November 23, 2020

Submitted Via Electronic Mail: VLAWDraftWIR@rl.gov

U.S. Department of Energy
Attn: Jennifer Colborn
P.O. Box 450, MSIN H6-60
Richland, WA 99354

RE: Hanford Challenge, NRDC, and Columbia Riverkeeper Comments on the *Draft Waste Incidental to Reprocessing Evaluation for Vitrified Low-Activity Waste*

Dear Ms. Colborn:

Hanford Challenge (HC), the Natural Resources Defense Council (NRDC), and Columbia Riverkeeper (CRK) write today to comment on the Department of Energy's (DOE's) *Draft Waste Incidental to Reprocessing Evaluation for Vitrified Low-Activity Waste* (Draft WIR Evaluation) (comment deadline extended to November 27, 2020).

Thank you for the opportunity to comment on this Draft WIR Evaluation and for extending the comment period deadline.

I. HC, NRDC & CRK Statement of Interest

Hanford Challenge is a non-profit, public interest, environmental and worker advocacy organization located at 2719 East Madison Street, Suite 304, Seattle, WA 98112. Hanford Challenge is an independent 501(c)(3) membership organization incorporated in the State of Washington and dedicated to creating a future for Hanford that secures human health and safety, advances accountability, and promotes a sustainable environmental legacy. Hanford Challenge has members who work at the Hanford Site and within the tank farms who are at risk of imminent and substantial endangerment due to DOE's handling, storage, treatment, transportation, and disposal of Hanford's solid and hazardous waste. Other members of Hanford Challenge work and/or recreate near Hanford, where they may also be affected by hazardous materials emitted into the environment by Hanford. All members have a strong interest in ensuring the safe and effective cleanup of the nation's most toxic nuclear site for themselves and for current and future generations.

NRDC is a national non-profit membership environmental organization with offices in Washington, D.C., New York City, San Francisco, Chicago, Los Angeles and Beijing. NRDC has a nationwide membership of over one million combined members and activists. NRDC's activities include maintaining and enhancing environmental quality and monitoring federal agency actions to ensure that federal statutes enacted to protect human health and the environment are fully and properly implemented. Since its inception in 1970, NRDC has sought to improve the environmental, health, and safety conditions at the nuclear facilities operated by the DOE and its predecessor agencies.

Columbia Riverkeeper (CRK) is a 501(c)(3) nonprofit organization with a mission to protect and restore the Columbia River, from its headwaters to the Pacific Ocean. Since 1989, Riverkeeper and its predecessor organizations have played an active role in educating the public about Hanford, increasing public participation in cleanup decisions, and monitoring and improving cleanup activities at Hanford. Columbia Riverkeeper and its 16,000 members in Oregon and Washington have a strong interest in protecting the Columbia River, people, fish, and wildlife from contamination at Hanford, including pollution originating in Hanford's tank farms.

As an initial matter, the commenters repeat our objections raised in earlier public comments to the application of DOE Order 435.1, *Radioactive Waste Management*, and the criteria in DOE Manual 435.1–1, *Radioactive Waste Management Manual*. Commenters next express our concerns regarding DOE's failure to properly protect Tribal members. Finally, we submit technical comments upon the Draft WIR Evaluation.

II. <u>The Waste Incidental to Reprocessing Rule is Contrary to Law</u>

DOE's determination in the Draft WIR to re-characterize 22 million gallons of treated tank waste as "low-level" to be permanently disposed of in the Integrated Disposal Facility, when the Nuclear Waste Policy Act clearly defines high-level waste using a source-based definition, is contrary to law. DOE asserts that waste which is derived from the underground nuclear waste tanks and vitrified at the Waste Treatment Plant is waste that is "incidental to reprocessing." As such, DOE erroneously concludes – pursuant to DOE Order 435.1 and the criteria in DOE Manual 435.1–1 – that this waste is not high-level radioactive waste and therefore may be managed as low-level radioactive waste.

Because high-level waste contains highly radioactive fission products and radionuclides that pose long-term dangers to human health and the environment, Congress enacted laws defining high level waste and defined DOE responsibilities to safely manage the waste at its sites and to dispose of that waste in geologic repositories. It has not given DOE authority to change the definition of high-level waste. DOE should therefore withdraw the Draft WIR and follow the statutory requirements in the Nuclear Waste Policy Act, which designates the Nuclear Regulatory Commission (NRC) as the appropriate agency to determine when high-level waste can be downgraded to low-level waste following the removal of radioactive constituents below "sufficient concentrations."

The Nuclear Waste Policy Act defines high-level waste as --

> (A) *the highly radioactive material resulting from the reprocessing of spent nuclear fuel*, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and
>
> (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.[1]

Thus, the Nuclear Waste Policy Act defines high-level waste by its source – "the highly radioactive material resulting from the reprocessing of spent nuclear fuel"– rather than specifics of its hazardous characteristics. Further, the Nuclear Regulatory Commission (NRC) has interpreted subparagraph (A) as "essentially identical" to the NRC's regulatory definition,[2] with one major difference. NRC's definition includes "solids into which such liquid wastes have been converted"[3] versus the Nuclear Waste Policy Act's definition states "solid material derived from such liquid waste *that contains fission products in sufficient concentrations*."[4] NRC read the distinction to "reflect the possibility that liquid reprocessing wastes may be partitioned or otherwise treated so that some of the solidified products will contain substantially reduced concentrations of radionuclides."[5]

It is plain that DOE's Draft WIR Evaluation violates the law and therefore must be withdrawn. We urge DOE to go back to the drawing board and commence a transparent public process, led by the States of Washington and Oregon, the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Nez Perce Tribe, and concerned members of the public that can finally put the cleanup of Hanford on a course that is both scientifically defensible and publicly accepted.

