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Kate Brown, Governor

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Mr. Jan Bovier
U.S. Department of Energy Office of River Protection
P.O. Box 450, MSIN H6-60
Richland, WA 99354

Dear Mr. Bovier:

Thank you for this opportunity to provide comment on the Draft Waste Incidental to Reprocessing (WIR) Evaluation and accompanying Performance Assessment for Waste Management Area C (WMA-C) at Hanford. Oregon appreciates the fact that the U.S. Department of Energy (DOE) granted Oregon's request for a 60-day extension of the public comment period for these documents, in consideration of the complexity of the decision being evaluated.

The State of Oregon retains a long-term interest in the safety of the Columbia River, which is directly influenced by subsurface conditions at Hanford. The DOE's decision whether to reclassify the high-level radioactive waste in the C Tank Farm via a WIR determination has the potential to directly threaten the Columbia River by allowing wastes to remain on site that otherwise by law would have to be disposed in a deep geologic repository. To support such a decision, DOE has produced the WIR Evaluation and accompanying Performance Assessment to try to demonstrate to the public, and stakeholders such as Oregon, that the risk is actually not that great.

Oregon previously joined litigation against DOE in 2002 after it first promulgated DOE Order 435.1, the Directive that introduced the WIR process. This decision to join the litigation was made for several reasons: because we believed DOE Order 435.1 failed to follow the statutory definition of high-level waste; the "evaluation method" of the order provided DOE with unlimited discretion to determine whether high-level waste was required to be disposed of in a deep geologic repository; and Oregon wanted to ensure that we had continued access to the discussions.

Waste remaining in the tanks originated directly from the reprocessing of spent nuclear fuel to produce plutonium for the nation's nuclear weapons program. By definition, this is high-level waste. However, we recognize that a rational approach to long-term radioactive waste management also considers the risk a waste poses to potential future receptors rather than the pedigree of the waste alone.

Oregon does not necessarily oppose DOE's attempt to test their Order 435.1 process for WIR determinations, in part because the plan for Hanford tank waste treatment depends on the ability to separate high-level waste into different disposal pathways. If the results of a rigorous and scientifically defensible analysis show there is a reasonable expectation for minimal risk to future receptors and the Columbia River, and DOE engages in an inclusive and integrative process of uncertainty management, then Oregon will respect that result.

We have historically differed with DOE on how to manage the remaining uncertainty that leaving key long-lived radioactive wastes on site at Hanford presents. DOE has made efforts to guarantee, via a suite of models, that receptors will be safe for the lifetime of those wastes. We have argued repeatedly that these models leave out key features and processes observable in the real world, supported by decades of data and evidence from DOE's own reports. Our concerns are shared by other interested parties, including the Washington Department of Ecology and the Nez Perce Tribe. Together these entities and the State of Oregon represent many decades of experience studying the Hanford environment.

To DOE's credit, they have conducted and supported numerous evaluations of the lateral waste transport mechanism that was at the heart of our concern. These studies have shed additional light regarding the scale of potential risks associated with lateral transport. However, our specific technical comments below will highlight that potentially significant uncertainties remain and are relevant to this and to other decisions on the horizon. We offer a recommendation for an inclusive Adaptive Management process to address these uncertainties while allowing the cleanup to move forward.

DOE has gone to great lengths to limit the scope of this WIR decision. The WIR Evaluation focuses exclusively on the residual waste in the WMA-C tanks post-retrieval, while consigning the high-level waste that historically leaked from these tanks into the soil to be addressed via RCRA and CERCLA. This approach presumes that the leaked waste, which derived directly from the reprocessing of spent fuel, can be treated as something other than high-level waste without the rigor of a WIR evaluation. Further, it leaves a hole in the present WIR Evaluation because the tank residuals are not modeled within the context of the contaminated environment in which they currently sit. We are also concerned that the data on past leaks from these tanks is sparse, meaning that our understanding of future risk from the migration of these wastes is ultimately uncertain.

