Public Comment Submittal on the U.S. Department of Energy Draft Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration

Comment submittal by Tami Thatcher

Comments Due: February 2, 2022. Sent by email to: *TBIWIR@rl.gov*.

BACKGROUND

The Department of Energy's *Draft Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration* (Draft WIR Evaluation) concerns DOE's proposed Test Bed Initiative (TBI) Demonstration. Under the proposed TBI Demonstration, approximately 2,000 gallons of waste from tank SY–101 at the Hanford Site in Washington will be pretreated to remove most key radionuclides, then solidified (grouted) offsite and subsequently disposed of at a licensed and permitted disposal facility outside of the State of Washington. [1] [2]

The Department of Energy has presented a reclassification of waste from high-level waste (HLW) to low-level waste (LLW) for treating and disposing of 2000 gallons of liquid waste "incidental to reprocessing" from a single tank containing roughly 1.1 million gallons of waste. The DOE's Hanford site has 177 tanks holding or leaking 56 million gallons of high-level waste. DOE estimates that 68 of the single-shell tanks may have already collectively leaked over 1 million gallons of waste into the ground. [3]

The reason to remove the 2000 gallons of the least radioactive waste in the tank is not to help clean up the Hanford site. The reason cited by the DOE in its Draft Waste Incidental to Reprocessing (WIR) evaluation is to make more room in the tank for additional radioactive waste.

SUMMARY

The Department of Energy's Draft WIR Evaluation for 2000 gallons of diluted and treated waste is intended to make the DOE's regulations appear to be reasonable and protective of human health and the environment, when the truth is that reliance on DOE's regulations, and in particular, DOE Order 435.1, *Radioactive Waste Management,* and DOE Manual 435.1–1, chg 3,

[1] Federal Register https://www.federalregister.gov/documents/2021/11/05/2021-24213/notice-of-availability-of-draft-waste-incidental-to-reprocessing-evaluation-for-the-test-bed Written comments should be submitted to: Ms. Jennifer Colborn, U.S. Department of Energy, Office of River Protection, 2440 Stevens Drive, Richland, WA 99354. Alternatively, comments may also be filed electronically by email to: *TBIWIR@rl.gov*.

[2] Department of Energy, *Draft Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration*, DOE-ORP-2021-01, Revision 0, October 2021. The Draft WIR Evaluation is available on the internet at *https://www.hanford.gov/page.cfm/ReprocessingEvaluationforBedInitiative*. (See also https://pdw.hanford.gov Administrative Records.)

[3] Government Accountability Office, Hanford Cleanup – DOE's Efforts to Close Tank Farms Would Benefit from Clearer Legal Authorities and Communication, GAO-21-73, January 2021 at www.gao.gov (Only 28 of the 177 tanks are double-shell tanks; 149 are single-shell tanks.)

Radioactive Waste Management Manual does not provide any certainty that reasonable and protective decisions will be made. The DOE Manual 435.1-1 allows DOE to bury its low-level or transuranic waste on DOE sites. The DOE Manual 435.1-1 allows DOE to approve any Performance Assessment and does not include a comprehensive set of waste burial performance criteria or Performance Assessment model standards. There is no waste compliance period. Any level of radioactive migration from the disposal site at a DOE facility can be deemed acceptable by DOE, according to DOE Manual 435.1-1. DOE can change its regulations, at whim, without public notification. DOE can waive any of its regulations at any time. The Draft WIR Evaluation and any other document that relies on DOE regulations, including DOE Manual 435-1-1 actually provides no assurance of the protection of the public and the environment. It appears that DOE intends to set a legal precedence for relying on DOE Manual 435-1.1 for the reclassification of HLW to LLW or to transuranic waste and this greatly undermines the protection of the environment and the ability of states to demand protective measures for waste storage and disposal.