III. DOE's Reliance on Institutional Controls are not Protective for Tribal Members

DOE's over-reliance on institutional controls is based on flawed assumptions about the future uses of Hanford. DOE's proposed plan does not account for tribal nations' future uses of Hanford, nor does it prove protective of tribal members. Three tribal nations are active in Hanford cleanup decisions, the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Nez Perce Tribe. These tribes approach cleanup through the frame of how tribal people used and will use Hanford in the future: for hunting, fishing, gathering, sweat lodges, and other activities. These uses bring people

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[1] 42 U.S.C. § 10101(12). The Price-Anderson Amendments Act of 1988, Public Law 100-408, later incorporated the Nuclear Waste Policy Act's definition of "high-level radioactive waste" into the Atomic Energy Act of 1954 by reference. 42 U.S.C. § 2014(dd).
[2] *See* 52 Fed. Reg. at 5994. NRC's high level waste disposal rules, adopted before Nuclear Waste Policy Act's 1982 enactment, include: (1) irradiated reactor fuel; (2) liquid reprocessing wastes as defined in the AEC's Appendix F; and (3) "solids into which such liquid wastes have been converted." 10 C.F.R. § 60.2.
[3] 10 C.F.R. § 60.2.
[4] 42 U.S.C. § 10101(12)(A) (emphasis added).
[5] 52 Fed. Reg. at 5994.

in close contact with soils, water, air, plants, wildlife, and fish at Hanford.[6] Tribal nations also point out that, unlike non-tribal recreational users, tribal people may live at and near Hanford year-round, and use resources far more extensively than recreational or non-resident people.[7] Both the Yakama Nation and CTUIR have detailed pollution exposure scenarios, describing how tribal people will use Hanford in the future.[8] For example CTUIR explains,

> The exposure scenario includes "residence, because permanent year-round fishing villages with resident CTUIR members were present along the Hanford Reach when Hanford was established." The tribal people scenario "is not a visiting scenario like a recreational scenario." The tribal exposure scenario includes a forager that "may obtain a site-specific percentage of his and her food from an irrigated garden to supplement the native plants in his or her diet." CTUIR also accounts for how tribal people are exposed to radioactive and toxic pollution from "a well and/or seep and/or river for drinking water, sweat lodge water, and irrigation."9

Similarly, The Yakama Nation takes the position that cleanup standards and waste management decisions at Hanford meet the goal of restoring what has been lost, as well as protecting the future resource uses reserved by the Treaty.[10] In addition,

> "The Nez Perce Tribe believes that the ultimate goal of the Hanford cleanup should be to restore the land to uncontaminated pre-Hanford conditions for unrestricted use." In the Nez Perce Tribe's view, tribal members, ecological resources, and cultural resources within Usual and Accustomed areas "should not be exposed to any potential adverse risk about that which has always existed for the tribe prior to the establishment of the federal government projects and facilities at Hanford in 1942.[11]

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[6] Tribal Use Scenarios developed by Columbia River tribes provide detailed information about how tribal members will use the Hanford site and adjacent areas.

[7] Competing Visions for the Future of Hanford, Columbia Riverkeeper (June 2018) available here, https://www.columbiariverkeeper.org/sites/default/files/2018-07/2018.6.1%20Hanford%20Vision%20Report_j_INTERACTIVE.pdf

[8] *See* RIDOLFI Inc. (Ridolfi), 2007. Yakama Nation Exposure Scenario for Hanford Site Risk Assessment, Richland, Washington. Prepared for the Yakama Nation ERWM Program at Section 3.1.2. https://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=DA06587583. *See also* Confederated Tribes of the Umatilla Indian Reservation. 2011. Exposure Scenario for CTUIR Traditional Subsistence Lifeways. https://health.oregonstate.edu/sites/health.oregonstate.edu/files/research/pdf/tribal-grant/CTUIRSCENARIO.pdf

[9] Competing Visions for the Future of Hanford, Columbia Riverkeeper (June 2018) available here, https://www.columbiariverkeeper.org/sites/default/files/2018-07/2018.6.1%20Hanford%20Vision%20Report_j_INTERACTIVE.pdf. Confederated Tribes of the Umatilla Indian Reservation. 2011. Exposure Scenario for CTUIR Traditional Subsistence Lifeways. https://health.oregonstate.edu/sites/health.oregonstate.edu/files/research/pdf/tribal-grant/CTUIRSCENARIO.pdf 16 Harris, S.G. and Harper, B.L. 2004. Exposure Scenario for CTUIR Traditional Subsistence Lifeways. Department of Science & Engineering, Confederated Tribes of the Umatilla Indian Reservation.

[10] Competing Visions for the Future of Hanford, Columbia Riverkeeper (June 2018) available here, https://www.columbiariverkeeper.org/sites/default/files/2018-07/2018.6.1%20Hanford%20Vision%20Report_j_INTERACTIVE.pdf.

[11] Nez Perce Tribe Executive Committee. Hanford Endstate Vision.

