



THE HANFORD SITE

Department of Energy's Response to Nuclear Regulatory Commission's Request for Additional Information on the Draft Waste Incidental to Reprocessing Evaluation for Waste Management Area C

Public Information Meeting

October 29, 2019

Richland, WA

- The **U.S. Department of Energy (DOE)** issued the Draft Waste Incidental to Reprocessing (WIR) Evaluation for Waste Management Area (WMA) C in June 2018.
- The **U.S. Nuclear Regulatory Commission (NRC)** is conducting a technical review of the Draft WIR Evaluation and associated Performance Assessment (PA).
- NRC provided comments in the form of a Request for Additional Information (RAI). A public meeting was held on May 30 to present and explain the RAI comments.
- The document containing DOE's responses to the RAI comments (ORP-63747, Rev. 2.) is now available to the public, and has been posted on the WMA C website.
- The purpose of tonight's public meeting is to present and explain DOE's responses to the RAI comments.

NRC Comment: An insufficient basis was provided that removal of waste from plugged pipelines is not necessary in order to satisfy removal of key radionuclides to the maximum extent that is technically and economically practical.

DOE Response:

- DOE's response focused on the cost/benefit analysis provided in RPP-PLAN-47559, *Single-Shell Tank Waste Management Area C Pipeline Feasibility Evaluation*, which demonstrates that pipeline removal is not technically and economically practical.
- Pipeline removal cost estimates are very high, with very limited reduction in risk.
- DOE also explained that a delay in the closure date assumed in the WMA C PA would significantly reduce the potential intruder dose.

NRC Comment: An insufficient basis was provided for terminating waste removal activities for some tanks.

DOE Response:

- For each tank in question, DOE provided additional details from the Retrieval Data Reports and other sources, explaining the basis for the decision to terminate retrieval in each case.
- Retrieval efficiency data for key radionuclides was also provided.

NRC Comment: An insufficient basis was provided in the Draft WIR Evaluation that pits, diversion boxes and pipelines were well-flushed, thereby removing waste containing key radionuclides to the maximum extent technically and economically practical.

DOE Response:

- DOE provided additional details on the design, operational history and status of pits, diversion boxes and pipelines.
- Examples of operating procedures and event reports provide documentation of the practice of routine flushing.
- Pits and diversion boxes will be inspected to verify conditions prior to closure.
- Taken together, this data provides a defensible basis for the conclusion that key radionuclides have been or will be removed from these structures to the maximum extent that is technically and economically practical.

NRC Comment: An insufficient basis was provided that demonstrates that procedures were effectively implemented to ensure proper quality assurance (QA) of the Draft WIR Evaluation and supporting analyses.

DOE Response:

- DOE provided the basis for the Quality Assurance Program used in the Draft WIR Evaluation and supporting PA analyses, and some examples of products prepared as a part of the QA process.
- DOE acknowledged several minor issues that will be corrected in the Final WIR Evaluation and a future update to the PA.
- DOE also provided feedback and clarification on a number of modeling assumptions identified by NRC in the Basis section of the RAI.

NRC Comment: The description of how viable alternative conceptual models or alternative future scenarios are identified is insufficient. DOE's current safety function methodology would not appear to be able to identify interdependencies and interrelationships between features, events, and processes (FEP) that could result in plausible alternative conceptual models or alternative future scenarios.

DOE Response:

- DOE provided additional detail on the safety function approach, including how safety functions are identified, how FEP interdependencies are captured, and how credible alternative models are identified.
- The response supplements the discussion in the WMA C PA, Chapter 8 and Appendix H, by providing specific details as to how these questions are answered in the methodology.
- At NRC's request, DOE also included responses to several related comments in NRC's 2009 RAI for Tank 241-C-106 Retrieval.

NRC Comment: An insufficient basis was provided for the inventory assigned to the C-301 Catch Tank. Assumptions regarding residual inventories are not consistent with operational history.

DOE Response:

- DOE provided additional justification for the assumptions supporting the residual waste inventory estimates used in the PA effort for the C-301 catch tank, including data on inventory and risk impacts.
- This information is summarized in the new Revision 4 of RPP-RPT-42323, *Hanford C-Farm Tank and Ancillary Equipment Residual Waste Inventory*.
- DOE is also currently developing plans to characterize the contents of the C-301 catch tank to provide an improved basis for retrieval decisions and subsequent closure planning.
- DOE expects that, as the residual waste inventory for the C-301 catch tank is revised, the PA analysis will be updated.