DOE'S DRAFT WIR EVALUATION IS DECEPTIVE CONCERNING DOE REGULATIONS

The Draft WIR Evaluation emphasizes that "DOE prepared the Draft WIR Evaluation pursuant to DOE Order 435.1, *Radioactive Waste Management,* and DOE Manual 435.1–1, chg 3, *Radioactive Waste Management Manual.* The DOE is working to try to make DOE regulations appear reasonably protective and to set a legal precedence for using DOE Order 435.1, *Radioactive Waste Management,* and DOE Manual 435.1–1, chg 3, *Radioactive Waste Management Manual.* But to do so, DOE omits key information.

First, the DOE misleads the public by misquoting DOE Manual 435.1-1 Section II.B.(2)(a), in the Draft WIR Evaluation and the Federal Register notice. This section of Manual 435.1-1 is in fact not quoted in its entirety and less restrictive requirements were lopped off mid-sentence. The DOE omitted the portion of the regulation that allows the DOE to reclassify high-level waste above Class C, that would become Greater-Than-Class C radioactive waste. There is no upper bound on the radioactivity of Greater-Than-Class C radioactive waste. DOE facilities such as Hanford and NRC-licensed facilities could accept Greater-Than-Class C radioactive waste, of unlimited radioactivity concentrations and longevity.

The Draft WIR Evaluation must correctly and completely quote the DOE Manual and then add further information to clarify why DOE might or might not exceed Class C concentrations during this operation.

The DOE's Draft WIR Evaluation also misrepresents the flexibility of DOE regulations. The Department of Energy can modify its regulations, including DOE Order 435.1 and DOE Manual 435.1-1 at whim, and without public notification and any requirement deemed too difficult can simply be waived by the Secretary of Energy.

In addition to the misrepresentation of the DOE's Manual 435.1-1 in the 2000- gallon Waste Incidental to Reprocessing draft document, [4] Congress is misinformed by the Government Accountability Office reports such as GAO-21-73, that while informative, leans toward an overly favorable presentation of the Department of Energy and does not provide an accurate depiction of DOE's enormous latitude under DOE Manual 435.1.

The Draft WIR Evaluation must include details of the ease with which the Department of Energy can change or waive its regulations, including the DOE Order 435.1 and Manual 435.1-1. The DOE can simply cite cost as the reason for gutting environmental protections and pollute the environment.

Details of the Misleading Quotation of DOE Manual 435.1-1, Section II.B.(2)(a):

The Draft WIR Evaluation misleads citizens by misquoting the DOE Manual 435.1-1 Section II.B.(2)(a), in the Draft WIR Evaluation, as it chose to replace the last phase with the punctuation of a single period. If the DOE Manual 435.1-1 was to be quoted and terminated the quote midsentence, then three dots are to be used to signify that the sentence was not stated in its entirety.

The DOE's Draft WIR Evaluation [5] states (and it added italics):

The criteria in Section II.B.(2)(a) of DOE Manual 435.1-1 provide, 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;

(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 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."

But in contrast, the most recent DOE Manual 435.1-1 [6] is stated below (and does not use italics throughout):

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[4] Department of Energy, *Draft Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration*, DOE-ORP-2021-01, Revision 0, October 2021. The Draft WIR Evaluation is available on the internet at *https://www.hanford.gov/page.cfm/ReprocessingEvaluationforBedInitiative*.

[5] Department of Energy, *Draft Waste Incidental to Reprocessing Evaluation for the Test Bed Initiative Demonstration*, DOE-ORP-2021-01, Revision 0, October 2021. The Draft WIR Evaluation is available on the internet at *https://www.hanford.gov/page.cfm/ReprocessingEvaluationforBedInitiative*.

[6] U.S. Department of Energy, *Radioactive Waste Management Manual*, DOE M 435.1-1, Approved: 7-09-99, Change 1: 6-19-01, Certified: 1-9-07, Change 2: 6-8-11, Chg 3 (LtdChg): 1-11-2021. Available online at www.directives.DOE.gov.

