the draft WIR evaluation.

# Model Support for the Performance Assessment

**RAI 2-2** Comment: Additional information is needed to demonstrate that the conceptual and numerical models used in the performance assessment (PA) were adequately supported over the range of projected future conditions.

- DOE provided extensive documentation and technical reports supporting development of the PA, especially inputs.
- However the strategy and information supporting the conceptual models and numerical modeling results were not clear.

# PA Model Discretization

**RAI 2-3** Comment: From the information provided, it isn't clear that the numerical model utilized had a discretization sufficient to ensure acceptable accuracy.

- DOE adequately described the modeling process and the discretization that was used in the STOMP flow and transport modeling as well as the releases from the wasteform.
- However, from the information provided it wasn't clear that the discretization was sufficient. It appeared that the discretization used was what could be run without determining what needed to be used.

# Near-field and Unsaturated Zone Modeling

**RAI 2-4** Comment: Use of uniform properties and discrete layers may not yield accurate contaminant flux rates primarily for near-field flow.

- Use of average homogeneous properties for moisture characteristic curves (MCC)'s combined with coarse model discretization could lead to artificial capillary barrier effects.
- The appropriateness of using homogeneous properties vs. heterogeneous properties was not demonstrated.

# Disposition of Nitrate

**RAI 2-5** Comment: Previous evaluations by DOE had a large amount of nitrate ($9 \times 10^6$ kg) that would be disposed of in IDF. The current inventory cases have values ranging from $1.6 \times 10^5$ kg to $2.2 \times 10^6$ kg. It is not clear how the nitrate is being removed or where it will be disposed.

- High-nitrate feed can impact glass quality/performance.
- It wasn't clear how nitrate will be removed from the glass feed and where it will be disposed.

# Glass Wasteform

**RAI 2-6 thru 2-11** Comment: Various technical comments associated with the glass wasteform performance and the release of key radionuclides.

- 2-6: Basis for assuming volatile species would be uniformly distributed in the glass.
- 2-7: Uncertainty treatment in the development of glass fractional release rates (FRR).
- 2-8: The basis for the 10x increase to account for cracking.
- 2-9: The basis that Stage III will not occur for glass as IDF.
- 2-10: The basis for Case 7 as the base case inventory.
- 2-11: Comparison of STOMP and GWB.

# Sensitivity and Uncertainty Analyses

**RAI 2-12** Comment: The sensitivity and uncertainty analyses presented by DOE did not include some aspects that may be important to risk-inform the review process and to determine if the relevant criteria are likely to be met.

- DOE completed a number of analyses to examine model sensitivity and the impact of uncertainties.
- Some additional types of uncertainties may be important to examine in individual or combined cases in order to risk-inform the review (e.g., glass degradation uncertainties, inventory splits, inventory uncertainties, failure rates of engineered systems).

# Quality Assurance (QA)

**RAI 2-13** Comment: Some aspects of the quality assurance program were not clear from the documentation provided.

- DOE provided detailed information associated with QA.
- The PA uses information from a large number of sources, and while the QA status of the primary sources was clear the QA status of the secondary sources (e.g., the HDW model) was not clear.
- Information on the verification of STOMP was provided but it wasn't clear if information directly applicable to capillary barrier effects and glass degradation was available.

# Geologic Uncertainty

**RAI 2-14** Comment: The basis for the interpretation of the geology underlying the footprint of the IDF that removed the Ringold E formation is not clear.

- The geology underlying the IDF was reinterpreted resulting in removal of the Ringold E.
- It wasn't clear why it was removed and why the geologic uncertainty was not evaluated.

# Vadose (Unsaturated) Zone Parameters

**RAI 2-15** Comment: The log-normal fit of the van Genuchten alpha parameter for the H2 unit does not appear to represent the data well at the tails of the distribution.

- DOE provided comparisons of data and probability distributions.
- The significance of the uncertainty associated with the goodness of fit was not clear.

# Saturated Zone Hydraulic Conductivity

**RAI 2-16** Comment: The changes to the estimated hydraulic conductivity values for the saturated zone over time suggest the base case value best estimate may not be reliable.

- The assigned value for saturated hydraulic conductivity of the saturated zone has undergone significant revisions over the years.
- Plans to verify the base case saturated zone hydraulic conductivity were not clear.

# Intruder

**RAI 2-17** Comment: DOE provided the dose result to an inadvertent intruder resulting from the average waste but did not provide the range of potential intruder doses that could be anticipated. NRC provided a number of comments and recommendations associated with intruder analyses for WMA-C that DOE was not able to address in this draft WIR evaluation due to timing differences.

- Each waste stream will have variability in concentrations. The resultant variability in potential intruder impacts were not clear.
- The impact of NRC's comments on the inadvertent intruder assessment for WMA-C to VLAW were not clear.

# $^{90}$Sr Inventory Uncertainty

**RAI 2-18** Comment: Additional information is needed regarding the uncertainty in the $^{90}$Sr inventory estimate and how the inventory uncertainties are propagated into the GoldSim model.

- The total quantity of $^{90}$Sr and the concentration of $^{90}$Sr in different waste streams is uncertain.
- $^{90}$Sr is a key radionuclide for chronic intruder doses.

# Releases from the ETF-LSW Waste

**RAI 2-19** Comment: Additional information is needed on the modeled release of $^{129}I$ and $^{99}Tc$ from the ETF-LSW waste.

- The basis provided for some of the parameters assigned to describe releases from the ETF-LSW waste was not adequate.
- The basis for the difference in the modeled relative performance of this waste stream compared to other cementitious wastes was not clear.
- The inventory in this waste stream is uncertain. The dose from the release of $^{129}I$ and $^{99}Tc$ from the ETF-LSW waste could be risk significant if the inventory of those radionuclides in the waste stream is higher than predicted.

# Sorption of Iodine on Wasteforms

**RAI 2-20** Comment: Additional information is needed for the assumed sorption of $^{129}I$ on the SSW-GAC (Granular Activated Carbon) and SSW-AgM (Silver Mordenite) wasteforms.

- The release of $^{129}I$ can be a significant contributor to dose.
- The modeled release of $^{129}I$ from the SSW-GAC and SSW-AgM wasteforms is significantly decreased by the relatively high values assumed for the sorption parameters for $^{129}I$ on those wasteforms.
- The basis for the sorption parameters assigned to these wasteforms was not clear.

# Releases from Cementitious Wasteforms

**RAI 2-21** Comment: More information is needed on the process for determining and evaluating the final cementitious grout specifications for waste streams stabilized with cementitious grout.

- The specifications for cementitious wasteforms were under development at the time of the LFRG review.
- It is not clear if further work has been completed since the time of that previous review.