DOE's proposed project fails to consider how tribal nations intend to use Hanford in the future and fails to explain how the proposed project will be protective of these uses. When considering a plan which will require the prevention of public access for 100+ years to areas of Hanford and store waste onsite at Hanford, DOE is ignoring tribal Treaty Rights, tribal nations, and tribal people's current and future uses of Hanford. This oversight means that DOE's proposed project will put tribal members at risk. DOE's proposed plan must reconcile with this.

IV. Technical Comments

The following technical comments were prepared by Marco Kaltofen, Ph.D, PE. Dr. Kaltofen reviewed the Draft WIR and related documents to determine whether the proposal to re-characterize 22 million gallons of treated tank waste as "low-level" to be permanently disposed of in the Integrated Disposal Facility (IDF) can meet the Draft WIR's three criteria requirements:

(1) As fully as possible, key radionuclides must first be removed from tank wastes.
(2) All applicable (10 CFR 61C) safety requirements must be met.
(3) Wastes must be in a solid form with radionuclide concentration limits not exceeding Class-C low-level waste (10 CFR 61.55).

Upon review of DOE's documentation for this proposal, Dr. Kaltofen concluded that it appears that this project can meet the Draft WIR's three criteria requirements, but only if specific critical uncertainties in the analysis are addressed. These are:

(R1) There are other projects among the Hanford Remedial and Operational Programs that already exert a measurable risk of radiation exposure to the public. The full quantity of potential allowable radiation exposure is therefore not available for this project due to the cumulative risk of radiation. The public radiation exposure allowances should be prorated for this proposed project and reevaluated, as other projects already exert some measured or expected exposure to public receptors.

(R2) The 2019 Performance Assessment of the Integrated Disposal Facility explicitly does not provide assurances regarding the sources of radioactive material that may be interred within the Integrated Disposal Facility at some future date. Compliance with the statutory criteria to be met before any VLAW can be separated from the existing high level wastes in Hanford's tank farms, pretreated to remove key radionuclides, vitrified, then disposed of onsite in the IDF can't be assured without first prohibiting future waste streams outside the current proposal, and fully characterizing all remaining waste streams prior to project approval.

(R3) The proposed project fails to meet the three criteria if public access to the IDF is not prevented for closure plus 100 years (or more). The evidence provided for success of institutional controls against such intrusion failure is far short of what is required. The

Project should not proceed without added engineering controls against early site intrusion at the IDF, such as robust, guard- and fence-free engineering controls that have been used at other sites such as Weldon Springs, MO.

A. Detailed technical comments

Hanford intends to remove millions of gallons of liquid tank waste from Hanford high-level waste tanks and filter that waste through the use of cesium-ion columns to remove cesium and other materials. This process would occur on an outdoor pad in the tank farms at Hanford. DOE has estimated that 10 mega-curies of cesium-137 would end up in the columns, for which there is presently no declared disposition pathway.

The treated liquids would then be sent to the Waste Treatment Plant, where the Low Activity Waste (LAW) melter facility would vitrify the waste. The canisters containing the vitrified waste (VLAW) would be disposed of in an onsite facility, which has already been built, called the Integrated Disposal Facility (IDF). Approximately 23.5 million gallons of Hanford's tank waste would end up being disposed at IDF in this proposal.

There are three criteria to be met before any VLAW can be separated from the existing high level wastes in Hanford's tank farms, pretreated to remove key radionuclides, vitrified, then disposed of onsite in the IDF. These are:

(1) As fully as possible, key radionuclides must first be removed from tank wastes.
(2) All applicable (10 CFR 61C) safety requirements must be met.
(3) Wastes must be in a solid form with radionuclide concentration limits not exceeding Class-C low-level waste (10 CFR 61.55).

This review asks a series of questions about whether or not the proposed plan for the WIR can meet these three regulatory criteria. If these questions don't have satisfactory answers, then the regulatory criteria cannot be met and the risks of the draft plan for WIR are not acceptable. If these questions do have satisfactory answers, then the potential exists that the three regulatory criteria will be satisfied, and both the short and long-term risks of the proposed plan may be acceptable.

The risks to the public and to the environment include exposure to contaminants via the air, via water or groundwater, or from accidental direct contact (sometimes called the inadvertent intruder scenario). Airborne risks stem from loss of volatile waste constituents to the atmosphere from breached waste containers or grouted objects. Additional contaminant vapors may be released from leachate in the vadose zone or from unanticipated chemical reactions of wastes. Waterborne exposures consist of both exposure to onsite groundwater or exposure to contaminants that reach the Columbia River.

This review concludes that inadvertent intrusion must be prevented until closure plus 100 years, and preferably until closure plus 500 years. If intrusion is prevented, the project may succeed; if significant intrusion is not prevented, the project will certainly fail.

Issue #1: How well can the IDF be expected to perform?

To comply with DOE requirements (Manual 435.1-1, post-closure performance objectives and performance measures) the target performance for the IDF requires that the total radiation exposure from all three pathways (air, groundwater and intrusion) must be less than 25 millirems (mrem) per year. The air pathway alone can't exceed 10 mrem per year. Inadvertent intrusion must be less than 500 mrem in the short term and also less than 100 mrem per year in the long term. Radon Flux must be less than 20 picoCuries per square meter per second (pCi/m^2/s).

To put these expectations into perspective, the 500-mrem intrusion limit is about the same as getting 250 chest X-rays all at once. If the basement floor of a typical single family home had a radon flux equal to the IDF performance standard of 20 pCi/m^2/s, then it would take less than 20 minutes to exceed the US EPA's radon limit of 4 pCi/liter. The all pathways target of 25 mrem per year is about the same as having a mobile van pull up to your house once a month and giving you a chest X-ray (EPA 2019).