By failing to account for these leaked wastes and the complexities of reactive transport and cumulative risk from waste sources in the vicinity, we are left without a holistic picture of the risk to a future receptor. We find it unlikely that the 10 CFR Part 61 regulations governing the creation of a new low-level radioactive waste disposal facility (which the grouted tank farms would become) intended such a facility to be located atop already contaminated and inadequately characterized soil and groundwater.

We believe that leaving the contaminated soil under the tanks that resulted from past high-level waste leaks would require a WIR evaluation and should have to meet the same performance standards and scrutiny as the tanks that once contained that waste. Alternatively, Oregon expects at the very least for the three WIR evaluation criteria to be applied to leaked tank waste in soil as a substantive Applicable Relevant or Appropriate Requirement under CERCLA, as required by DOE Order 435.1[1].

We are willing to accept DOE's approach to separate decisions for waste tank residuals and the leaked high-level wastes that are currently migrating toward groundwater beneath the tank farm. However, we contend that the appropriate use of DOE Order 435.1 should consider cumulative impacts from all nearby wastes that could impact future receptors, and therefore DOE should make a Composite

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[1] Per DOE-M-435.1-1, Field Element Managers are responsible for, "Ensuring the management and disposal of radioactive waste resulting from environmental restoration activities, including decommissioning, meet the substantive requirements of DOE O 435.1, Radioactive Waste Management, and this Manual . . . Compliance with all substantive requirements of DOE O 435.1 not met through the CERCLA process must be demonstrated."

Analysis, as required by DOE Order 435.1, available for public review before making a final WIR determination.

Finally, near-term tank closure is not a schedule or budget priority for Oregon. We believe that early closure of these tanks could also foreclose future cleanup of waste in the vadose zone or a chance to retrieve more waste from tanks in the future if more varied technologies are pursued. Furthermore, DOE's decision to devote limited site resources to tank closure while the capacity to treat tank wastes is still under construction is not representative of a priority to reduce the highest impact risks at Hanford.

We recognize the technical and financial difficulties of emptying, let alone fully excavating these tanks, and we understand the pressure on DOE to look for less costly alternatives. However, we remain concerned that the criteria for a WIR determination have not been met with the utmost confidence this decision requires.

Given the uncertainty of the risk that remains, we offer the following recommendations to introduce additional safety factors and process improvements into DOE's prospective decision and better manage the residual risk:

1. Prior to making a final WIR determination, DOE should conduct additional uncertainty analyses in the WMA-C Performance Assessment to address the potential risk stemming from compound model uncertainties.

2. Because the post-WIR DOE Closure Plan for WMA-C has no requirement for public involvement under DOE Order 435.1, it is important that DOE presents the whole package of this decision for public view as part of the WIR decision. This includes the Composite Analysis required for Closure Plans under DOE Order 435.1 and the Performance Assessment Maintenance Plan.

3. The Performance Assessment Maintenance Plan represents an opportunity to manage the remaining uncertainties associated with potential lateral transport of moisture and wastes into and out of WMA-C, while still moving forward with cleanup. Oregon would like to be involved in the development of this plan, in addition to other stakeholders, as a form of collaborative Adaptive Management[2]. Engagement in such a process would instill confidence in Oregon that DOE is committed to good long-term risk governance, and that the Performance Assessment maintenance process will seek the right information.

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[2] An innovative approach to resource management in which policies are implemented with the express recognition that the response of the system is uncertain, but with the intent that this response will be monitored, interpreted, and used to adjust programs in an iterative manner, leading to ongoing improvements in knowledge and performance (Holling, 1978; Walters, 1986, 1997; Walters and Holling, 1990; Lee, 1993). As noted by Lee (1999), "Adaptive management is learning while doing; it does not postpone action until 'enough' is known but acknowledges that time and resources are too short to defer…action." As such, adaptive management provides a structured approach for addressing uncertainty, making decisions in the face of it, and seeking to improve these decisions in an iterative manner by actively acquiring the knowledge necessary to reduce uncertainty. Excerpted from: National Research Council. 2003. *Environmental Cleanup at Navy Facilities: Adaptive Site Management, Washington D.C., The National Academies Press.* https://doi.org/10.17226/10599.