(a) Will be managed as low-level waste and meet the following criteria:

(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 Part 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*; **or will meet alternative requirements for waste classification and characterization as DOE may authorize. [Emphasis Added]**

I think the DOE knows that the proper way to quote a portion of a sentence is to use three dots at the end of the quote, signifying that there were more words following what is quoted. The Department of Energy deceptively simply places a period where it truncated the quoted section of the regulation it was quoting.

Then, importantly, in other places in DOE's document for the treatment of 2000 gallons of waste, the Department of Energy cites "the criteria in Section II.B.(2)(a) of DOE Manual 435.1-1" and the reader has no idea whether or not the truncated requirement or the full and far less restrictive requirements in Manual 435.1-1 are intended. [7]

The Draft WIR Evaluation misleads the public by presenting what appears to reasonably comprehensive requirements for radioactive waste management, in particular, because the lopped off phrase – "or will meet alternative requirements for waste classification and characterization as DOE may authorize" adds infinite flexibility for the DOE to decide, at whim, to reclassify and dispose of HLW is any manner it chooses.

The Draft WIR Evaluation must include the complete criteria in Section II.B.(2)(a).

The Draft WIR Evaluation must include the complete criteria in Section II.B.(2)(a) and also Section II.B.(2)(b).

DRAFT WIR EVALUATON MUST STATE HOW ALLOWING DOE TO RECLASSIFY ITS HLW ALLOWS WASTE TO BE DISPOSED OF ON DOE SITES WITH DOE AS THE SOLE AUTHORITY TO DETERMINE COMPLIANCE

[7] U.S. Department of Energy, *Radioactive Waste Management Manual*, DOE M 435.1-1, Approved: 7-09-99, Change 1: 6-19-01, Certified: 1-9-07, Change 2: 6-8-11, Chg 3 (LtdChg): 1-11-2021. Available online at www.directives.DOE.gov.

DOE Order 435.1, *Radioactive Waste Management,* and DOE Manual 435.1–1, chg 3, *Radioactive Waste Management Manual* [8] allow the Department of Energy to not even attempt to meet 10 CFR 61, Subpart C Performance Objectives. The DOE Manual 435-1-1 allows DOE to be the sole authority over the decision to accept a Performance Assessment of radioactive waste disposal on DOE sites. When waste is not classified as HLW, DOE may dispose of it on DOE sites. It could also move the waste to a different DOE site, such as moving the radioactive waste from Hanford to Idaho. Nothing in the DOE Manual 435.1-1 would prohibit this. There would be no Nuclear Regulatory Commission licensing or authority and there would be no consultation with the affected state or public.

The Draft WIR Evaluation must admit that it is using this 2000 gallon case of diluted HLW to establish a legal precedence for making it appear acceptable for the DOE to reclassify any amount of HLW based on its regulations, such as DOE Manual 435.1-1, without authority from the NRC or the affected state to interfere.

Two other portions of DOE Manual 435.1-1 are particularly relevant:

Details of the HLW that becomes Transuranic Waste, DOE Manual 435.1-1, Section II.B.(2)(b):

(b) Will be managed as transuranic waste and meet the following criteria:
(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 incorporated in a solid physical form and meet alternative requirements for waste classification and characteristics, as DOE may authorize; and

(3) Are managed pursuant to DOE's authority under the *Atomic Energy Act of 1954*, as amended, in accordance with the provisions of Chapter III of this Manual, as appropriate.

Details of the HLW that becomes low-level waste or transuranic waste

DOE Manual 435.1-1, Section I.2.F(4) includes the following: "DOE waste shall be treated, stored, and in the case of low-level waste, disposed of at the site where the waste is generated, if practical, or at another DOE facility."