These comparisons aren't meant to opine that members of the public will actually get these doses. These comparisons are meant to show that the performance standards for the IDF are deliberately loose and attainable, and are not meant to assure that the public will not be exposed. The standards show that the public doses are manageable or acceptable, rather than de minimis or zero.

Keep in mind that there are other Hanford sources of radiation exposure to members of the public. If another project or site at Hanford creates an all-pathways exposure of 5 mrem per year, then the IDF must produce an exposure of no more than 20 mrem per year, not 25. This analysis is missing from most of the analyses in the IDF Performance Assessment, and must be addressed before final approval in order to meet the requirements of federal regulations.

The relatively relaxed performance standards are possible because the IDF is assumed to be relatively isolated from contact, now and in the future. The models show that the IDF will fail to prevent rainfall intrusion, it will fail to contain its waste, it will leak into the environment. The single key performance evaluator then, is the continued isolation of the IDF. If the IDF remains isolated from public life, then its performance will be sufficient despite the near certainty of engineering decay and scheduled failure.

This means that all wastes in the IDF must be “good as glass”, the IDF sumps must operate until 2151-ish, the surface barrier must not be penetrated before 2151, that no wastes are interred that have a less favorable isotopic profile than LAW, that no chemical wastes are interred that could potentially be reactive, evolve heat or gases, or attack the liner; and that the groundwater model is correct and complete. If all of these are true, and climate changes do not invalidate the groundwater model, then the planned ultimate failure of the IDF will not create unacceptable hazards for public health or the environment – if the IDF remains isolated.

Issue #2: What will be in the waste sent to the IDF?

The key materials in the wastes sent to the IDF include technetium-99 (Tc-99, up to about 26,400 Curies), iodine-129 (I-129, up to about 16 Curies), plutonium-239 (Pu-239, up to about 5,070 Curies), cesium-137 (Cs-137, up to about 14,000 Curies), strontium-90 (Sr-90, up to about 257,000 Curies) and neptunium-237 (Np-237, up to about 17 Curies) (PA 2019 table 3-29). These are maximum figures, depending on the final configuration of the WTF.

The IDF wastes will also contain nonradioactive chemical pollutants, chromium (498 metric tons) and nitrate (164 metric tons), and 2 metric tons of mercury (PA 2019 table 3-30).

The immobilized low activity waste (ILAW) also contains about 165 Curies of plutonium-238 (half life: 88 years), 4,477 Curies of Pu-239, 943 Curies of Pu-240, as well as about 16 Curies of uranium (8 metric tons).

The plutonium-238 will decay away by closure + 2000 years. The uranium will slowly decay into the volatile radioactive gas, radon-222, which must be controlled by the IDF surface barrier to reduce radon-222 migration into the atmosphere.

There are important uncertainties in the nature of wastes to be disposed of at the IDF. The first uncertainty stems from the likelihood of intentional storage of unanticipated wastes. The IDF is designed primarily but not exclusively to store vitrified low activity waste (VLAW) in the shallow subsurface at Hanford. About 10% of the volume of the IDF is reserved for nonvitrified radioactive wastes generated or currently stored at Hanford (PA 2019 p. 1-1). The 2019 Performance Assessment of the IDF (ibid) explicitly does not provide assurances regarding the sources of radioactive material that may be interred within the IDF at some future date. No prohibition against future disposal of additional wastes, including currently unanticipated radioactive wastes, is assured. No decision has been made on bringing wastes from other DOE sites to Hanford for disposal in the IDF.

We recommend that DOE either abandon the plan to utilize 10% of the storage space at IDF for materials not included in the Performance Assessment, or re-do the Performance Assessment and re-issue this document for public comment when all such new additions to IDF are characterized, modeled, and accounted for.

Issue #3: How well will tank waste filtering proceed?

The 6/23/2011 Environmental Management Advisory Board EM Tank Waste Subcommittee Report for SRS / Hanford Tank Waste Review (Report Number TWS #003 EMAB EM-TWS SRS / Hanford Tank Waste) concluded that Cs-137 would likely be successfully separated from Hanford tank waste by ion exchange. The same report also concluded that Tc-99 and 1-129 were highly mobile in the environment and not filterable. The IDF PA therefore, concentrates on public doses from these two nonfilterable isotopes (Tc-99 and I-129) and does not review the impact of Cs-137 in the IDF.

This means that the model for the magnitude and timing of the public doses does not include the impact of the bulk of the Cs-137 in the tank inventory. According to the project specifications, less than 0.05 % of the Cs-137 inventory in the Hanford high level waste tanks is targeted for disposal in the IDF. This is understandable given that onsite shallow disposal of excess unfiltered Cs-137 is a violation of the criteria in Chapter II.B.(2)(a) of DOE M 435.1-1 and probably a violation of 10 CFR 61, Subpart C. It does mean that under no circumstances may filtered waste with excess levels (more than about 0.05 % of the total inventory) of Cs-137 be interred in the IDF. It also means that if the overall removal rate for Cs-137 does not meet the specification (99.97% removal), then the project fails and the IDF PA must be redone with Cs-137 added to Tc-99 and I-129 in the PA dose calculations.

Issue #4: What constituents will not be removed by filtering, but should be removed?