NRC Comment: An insufficient basis for the inventory assigned to the 244-CR Process Vault (with four small tanks) was provided. Assumptions regarding residual inventories are not consistent with operational history. Characterization data of ancillary equipment has not been provided.

DOE Response:

- DOE provided additional justification for the assumptions supporting the residual waste inventory estimates used in the PA effort for the 244-CR vault and tanks, including data on inventory and risk impacts.
- This information is summarized in the new Revision 4 of RPP-RPT-42323, *Hanford C-Farm Tank and Ancillary Equipment Residual Waste Inventory*.
- DOE is also currently developing plans to characterize the contents of the 244-CR vault and tanks to provide an improved basis for retrieval decisions and subsequent closure planning.
- DOE expects that, as the residual waste inventories for the 244-CR vault and tanks are revised, the PA analysis will be updated.

NRC Comment: An insufficient basis for the inventory of plugged pipelines was provided. The dose from intrusion into a plugged pipeline may be higher than the dose from intrusion into any other ancillary component or tank.

DOE Response:

- DOE provided additional information demonstrating that the inventory for plugged pipelines is conservative and defensible.
 - Historical data demonstrates that the use of the average concentration of residual waste in retrieved tanks for pipeline inventories is conservative.
 - Evidence shows that there are fewer potentially plugged pipelines than assumed in the PA.
- DOE also explained that a delay in the closure date assumed in the PA would significantly reduce the potential intruder dose.

NRC Comment: Some pipelines were taken out of service or replaced during operations, but the documents do not indicate what happened to a line when it was replaced during operations. The total amount of piping within the scope of the Draft WIR Evaluation has not been sufficiently established.

DOE Response:

- DOE provided clarification on the current status of the waste transfer pipelines at WMA C.
 - ALL underground waste transfer pipelines in WMA C have been removed from service.
 - ALL pipelines remain in place and are included in the inventory.
- The list of pipelines and related information used in the PA is based on an extensive review of drawings and operational information documented in RPP-PLAN-47559, *Single-Shell Tank Waste Management Area C Pipeline Feasibility Evaluation*.

NRC Comment: The inventory of waste assigned to pipelines is represented by two assumptions that have insufficient technical basis. First, pipelines are assumed to be 5% full of waste. Second, the piping is assumed to be represented by 7.6-cm [3-inch] diameter lines. Some piping is contained in encasements that can contain much larger amounts of radioactivity than would remain in the pipes themselves, but encasements were not evaluated. The DOE inadvertent intruder analyses for pipelines provides inadequate basis to support limiting the analyses to the 7.6-cm [3-inch] diameter lines and residual inventories based on 5% of the pipeline volume.

DOE Response:

- DOE provided detailed rationale for the assumptions for pipeline inventory, including the following:
 - The “5% Full” assumption only applies to pressurized pipelines in WMA C, which were flushed after use.
 - Documentation providing the basis for the “5% Full” assumption (DOE/RL-2003-11, and RPP-PLAN-47559).

NRC Comment: The inventory of waste assigned to pipelines is represented by two assumptions that have insufficient technical basis. First, pipelines are assumed to be 5% full of waste. Second, the piping is assumed to be represented by 7.6-cm [3-inch] diameter lines. Some piping is contained in encasements that can contain much larger amounts of radioactivity than would remain in the pipes themselves, but encasements were not evaluated. The DOE inadvertent intruder analyses for pipelines provides inadequate basis to support limiting the analyses to the 7.6-cm [3-inch] diameter lines and residual inventories based on 5% of the pipeline volume.

DOE Response:

- Pipeline encasements are designed to drain back to the tanks. The one known instance of a pipeline leak within an encasement indicates the drains were functional. Therefore, residual waste is assumed to be minimal.
- An additional analysis was conducted to evaluate inadvertent intrusion intersecting two 6-inch pipelines within an encasement. Results remain well below performance measures.

NRC Comment: The amount, type, and impact of chelating agents in waste residuals were not provided.

DOE Response:

- DOE provided information on the type of organic complexants received at the WMA C tanks.
- Available analyses of tank samples indicate that organic complexants have largely decomposed under the chemical and radiological conditions occurring in the tanks to low energetic compounds such as formate, oxalate and carbonate.
- Due to high solubility of organic compounds, most of them were removed during waste retrieval operations.
- Therefore, negligible amounts of chelating agents exist in WMA C tank residuals. Any effect on radionuclide transport or on grout durability is expected to be insignificant.