4. DOE should conduct a WIR Evaluation process or equivalent for the wastes associated with past WMA-C tank leaks and spills. This evaluation should be concurrent with the RCRA process currently ongoing for WMA-C soils.

5. Before implementing a final closure action for the WMA-C tanks, DOE should continue to evaluate new and more powerful waste retrieval technologies, including stronger pumps and/or dry mining techniques, and fulfill the promise of using the C Farm as a proving ground for more effective retrieval technologies. DOE has committed to a goal within the Tri-Party Agreement Milestone M-45-00, TPA Appendix H, and the Record of Decision following the Tank Closure and Waste Management EIS (2012) to retrieve at least 99 percent of waste from the tanks. Retrieval efforts within the C Tank Farm have fallen short of that total.

6. DOE should not proceed to approval of a Closure Plan for WMA-C at least until after the Waste Treatment Plant is operational.

It has been said that one of the reasons why Hanford is in the situation it is in now is because operators of the past treated the environment as a container for waste. That decision was based on the best information of that time, and it proved to be short-sighted. The question today is very similar to the one grappled with 70 years ago: is the environment an adequate container for waste? If we are wrong today, future generations could suffer harmful health effects, and the Columbia River that Oregon stewards could be irreversibly changed for centuries. Together we share a responsibility to design a decision that is coherent, risk-aware, inclusive, and adaptive if it is to endure.

Our more detailed technical comments follow, along with more specific recommendations.

Sincerely,

Ken Niles
Assistant Director for Nuclear Safety

Cc: Kristen Sheeran, Energy Policy Advisor to Governor Kate Brown
Alex Smith, Washington Department of Ecology
Brian Vance, U.S. Department of Energy, Office of River Protection
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Matt Johnson, Confederated Tribes of the Umatilla Indian Reservation
Rose Longoria, Yakama Nation
Jack Bell, Nez Perce Tribe
Oregon Hanford Cleanup Board
Susan Leckband, Hanford Advisory Board

Evaluation of the Three WIR Criteria for WMA-C Tanks and Residuals

Criterion 1: Wastes have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical

- The use of the term "cleaned tanks" (Page 1-4 of the draft WIR evaluation), implies a level of no risk, which is not accurate. "Retrieved tanks" is a more accurate term.

- On cessation of retrieval activities at WMA-C, a total of 62,900 gallons of waste representing an estimated 472,000 curies of radioactivity[3] are proposed to be left behind for potential future release to the environment. The WIR Evaluation document notes that in Tank C-112 and others, waste solids larger than grains of sand were not able to be suspended and pumped from the tanks, and thus were left behind as "impractical" to retrieve.

    - The WIR evaluation does not specify the strength of the suction pumps used to lift tank solids from the tank bottoms to the transfer lines at ground surface. This is an important detail, as the justification given at the June 18, 2018 public meeting for why particles larger than grains of sand could not be retrieved from the tank was that the pumps lacked sufficient power. By contrast, the F Tank Farm retrieval at Savannah River achieved 99.7% retrieval efficiency[4] via a Sand Mantis retrieval technology that used a 17,500 PSI eductor to aspirate dislodged wastes. Tank retrieval in Idaho achieved an estimated 99.9% retrieval[5] using a washball, directional nozzle, and steam jet pump, with residual solids pumped out during the first stages of grouting as wastes were pushed toward the pump[6]. The WIR evaluation should provide sufficient detail for a reader to more fully determine how the retrieval technologies used in the C Farm tanks compare to those at Savannah River and Idaho.