The criteria in Chapter II.B.(2)(a) of DOE M 435.1-1 are, in relevant part, that the wastes:

"1. Have been processed, or will be processed, to remove key radionuclides to the maximum extent that is technically and economically practical; and
2. Will be managed to meet safety requirements comparable to the performance objectives set out in 10 CFR 61, Subpart C, Performance Objectives; and
3. Are to be managed, pursuant to DOE's authority under the Atomic Energy Act of 1954, as amended, and in accordance with the provisions of Chapter IV of this Manual, provided the waste

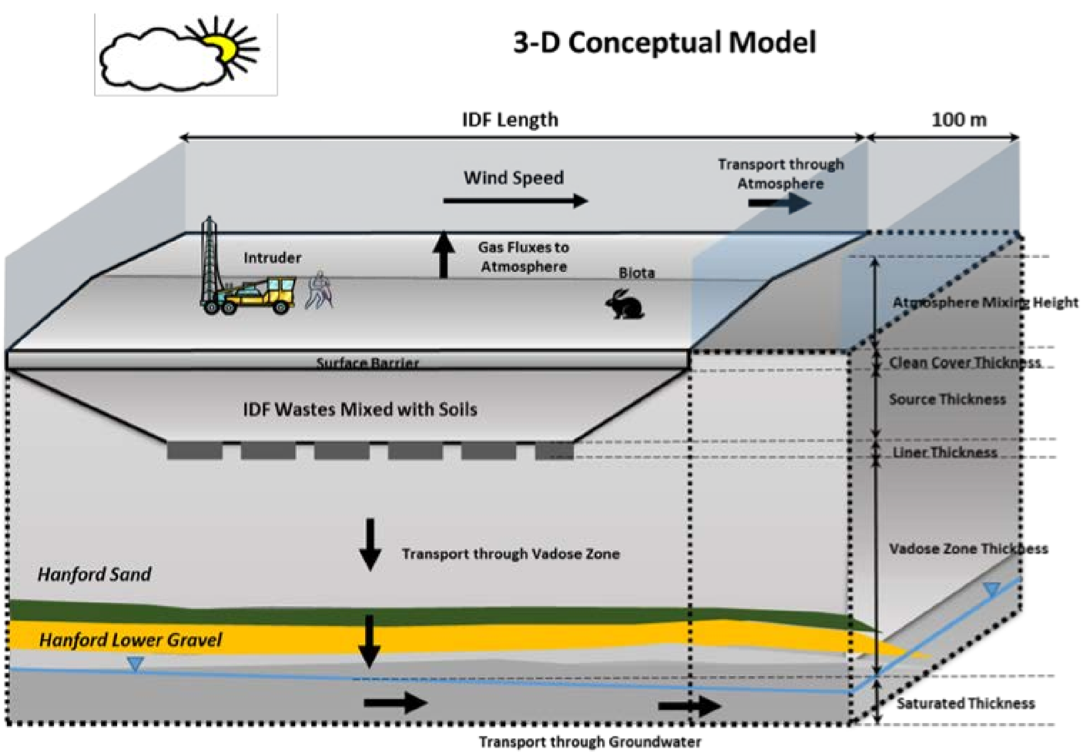
will be incorporated in a solid physical form at a concentration that does not exceed the applicable concentration limits for Class C low-level waste as set out in 10 CFR 61.55, Waste Classification...”

The filtration process has a goal of greater than 99.97 percent cesium-137 removal from the liquid tank waste before it is sent for vitrification. Other radioisotopes are not as easily removed. Some fraction of soluble uranium, strontium-90, neptunium-237, carbon-14 and plutonium will not be removed, and will remain in the vitrified waste that will be sent to the IDF.

Iodine-129 and technetium-99 will not be removed from the liquid tank waste before vitrification. These will be important drivers of risk to members of the public. Iodine-129 dominates the airborne dose risk to the public. Tc-99 dominates the groundwater risk to the public. These two isotopes are highly mobile contaminants. In addition, I-129, like radon, is a radioactive gas, with significant potential air pathway public doses. The nonradioactive waste constituents, chromium and nitrate, are also highly mobile in groundwater. This means that their retardation factors are low. The lower the retardation factor, the faster the contaminant moves with groundwater.

Issue #5: Are DOE modeling uncertainties acceptable?

Below: IDF Conceptual model (PA 2019 Fig. 4-3)



The surface barrier life assumed to be 10,000 years, with partial failure at closure + 500 years. The assumed infiltration rate through the surface barrier of the IDF is 0.5 mm per year, and 75 mm per year at the edge of the barrier (Battelle 1995, PA sec. 5.2.1 p. 5-178). Each doubling of the infiltration rate results in a 45% ± 5% increase in the amount of Tc-99 reaching the saturated zone (PA 2019 p. 1-22).

An inadvertent intrusion may result in an acute dose of up to 500 mrem. The same intrusion can also locally increase the infiltration rate. If an intrusion damages the IDF surface barrier (for all or part of the IDF) the resulting infiltration rate would increase up to the rate at the barrier edge, which is 75 mm per year. This would increase the amount of Tc-99 reaching the saturated zone by as much as (75 mm / 0.5 mm) X 0.45 = 67.5 times. Note that the 2019 PA uses a maximum infiltration rate of 3.5 mm per year, which is assumed for the surface barrier after closure + 500 years.