NRC Comment: An insufficient basis is provided for the assignment of the Hanford formation sand hydraulic properties to the degraded grout infill for the grout infill degradation sensitivity case analyses.

DOE Response:

- DOE explained that the purpose of the sensitivity analysis is to evaluate the robustness of the performance assessment with regard to the loss of the grout safety function, and that there is no known FEP or combination of FEPs that could produce this condition.
- DOE also conducted an additional technetium-99 sensitivity case with tank infill material assigned the same hydraulic properties as the gravel-dominated backfill material, to remove the contrast in permeability between the grout and surrounding backfill material. Results remain well below performance objectives.

NRC Comment: Additional information is needed to support a technical basis for using a relatively high hydraulic conductivity value for the unconfined aquifer.

DOE Response:

- DOE provided the following bases for hydraulic conductivity assumptions:
 - The applicability of the calibrated Central Plateau Groundwater (CPGW) model as the primary basis for establishing local-scale hydraulic conductivities at WMA C, rather than estimates of hydraulic properties based on pump and slug tests.
 - The general technical literature that supports the use of calibrated modeling results and parameter estimates that are conditioned or inverse upscaled by available data as superior to estimates derived from test measurements.

NRC Comment: Additional information is needed to support a technical basis for using a relatively high hydraulic conductivity value for the unconfined aquifer.

DOE Response:

- DOE also provided the following bases for hydraulic conductivity assumptions:
 - The differences in the geological conceptualizations and the scales of the two models, and the differences in the representation of the paleochannel in both models.
 - The method of evaluating uncertainties in hydraulic conductivity and hydraulic gradient by evaluating uncertainty in the Darcy flux, because groundwater concentrations are inversely proportional to the groundwater flux.

NRC Comment: The mass loading and soil ingestion parameters assigned to the acute intruder exposure scenarios may not be appropriate for the Hanford Site.

DOE Response:

- DOE provided additional technical basis information for the mass loading and soil ingestion parameters assigned to the acute intruder exposure scenarios.
- DOE also provided additional context for the estimated parameters by comparing them with other estimates developed for the Hanford Site and in NRC guidance.

NRC Comment: An insufficient basis was provided to demonstrate that the WMA C PA model is a valid representation of the system. It has not been demonstrated that the simplified WMA C PA model includes the real-world features in a sufficient or conservative manner to support decision-making.

DOE Response:

- DOE's response focused on the methods and available data used to develop confidence that the WMA C PA results provide an adequate basis for decision-making.
- The response described work documented in RPP-RPT-59197, *Past Leaks Analysis*, to evaluate the ability of the model to represent contaminant concentration data associated with past leaks. The comparison with available data provides some support for the PA model, subject to some caveats.

NRC Comment: An insufficient basis was provided to demonstrate that the WMA C PA model is a valid representation of the system. It has not been demonstrated that the simplified WMA C PA model includes the real-world features in a sufficient or conservative manner to support decision-making.

DOE Response:

- Several fixed-gradient analysis cases, including the primary model, produced technetium-99 transport results comparable to each other, and none were obviously superior to the others in terms of explaining the observed monitoring well data.
- Analysis cases attempting to account for uncertainties in groundwater fluxes caused by changes in the magnitude and direction of the aquifer gradient were capable of producing both arrival times and groundwater concentrations consistent with observed data for technetium-99.

NRC Comment: Differences in the conceptual hydrogeological models near WMA C between the regional CPGW model and the WMA C Subsurface Transport Over Multiple Phases (STOMP) model are considerable and some of the techniques for abstracting information and data from the CPGW model to the STOMP model require additional information. Additional information is needed on the calculated groundwater flux into the STOMP model and on the water budget from that model.

DOE Response:

- DOE's response focused on consistency between the equivalent homogeneous medium (EHM) approach for evaluating dilution in the performance assessment with the amount of aquifer dilution that would be estimated by the CPGW model.
- The response addressed the spatial variability of the thickness of the aquifer, and the quantity of flux at the upgradient boundary necessary to maintain consistency with the flux through the rectangular volume representing WMA C calculated in the CPGW model.