    - During the public meeting for the WIR process on June 18, 2018, a DOE presentation showed that a miniature robotic bulldozer (Off Riser Sampler) was capable of collecting residual solids for the purposes of post-retrieval characterization. This begs the question of why dry mining or mechanical retrieval of waste solids were not pursued as a supplemental retrieval technology. We have heard that multiple dry mining proposals have been put forward in recent DOE Grand Challenge competitions, so it is reasonable to expect this is a new technology avenue that may be forthcoming. Looking to the future as DOE plans to retrieve single-shell tanks that have breached or corroded to the point that liquid-based retrieval threatens to mobilize tank residuals further into the environment, DOE should plan on the need to incorporate non-liquid-based retrievals. As the WMA-C retrieval was originally intended to be the proving ground for retrieval

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[3] Estimate based on data retrieved from phoenix.pnnl.gov on 8/23/18.
[4] Savannah River Remediation LLC, 2012. "Cost Benefit Analysis for Removal of Additional Highly Radioactive Radionuclides from Tank 18." SRR-CWDA2012-00026.
[5] US NRC, 2006. "U.S. Nuclear Regulatory Commission Technical Evaluation Report for the U.S. Department of Energy Idaho National Laboratory Site Draft Section 3116 Waste Determination for Idaho Nuclear Technology and Engineering Center Tank Farm Facility." October 2006. https://www.nrc.gov/docs/ML0624/ML062490142.pdf.
[6] US Department of Energy, 2006. "Basis for Section 3116 Determination for the Idaho Nuclear Technology and Engineering Center Tank Farm Facility." November 2006. https://www.nrc.gov/docs/ML1431/ML14317A056.pdf.

technologies to be used throughout the tank closure mission, this seems a missed opportunity that can still be remedied.

- For multiple retrievals, a justification in the evaluation to not pursue additional retrieval via caustic dissolution was that limitations on double-shell tank space would further limit future retrieval activities. We do not agree that double-shell tank space limitations are a reasonable justification for declaring technical or economic impracticality for further risk reduction. This is an issue of timing due to the unavailability of the Waste Treatment Plant and DOE's decision to not build the storage capacity needed to properly complete the retrieval mission.

- The Tri Party Agreement (TPA) documents agreement between DOE, the U.S. Environmental Protection Agency, and Ecology that, "Closure will follow retrieval of as much tank waste as technically possible, with tank waste residues not to exceed 360 cubic feet in each of the 100 series tanks, 30 cubic feet in each of the 200 series tanks, or the limit of waste retrieval technology capability, whichever is less" (M-045-00). Cost is not a TPA retrieval factor unless Appendix H of the TPA is invoked and accepted by Ecology. Even if DOE determines, based on its criteria of practicality, that waste retrieval has been performed adequately enough for a WIR determination, this does not automatically mean that the TPA requirements have been satisfied. It would therefore be inappropriate to grout the tanks until the full breadth of regulatory decisions have been made regarding the tank residuals and the surrounding environment.

- The definition of practicality is by its nature subjective. It can be defined in a dictionary as "adapted to actual conditions," or, "mindful of the results, usefulness, advantages, disadvantages, etc., of the action or procedure." However, all definitions require an application of judgment. DOE's modifiers of "technically and economically" introduce a bias away from precautionary safety. DOE's usage of the term "practical" in the WIR Evaluation seems to center around the concept of "bang for the buck." Additional waste retrieval is deemed impractical if diminishing returns have been reached in the rate of retrieval using the current technologies, and if DOE's Performance Assessment indicates that remaining wastes pose minimal risk. We suggest that the "actual conditions" to be "adapted to" should include consideration of remaining uncertainties in the natural system model, future uses of the area, and other unknown unknowns. Actual conditions should also include WMA-C's proximity to the Columbia River and the corresponding risk of irreversible harm to an irreplaceable resource if the unexpected should come to pass. In other words, practicality should be enhanced by a healthy dose of precaution that involves additional source term removal using new, more varied methods.