This increase causes the project to exceed the all-pathways dose in the post-compliance period of 3051 to 12051 at the 100-meter downgradient exposure point. The current groundwater pathway dose for that period is 1.5 mrem per year versus a maximum of 25 mrem per year. Recall that this maximum value assumes that no other Hanford sources contribute to dose. At the 75 mm per year infiltration rate the 100-meter exposure point dose potentially rises to greater than 100 mrem per year. The unacceptable post-intrusion dose due to Tc-99 at the 100-meter exposure point would also likely arrive sooner than in the base case, potentially pushing the excess dose (greater than 25 mrem per year) into the compliance period of 2051 to 3051. Note that this discussion details the effect on the maximum public offsite dose. This is distinct from discussions in the IDF PA regarding the onsite maximum dose to an intruder or future rancher.

At the higher infiltration rate, the limiting factor in modeling Tc-99 transport may be its dissolution rate rather than the groundwater infiltration rate. If that were the case, then the ultimate dose at the 100-meter exposure point may be less than the potential maximum. In effect, if wastes containing Tc-99 were successfully vitrified, the increase in groundwater dose after intrusion and damage of the surface barrier might still be within the acceptable range.

Chemical dissolution of radioisotopes from vitrified waste: The 2019 PA describes the process of glass and waste leaching from the ILAW glass stacks (the steel-encapsulated glass canisters are stacked four-high in the IDF, separated by a meter of backfill). As the glass and waste dissolve into intruding groundwater in the IDF, some of the dissolved matter reforms back into crystalline or amorphous solids. These solids in turn redissolved and migrate downward to the saturated groundwater aquifer, where the dissolved isotopes become available for an inadvertent intruder, such as a farmer withdrawing groundwater for irrigation (for example). The 2019 PA (p. 4-21) states,

"... these solids are typically amorphous (although some may be crystalline), with uncertain and potentially variable compositions (i.e., behaving as solid solutions) and with uncertain or unknown thermodynamic properties. Several different idealized secondary mineral reaction networks, consisting mainly of various clay minerals, zeolites, and oxides/oxyhydroxides, have been assumed in models of ILAW glass corrosion."

This language reveals a disconcerting level of uncertainty regarding the rate at which radioisotopes will leach from the vitrified wastes. This example once again points to the sensitivity of the entire project to intruder activities, especially during the period before closure + 100 years.

Sump failure: The impact on the maximum public dose from degradation of the IDF surface barrier is mitigated by the presence of a functioning sump system, meaning one that prevents the leachate from the IDF waste cells from reaching the vadose zone. This protection is assumed lost after closure + 100 years. The increased volume pumped by the sumps in the event of increased rainfall rates (climate change) or degradation of the surface barrier by an intruder, may in turn reduce the lifetime of the sump system and contribute to reduced time to failure for the project as a whole.

<u>Vadose zone retardation factors and waste partitioning coefficients</u>: The compliance period public doses are more sensitive to errors in modeling retardation factors for Tc-99 than they are for I-129. This is particularly true for the partition coefficients from filtration media. Retardation factors express the tendency of Hanford sands to retain contaminants in groundwater, so that Tc-99 and I-129 travel more slowly than the groundwater itself. The partitioning coefficient expresses how many volumes of groundwater are required to leach Tc-99 and I-29 from the solidified carbon bed media, solidified ion exchange resin (generated by the WTP), and solidified silver mordenite.

This means that the speed at which Tc-99 and its slower co-contaminant, I-129, is controlled by both the retardation factors and the partitioning coefficients. The IDF PA notes that a guess of one half the partitioning coefficient for spent media was used for both spent media and grout. The actual partitioning coefficient is not known. The end result is that the public dose for Tc-99 from solidified carbon bed media is likely underestimated, and that the same parameter for items such as grouted damaged WTP equipment is potentially overestimated.

Issue #6: What cumulative or sequential risks exist?

Cumulative and sequential risks exist at the Hanford Site. Cumulative risks are risks from other locations and projects at Hanford that are not related to the shallow onsite disposal of VLAW within the IDF, but that have the same target receptors. The 25 mrem per year all-pathways limit or the 100 mrem per year chronic dose limit for an onsite inadvertent intruder may not be available due to risks from other projects/sites. An onsite farmer/rancher (for example) who irrigates their crop or amends their soils onsite during the initial post-closure 100-year compliance period can receive a significant dose. They would receive a dose as high as 44 mrem per year of the allowable 100 mrem per year chronic maximum dose. They would get an added unknown dose from using irrigation water on amended soils (the amended soil scenario is not covered in the 2019 IDF PA). They could get an additional dose from another unrelated project on the Hanford Site (for example a cesium capsule storage incident) that puts this farmer/rancher above the 100 mrem limit. Note that once again, the inadvertent intruder scenario generates the highest risks.

The sequential risks are those that are endured because risks from different events are cumulative. Going back to the intruder scenario, increased risks from the air pathway will be cumulative with (for example) increased risks from degradation of the IDF surface barrier related to an inadvertent intrusion. Radon emanation or resuspension of soils and dusts contaminated with radioactive materials can raise the air pathway dose to levels near or above the allowable limit of 10 mrem per year for members of the public, even if this receptor is not an inadvertent intruder onsite.

Issue #7: How likely are airborne, waterborne, or direct contact exposures?

The inadvertent drilling scenario leaves the IDF, and particularly the surface water barrier, in a degraded state, allowing water into the waste cells. The PA assumes no intruder before closure + 100 years. This is based on three assumptions. First, that groundwater remedial programs will be funded until at least closure + 100 years. Two, the Hanford Reservation will remain under federal control. Three, the concentration and activity limits for unrestricted land use will not be loosened until closure + 100 years or later.