NRC Comment: Differences in the conceptual hydrogeological models near WMA C between the regional CPGW model and the WMA C STOMP model are considerable and some of the techniques for abstracting information and data from the CPGW model to the STOMP model require additional information. Additional information is needed on the calculated groundwater flux into the STOMP model and on the water budget from that model.

DOE Response:

- The response also addressed the water budget and mass balance, the upgradient boundary hydraulic head, the approximate gradient throughout the model domain, and the average flux within the aquifer and at the boundaries.

NRC Comment: The approach to sensitivity and uncertainty analyses does not provide a complete assessment of uncertainty and variability.

DOE Response:

- DOE's response clarifies the approach to uncertainty, and how it addresses the overall uncertainties of concern in this RAI.
- Additional information on the framework for identifying sensitivity analysis cases and their significance in the PA is presented in the response to RAI 2-2.
- As a further demonstration of system robustness, DOE also conducted a new analysis which combines failure of multiple safety functions. Even this extreme case meets performance objectives.

NRC Comment: The approach to inventory uncertainty does not reflect all important sources of uncertainty in the estimates of radionuclide inventory remaining in waste residuals.

DOE Response:

- DOE's response focused on representativeness of waste samples, and uncertainty of Hanford Defined Waste (HDW) model inventory estimates.
- Additional information was provided on the post-retrieval sampling approach, and the number and type of waste samples obtained for each of the tanks.
- Additional information was provided regarding the limited use of HDW model waste concentrations, HDW comparisons with new sample results, and plans to incorporate new sample results in future assessments.

NRC Comment: DOE did not provide the acute intruder doses from disturbance of a plugged pipeline, or from intrusion into diversion boxes. The thickness of waste used to assess the inadvertent intruder in the 244-CR Vault appears to be too low. Intruder dose calculations may need to be revised pending resolution of other requests for additional information.

DOE Response:

- DOE's response included separate discussions of inadvertent intrusion into a plugged pipeline, into diversion boxes, and into tanks within the 244-CR Vault.
- For inadvertent intrusion into a plugged pipeline, additional information and analysis was provided, showing results that remain below the relevant performance measures.
- For diversion boxes, a technical basis was provided, explaining why inadvertent intrusion into a diversion box was not evaluated.

NRC Comment: DOE did not provide the acute intruder doses from disturbance of a plugged pipeline, or from intrusion into diversion boxes. The thickness of waste used to assess the inadvertent intruder in the 244-CR Vault appears to be too low. Intruder dose calculations may need to be revised pending resolution of other requests for additional information.

DOE Response:

- For inadvertent intrusion into tanks within the 244-CR Vault, additional information was provided on sludge levels in individual tanks within the CR-Vault, with particular emphasis on Tank CR-011 (bounding case).
- A new analysis was conducted, comparing the acute and chronic doses for the base case with inadvertent intrusion into Tank CR-011 for the various scenarios evaluated. All results remain below the relevant performance measures.

NRC Comment: DOE's basis for concluding that the waste will be incorporated into a solid physical form is insufficient.

DOE Response:

- DOE provided the estimated amounts of liquid expected to be present in each structure at closure.
- A supporting calculation was prepared to demonstrate that the amount of liquid present will be absorbed within the grout as the cement hydrates, or evaporated by the heat of hydration, and that the resulting grouted mass will be a solid physical form.
- No liquids are expected to remain in pipelines, which will not be grouted.

NRC Comment: DOE's calculations that demonstrate the waste residuals do not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55 were incomplete. All components remaining in WMA C were not classified.

DOE Response:

- DOE developed new Class C averaging expression equations in consultation with NRC.
- DOE expanded the Class C calculations to include all components remaining at the WMA C after closure (e.g., CR-Vault tanks and cells, diversion boxes, and valve pits).
- All components were found to meet the Class C concentration limits in 10 CFR 61.55, "Waste Classification."
- DOE also provided an alternative analysis derived from the estimated intruder doses calculated in the WMA C PA. Either approach provides reasonable assurance that performance objectives and measures will be met.

- DOE has responded to each RAI comment with additional background information, basis of assumptions, or new analyses as needed.
- Next steps:
 - DOE and NRC will schedule technical clarification conference calls as needed – open to the public to observe.
 - NRC will complete their Technical Evaluation Report on the Draft WIR Evaluation and PA; approximately March, 2020.