- A 2006[7] report by the National Academy of Sciences urged the DOE to not be hasty in its tank retrievals and to consider the potential benefits of delaying tank closure in order to allow time for additional retrieval technologies to mature. Specifically, the NAS report concluded: "*DOE should decouple its schedule for tank waste retrieval from its schedule for tank closure for those tanks that still contain significant amounts of radioactive material after initial waste retrieval is completed. . . Decoupling will enhance future opportunities to remove additional*

[7] https://www.nap.edu/read/11618/chapter/6 National Academies Press, 2006. Tank Waste Retrieval, Processing, and On-site Disposal at Three Department of Energy Sites: Final Report.

radioactive material from these tanks as retrieval technologies are improved." DOE appears not to be heeding this advice in an effort to push forward with a WIR determination. If the TPA agreed-upon retrieval targets cannot be met with the technology DOE has employed so far, it would be wise to leave the option open for further retrieval in the future rather than preclude the use of future technologies by grouting the tanks and installing an interim asphalt cap over the area.

Criterion 2: Wastes will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, *Performance Objectives*

- The draft WIR evaluation indicates that the Oregon Department of Energy, among many other entities and agencies, have reviewed the technical aspects of the Hanford geological data package, and that this high-level of review, "has helped ensure a rigorous understanding of bounding geologic, seismic and volcanic risks (page 2-6)." The language implies the review equates to concurrence, which is not entirely the case.

- Oregon acknowledges the work performed by DOE to improve the Performance Assessment modeling via a stochastic parameter sensitivity analysis. We generally agree this effort resolves some of the uncertainties associated with variability of parameters in DOE's chosen base model (e.g., groundwater recharge rates, residual waste inventory, etc.). However, the parameter sensitivity analysis does not adequately account for conceptual/structural uncertainties in the coupled natural-engineered-human system. DOE conducted a "sensitivity case" uncertainty analysis, which evaluated the effect of <u>single aspects</u> of the larger disposal system performing differently than expected (e.g., early cap failure, alternative subsurface conceptual models, presence of a clastic dike, etc.). These analyses are a good start, but we contend that a more complete uncertainty analysis should consider the effects of cumulative uncertainty if <u>more than one</u> of these unexpected conditions were to occur at once. For example, no apparent scenario included an alternative conceptual subsurface model with additional fine-grained subunits, a clastic dike, early cap/grout failure, and variable recharge rates.

    - <u>Recommendation</u>: Additional uncertainty analysis should be included in the Performance Assessment supporting the final WIR Evaluation. This analysis should include multiple fine scale silt layers, a clastic dike, the highest average precipitation, and early failure of the cap and grout. Additional combination uncertainty cases may also be appropriate, but the proposed scenario would at least provide a bounding uncertainty case to increase confidence that the proposed action is robust enough to withstand multiple unexpected conditions.

- Oregon has long maintained that lateral contaminant transport along preferential fast travel pathways, including fine-scale heterogeneous subsurface layers and vertical clastic dikes, is a significant natural process not captured by the Performance Assessment model. The heart of our concern is that fine grain layers may promote lateral transport of water. This matters for two reasons. First, if water can enter the soil outside of the engineered control and circumvent the proposed cap, then waste may be mobilized faster than predicted. Second, if waste migrates laterally through preferential pathways, then the peak dose to future residents may be in a place not modeled, at a time sooner than predicted, at a higher concentration that no attempt has been made to calculate. This leaves the future risk uncertain if three conditions are present: 1) these subsurface conditions do indeed exist in this specific location, 2) thin silty layers surrounded by sand and gravel will actually act as a sufficiently impermeable surface to cause water to travel laterally; and 3) the amount of lateral transport is significant enough to affect peak dose.

- Regarding Condition 1, neutron moisture data from probes at WMA-C exhibited characteristics that Oregon and others interpreted to show the possible location of sloping fine-grained soil layers that were correlatable and mappable. PNNL-15617 documented the investigation of a pipeline leak within the WMA-C boundary, and Page 2.3 contains neutron moisture log cross-sections that identify correlated spikes of subsurface moisture similar to the work of Oregon and the Nez Perce, providing further evidence of the existence of at least four discernable lithologic boundaries (fine layers) where moisture concentrates within 40 feet of the surface (p. 2.8). The geologists' core logs from the boreholes also identify many moist samples containing silts, laminated fine sands, and "mud." The location of the investigation was outside the original backfilled excavation of the tanks, where the shallow soils are consistent with the H2 formation that dips northeast to underlie the backfill for the tanks. Based on the available evidence, Oregon concludes that fine layers likely exist within WMA-C, and those layers can be treated as continuous with respect to the model.