None of these three conditions (continued funding, site control, unchanged environmental criteria) are reasonably guaranteed for the compliance period. The assumption of no human activity degrading the IDF surface barrier is built on a fragile foundation.

The IDF PA found that maximum offsite public dose was highly sensitive to degradation of the IDF surface barrier. In turn, the integrity of the IDF surface barrier is threatened by an inadvertent intrusion, particularly if it occurs early in the life of the IDF. In this fashion the inadvertent intrusion scenario can create a cascade of events that lead to project failure; eg, an inability to maintain actual public doses below those required in Manual 435.1-1, post-closure performance objectives and performance measures.

A second direct contact scenario is the use of contaminated groundwater for farming after closure + 100 years. This public dose is within limits, but only if very restrictive assumptions are used. For example, soil amendments and fertilizing would increase the absorption capacity of soils. This increases the amount of radioactive contaminants retained in surface soils and thus increases the public dose beyond acceptable limits (100 mrem per year chronic exposure). Once again, the intrusion scenarios result in the highest public doses.

In this case even with the assumptions that there is no agriculture before closure +100 years and no use of farming practices that increase retardation factors (such as use of compost fertilizer or surface mulch paired with irrigation), the calculated dose is 44 mrem per year. This is the smallest safety factor in the PA.

Issue #8: How will climate changes impact the IDF models?

Increased precipitation results in decreased time to failure and increased contaminant flux. If we were to assume an annual increase in aquifer recharge equivalent to an added four inches per year of rainfall, the amount of Tc-99 reaching the saturated zone would increase by 40 to 50 percent in the first 1000 years (PA 2019 p. 1-22, Battelle 1987). US average rainfall is 38 inches per year.

The Weldon Springs Quarry/Plant/Pits onsite disposal facility in Weldon Springs, MO, was constructed according to the requirements of the 1993 Record of Decision (EPA/ROD/Ro7-93/067) for this site. These requirements including sufficient armoring of the onsite disposal facility's surface barrier to resist infiltration from extreme rainfall events. Notably the focused feasibility study (FFS) for the Weldon Springs site rejected disposal of the Weldon Springs mixed waste material at Hanford, as the armored onsite disposal cell was considered a superior solution to a less well-engineered site at the Hanford Plateau.

In addition, the Weldon Springs (now completed) onsite disposal cells' surface barrier was of sufficient engineering robustness that twenty-seven years after the 1993 ROD, onsite recreational and educational visitors are permitted.

Above: Recreational visitors atop the completed Weldon Springs onsite disposal facility. This disposal cell contains uranium, thorium and radium wastes once thought destined for burial at Hanford. The worst-case receptor for this facility was determined to be an onsite ranger exposed 8-hours per day, 200-days per year. Nevertheless based on the facility's design, onsite receptors do not receive an unacceptable all-pathways (25 mrem/yr.) or air (10 mrem/yr.) dose.

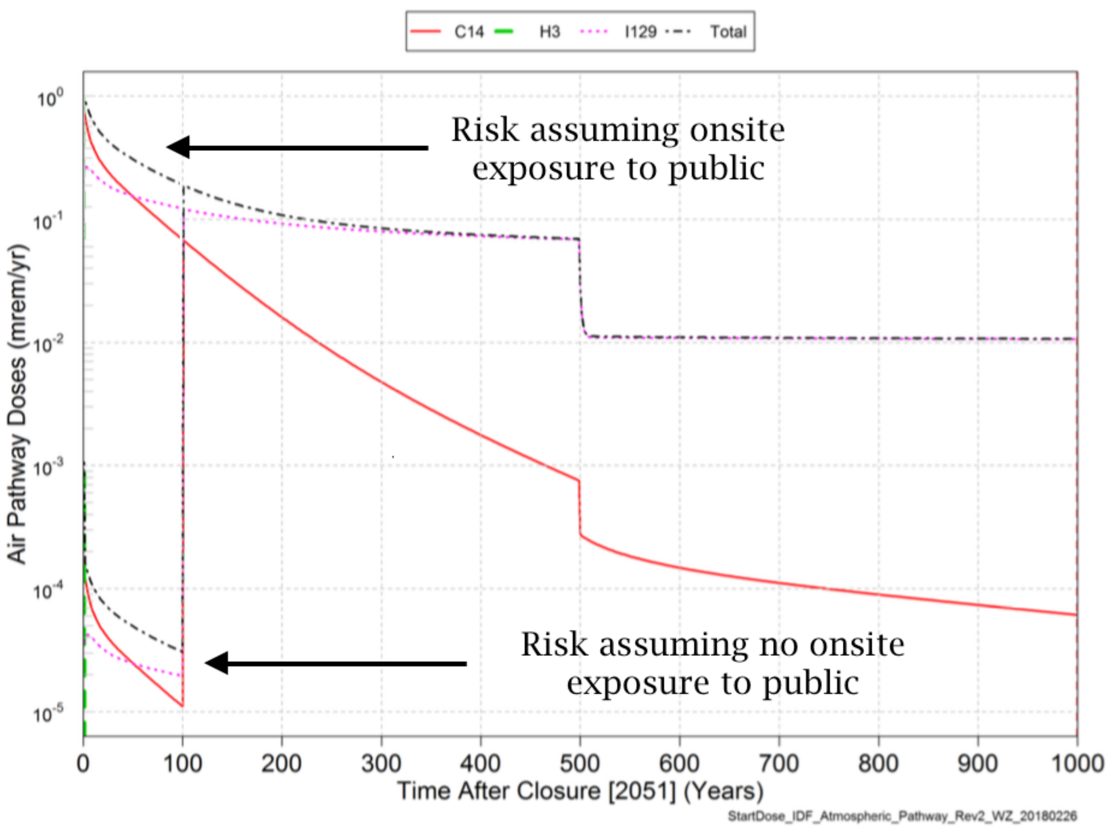
B. Some perspective on the required timelines.