- Regarding Condition 2, Oregon remains uncertain. While numerous studies at Hanford describe lateral transport of contaminants from source zones, the scale of this travel tends to be on the order of tens of meters in past events. These events were during site operations, when greater amounts of water were released to soil than what is predicted for future meteoric water infiltration. The field study experiments at the "Sisson and Lu" site also provide well-documented evidence of lateral transport, but again this was based on a relatively large moisture infiltration event (20,000 liters over four discrete injections). A validated relationship between the amount of infiltration required to mobilize transport laterally within fine subsurface layers and the distance traveled still needs to be established. Further work could help define the permeability characteristics of these layers.

- Regarding Condition 3, Oregon remains uncertain. We recognize that lateral transport of "tens of meters" from the tanks would not significantly affect the peak dose in a hypothetical groundwater well 100 meters downgradient of the WMA; however, increased lateral inflow could drive potentially significant additional mobilization of tank wastes. We further recognize that DOE's repeated efforts to model heterogeneity have all predicted that the peak dose concentration and time of arrival are not significantly different between a subsurface with heterogeneous layers versus one without. However, aspects of DOE's supplemental modeling designs impede their usefulness.

    - An early modeling exercise (presented to Oregon but not documented in a report) uses a stylized 2-D modeling approach to argue that the arrival time and concentration of a hypothetical Technetium 99 source is not appreciably different between a subsurface with, versus without, fine layers fitting hypothetical hydraulic conductivity properties. However, if the layer acted as a plastic barrier and was totally impermeable, then waste concentrations would be more than three times higher and the arrival time approximately 30 percent sooner. Three aspects of the stylized model make the significance of these findings difficult to conclude definitively. First, the lack of sloping in the stylized fine layers underestimates the contributing force of gravity to facilitate transport. Second, the model may be underestimating the effect of extreme pressure and earthquakes to create a less permeable surface than the silt characteristics used in the model. Third, the episodic nature of precipitation or rapid snowmelt events at Hanford allows the possibility for future flooding to form “temporary lakes” in the vicinity of WMA-C, which may introduce enough water to make fine layers more active transport features.

- A PNNL study from 2017 attempted to more accurately model the potential effects of heterogeneity using a data driven approach. This effort applied a kriging methodology to build a three dimensional image of the subsurface based on the neutron moisture data. The kriged data were then used to statistically synthesize “pseudo-boreholes” to further populate the parameters in the model domain. This report concluded that the arrival time and concentration of a hypothetical Technetium 99 source in soil was not appreciably different than the Performance Assessment base model. Unfortunately, the research was not designed to address the specific concern raised by Oregon. Rather than evaluate the potential effects of structured heterogeneity (i.e., discrete layers of bedded fine layers consistent with the natural historical process of cataclysmic Ice Age floods that would have created them), the applied kriging method "smeared" the fine soils. This approach failed to capture the essence of our concern, which is the potential for lateral inflow and preferential fast travel pathways due to the specific behavior of low-permeability lenses. We are also concerned that the modeled parameter values for the soil types may not be sufficiently different to mimic the natural process of interest.

- Appendix F of the Performance Assessment presents a facies-based model approach. This model also concluded that arrival time and concentration of a hypothetical Technetium 99 source would not be significantly different from the base model; however, this model assumed a very low infiltration rate of 3.5 mm/year and therefore cannot address the potential of greater lateral flow under higher infiltration conditions.

- It is unclear from the provided reports whether and/or how any of DOE’s supplemental modeling approaches incorporated the potential for lateral inflow from outside an assumed cap.

- PNNL-15617 showed lateral transport to the northeast of a pipeline leak from the 1960s, but it is likely that this transport occurred along the compacted excavation in which the ancillary pipelines were laid. While this finding does not strengthen the case of fine layer transport, it does demonstrate that anthropogenic lateral transport pathways not modeled in the Performance Assessment exist within WMA-C, which could be a future moisture infiltration pathway from outside a future WMA-C cap. However, this study also showed that the highest observed concentrations of Technetium 99 occurred 80 feet beneath the site of the original leak, which supports

DOE's assertion that the majority of transport will still be vertical.

- The Performance Assessment model does not appear to consider the effects on contaminant migration if rapid-snowmelt lakes form around the tank farm. A similar event happened in January 1979 when a lake formed over the T Farm. While the presence of a cap will encourage runoff, the presence of lateral subsurface migration pathways leaves the possibility that a large infiltration event could allow water to travel laterally under the cap and into the tank backfill material.

- The WIR Evaluation does not contain the results of a Composite Analysis.

    - Recommendation: The Composite Analysis specific to the closure of WMA-C, required under 435.1, should be included as part of the "decision package" for the WIR determination.

- The Best Basis Inventory for the C Tank Farm reports 175 Curies of Plutonium 239 and 164 Curies of Americium 241 remaining in tank residuals. The migration of Plutonium 239 to groundwater was pre-screened from being modeled in the Performance Assessment under the expectation that no radionuclide with a Kd >1.5-2.0 would reach groundwater within 10,000 years (plutonium was given an assumed Kd of 600). However, a 2015 study by PNNL (PNNL-23468 Rev. 1) found that when considered in the context of actual Hanford soils and tank waste compositions including organic complexants, plutonium sorption was limited with Kds ranging from 1.4 to 40. Another recent report (PNNL-21651) concludes that, "In order to demonstrate to regulators and other interested parties that we have a technically defensible understanding of plutonium and americium behavior in the Hanford environment, and to predict the impact of remediation or closure options with reasonable confidence, a number of unresolved issues and research needs and challenges need to be addressed."

    - Recommendation: Due to these uncertainties, a sensitivity case in the Performance Assessment should evaluate the potential effects of more rapid plutonium and americium migration in the subsurface.

- Guidance within DOE M-435.1 IV (P) 4 requires that Performance Assessment maintenance be conducted to "*evaluate changes that could affect the performance, design, and operating basis for the [disposal] facility… and shall include the conduct of research, field studies, and [environmental] monitoring needed to address uncertainties or gaps in existing data . . . Additional iterations of the performance assessment and composite analysis shall be conducted as necessary during the post-closure period*."

    - Recommendation: Oregon recommends that DOE fully develop the Performance Assessment Maintenance Plan consistent with the tenets of Adaptive Management (Holling, 1978), in consultation with the U.S. Nuclear Regulatory Commission, Oregon, Washington, Native American tribes and the public, prior to making a final WIR determination. This activity would make the complete package of the decision available for review and should include funding for additional investigation and verification of the assumptions supporting the Performance Assessment.

- The Performance Assessment states that "*The engineered cover for WMA-C is not yet designed, but is assumed to be similar to the Modified RCRA Subtitle C Barrier that limits infiltration through the waste primarily by evapotranspiration processes (i.e., surface barrier) based on the work done for the Hanford Prototype barrier*." If the infiltration rate (i.e., performance) of the assumed barrier relies on vegetation to provide evapotranspiration, the barrier should be considered an "active control" that would degrade after loss of Institutional Control at 100 years, because it will require upkeep to recover from future fires and invasive plant species that could change evapotranspiration assumptions. Furthermore, the figure for the Generic Modified RCRA C Baseline Design (Figure 3-50) assumes that vegetation root depth will not exceed 1 meter. Studies of Hanford flora have found that rooting depth of native species can exceed 15 feet[8] and could conceivably penetrate the deeper layers of the cover, thereby increasing water infiltration. At the same time, the RCRA process for remediating past leaks to the soil assumes the placement of asphalt covers over portions of the WMA to reduce infiltration and direct exposure risk, yet this interim cover does not appear to be integrated into the design of the final cover proposed in this WIR evaluation.