The sumps in the Integrated Disposal Facility (IDF), where vitrified waste will be put into shallow burial, must last 100 years to meet the design specifications.

DOE risk models assume no onsite receptor until 2151, which is 131 years from the present.

The DOE models make some important assumptions about the first one hundred years of the life of the IDF. One assumption is that the sumps at the IDF that actively pump leachate to protect the vadose zone will operate for the full 100-year initial life of the IDF. Should the sump system fail before the end of its projected 100-year life, the risks to offsite populations and to the environment will increase.

Figure 1-2. Atmospheric Pathway Dose During the 1,000-Year Compliance Period.



Likewise, DOE assumes no onsite exposure to members of the public before 2151. In fact the DOE model is extremely sensitive to any failure to successfully exclude members of the public from the site for the next 130 years. For this first 100-years of operation after 2051, the nearest receptor (member of the public) is assumed to be 20 kilometers from the IDF. After that, the theoretical receptor is moved to within 100 meters of the IDF. If the DOE fails to keep members of the public away from the IDF in 2051, the modeled dose (via air contamination) increases by about 10,000 times (PA 2019 p. 1-12). This increased risk is shown graphically on the following page, using an adaptation of Figure 1-2 from the 2019 IDF Performance Assessment.

This implies that site security is a critical failure risk for the IDF, and requires substantial attention and guarantees prior to committing to opening of the IDF.

C. References

Battelle 1987 G.W. Gee, Recharge at the Hanford Site: Status Report, PNL-6403-UC-70

Battelle 1995 Rockhold, et al., Estimation of Natural Groundwater Recharge for the Performance Assessment of a Low-Level Waste Disposal Facility at the Hanford Site, PNL-10508-UC-702

EPA 2019 URL (accessed 10/15/20) https://www.epa.gov/radiation/how-much-radiation-am-i-exposed-when-i-get-medical-x-ray-procedure

PA 2019 Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington, RPP-RPT-59958, Rev. 1A, 7/31/2019

D. Summary of Concerns

Site security is a critical failure risk for the IDF, and requires substantial attention and guarantees prior to committing to opening of the IDF. An important failure mode in the short term is from failure of the surface IDF barrier from intentional or inadvertent entry at any time before closure + 500 years. Early failure of the surface barrier due to human activity or an unexpected event increases the severity of all failure modes, and hastens the time before peak public exposure.

The critical assumption is that no human activity will degrade the IDF barrier before closure + 100 years. This is conditional on three further assumptions relating to continued funding, site controls, and environmental policies and criteria that are subject to political alteration. DOE should not rely on institutional controls to safeguard the integrity of the surface barrier. Instead, DOE should follow the example at Weldon Springs and build a robust engineered barrier that does not rely on guards, fences, or the institutional memory of a society that may or may not have moved on.

Early inadvertent intrusion due to changes in what are all political decisions, results in early failure and significantly increased maximum public doses from all pathways (air, groundwater and intrusion).

The IDF will contain mostly vitrified waste, but will also contain up to 10% (by volume) of non-vitrified radioactive wastes. No prohibition against future disposal of additional wastes, including currently unanticipated radioactive wastes, is assured. No decision has been made on bringing wastes from other DOE sites to Hanford for disposal in the IDF. We recommend that DOE either abandon the plan to utilize 10% of the storage space at IDF for materials not included in the Performance Assessment, or re-do the Performance Assessment and re-issue this document for public comment when all such new additions to IDF are characterized, modeled, and accounted for.

Effective Iodine-129 and technitium-99 removal from tank waste supernatant is not expected, nevertheless these two isotopes are highly mobile contaminants. These will be important drivers of risk, especially groundwater risk, to members of the public. Peak dose and time to peak dose for these isotopes via the groundwater pathway is sensitive to climate change because increases in precipitation reduce the travel time of wastes through the vadose zone.

The analyses of IDF performance compared to standards (Radon flux of pCi/m^2/s, all pathways 25 mrem/yr., air pathway 10 mrem/yr., intrusion 500 mrem, 100 mrem/yr. – acute, chronic) should include the contributions from other Hanford radiation sources to the same theoretical receptor. Given that other sources already expose the same target population to net activity, the allowable limits must be reduced accordingly. All parallel exposures must be considered, and the remaining allowable dose should be apportioned to the IDF. It is not acceptable under federal law (10 CFR 8.2) to yield the full maximum exposure limit to a single source if other net sources exist in parallel.

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V. **Additional comments:**

- All concerns and comments submitted by or given to the DOE by the Nuclear Regulatory Commission related to the draft VLAW WIR evaluation should be resolved to the NRC staff's satisfaction, prior to finalization of the VLAW WIR.

- The process of making glass preferentially removes iodine-129 and technetium-99. Rather than recycle the "steam" containing these key radionuclides to get them into the VLAW glass, the volatilized Tc-99 and I-129 "steam" should be captured and sent into the high-level waste stream.

Thank you for the opportunity to provide these comments.

Sincerely,

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