    - <u>Recommendation:</u> DOE should clarify whether and how these uncertainties are addressed in the uncertainty analysis, or revise the uncertainty analysis to include these potential failure factors.

- If the tanks and the residual waste contained therein are modeled with the assumption that no external contamination is present, as presented in the scope-limited WMA-C Performance Assessment, then the proposed closure strategy for the tanks appears to present minimal risk to human health and the environment. However, multiple variables preclude meaningful calibration of the transport model. First, underlying soils and groundwater have been contaminated by past releases. The Technetium 99 contribution of contaminant mass resulting from residual tank waste cannot be measured in isolation. Second, and more importantly, the model is run forward through time beginning at the installation of the cap and emplacement of the grout. Without an initialization period which can be compared to existing data, the model cannot be referenced to observed physical conditions. Although a calibration of transport of existing contamination is located in the Analysis of Past Leaks document (RPP-RPT-59197), that calibration is not included in the Order 435.1 Performance Assessment.

- While the WIR evaluation attempts to limit the scope of the Performance Assessment to tank residuals, excluding contaminated soils within the Waste Management Area, this approach fails to consider the actual risk to receptors under a well driller scenario. It is reasonable to expect that if a well driller exhumes waste from a subsurface pipeline on the way to groundwater, any contamination in the excavated column of soil would also be brought to the surface for human exposure. Presently, the WMA-C WIR Performance Assessment is the only analysis that evaluates a well driller scenario.

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[8] Lovtang, S., Delistraty, D., & Rochette, E. (2018). The biologically active zone in upland habitats at the Hanford Site, Washington, USA: Focus on plant rooting depth and biomobilization. *Integrated environmental assessment and management*, 14(4) 442–446.

- Recommendation: The intruder well driller exposure scenario should be revised to include a reasonably anticipated contaminated soil column from the surface to groundwater in addition to the waste from a remaining subsurface pipeline.

Criterion 3: The 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 as set out in 10 CFR 61.55, *Waste Classification*

- We understand that DOE is opting to make a scenario-based argument, consistent with NRC Guidance NUREG-1854, in the development of Class C equivalent concentrations. In this analysis, DOE asserts that due to the depth of the buried tanks and ancillary structures and pipelines, the concentrations in 10 CFR 61 that were based on a basement excavation scenario are not appropriate. Therefore, the near-surface pipelines contained the "most credible" source term for the assessment. In order to qualify for the "deep waste, no intruder barrier" category within NUREG-1854, these pipelines would need to be deeper than 15 feet below ground surface. Page 6-5 of the WIR Evaluation only commits to burying the pipes greater than 10 feet below the WMA-C closure barrier, which is assumed to be approximately nine feet thick. It is uncertain whether the phrase, "below the barrier" is meant to indicate below the bottom or the top of the barrier. For DOE to pursue this path, the final fill material and barrier will need to be massive enough to ensure that all buried pipelines associated with WMA-C are at least 15 feet below ground surface. This represents a significant additional soil overburden requirement, which will come at significant cost, and we suggest an analysis to determine if it would be more economically practical and protective in the long-term to remove the pipelines and emplace a less massive cover.

- Based on Page 6-4 of the WIR evaluation, it appears that DOE does not intend to grout an unknown portion of the nearly eight miles of ancillary pipelines within WMA-C. The residual wastes within these pipelines would consequently not be incorporated in a solid physical form. It is unclear how DOE proposes to satisfy Criterion #3 for the wastes remaining in these pipelines.

- Oregon is concerned that residual wastes in the tanks will not be incorporated into the grout but will rather be overlain while remaining in a concentrated mass or, in some cases, may be pushed to the sides of the tank or floated to the top of the pour. These concentrated lumps/layers of waste could potentially be located in the portions of the tank that would be the first to encounter water as the tank liners corrode and water works preferential pathways into the layer cake monolith. It is unclear how DOE's proposed approach will satisfy Criterion #3 requiring incorporation of the waste into a solid physical form.