The Draft WIR Evaluation misleads the public by not disclosing Section II.B.(2)(b) which does not commit DOE to even attempt to meet the performance objectives set out in 10 CFR 61, Subpart C. The DOE will be able to approve any waste disposal Performance Assessment. The Draft WIR Evaluation misleads the public by not disclosing how acceptance of DOE to reclassify its HLW can allow DOE to dispose of vast amounts of what had been HLW on DOE sites. The Draft WIR Evaluation is being used to make the appearance that reliance on DOE regulations, including DOE Manual 435.1-1 would be adequately protective of human health.

[8] U.S. Department of Energy, *Radioactive Waste Management Manual*, DOE M 435.1-1, Approved: 7-09-99, Change 1: 6-19-01, Certified: 1-9-07, Change 2: 6-8-11, Chg 3 (LtdChg): 1-11-2021. Available online at www.directives.DOE.gov.

BAIT AND SWITCH TACTICS FOR RECLASSIFYING VAST AMOUNTS OF HLW

The Federal Register announcement includes this statement: "DOE may determine, in a future WIR Determination, whether the pretreated and solidified waste is incidental to reprocessing, is non-HLW, and may be managed as LLW."

The DOE has not stated what quantity of HLW it may reclassify as LLW at its DOE sites, including Hanford.

The DOE has not stated what quantity of HLW may become Greater-Than-Class C low-level waste (LLW).

The DOE has not discussed that its regulations allow shallow burial of LLW at Hanford and at other DOE sites.

The Draft WIR Evaluation is trying to imply that the DOE would make sound and protective practices based on DOE Manual 435.1-1. The DOE is trying to mislead the public about the infinitely flexibility of its regulations in granting itself exemptions to its DOE Orders (and Manuals), including DOE Manual 435.1-1.

It appears that an objective of this project is to set a precedence for invalidating other federal laws that apply to the DOE's high-level waste.

This matters because the Department of Energy already shallowly buries low-level waste (LLW) including Greater-Than-Class-C LLW over the Snake River Plain Aquifer at the Idaho National Laboratory. At the INL, the Department of Energy offers this excuse: that DOE is not required to classify its low-level radioactive waste into classes at all, for the disposal of LLW at Department of Energy sites.

The DOE has been recognized by the courts as modifying it radioactive waste DOE Orders at whim, which means no waste-incidental to reprocessing evaluation, no environmental impact statement (EIS), or other document that cites a DOE Order can be relied upon.

The DOE has ignored federal law and state legal agreements by unilaterally declaring it can declare its high-level waste is now low-level waste, and with vastly reduced disposal limitations.

The DOE has for many years made a practice of not referring to the sodium-bearing waste at the Idaho National Laboratory as high-level waste, despite not having made any steps to officially reclassify it as such — because of the legal challenges this may bring. But not calling the waste high-level waste, it sought to systematically misinform citizens and State of Idaho officials.

Under the DOE's approach, it would appear that the DOE is driving toward diluting waste to the concentrations accepted by available radioactive waste facilities off the Hanford site and/or (with or without dilution) reclassify the HLW to be "low-level waste." This will only make it seem that progress is being made in solving the enormous radioactive waste problem at Hanford.

When disposed of on the DOE's Hanford site, DOE regulations for disposal of LLW do not require determining whether or not the waste is Greater-Than-Class C waste. The Department of

Energy here in Idaho at the Idaho National Laboratory has long buried spent fuel from experiments (by a DOE exemption) and also buries Greater-Than-Class C waste over the Snake River Plain aquifer, and it continues to do so.

The Draft WIR Evaluation works hard to make DOE's regulations of radioactive waste appear reasonable. If DOE's regulation of its radioactive waste were reasonable, would we have countless contaminated sites across the U.S. from its operations? Would we have decades of accumulating radioactive waste at Hanford, Savannah River Site and the Idaho National Laboratory despite billions of dollars having been spent?

Other organizations are worried about the ramifications of this Waste Incidental to Reprocessing effort. Columbia Riverkeeper has stated: "The U.S. Dept. of Energy's Test Bed Initiative will determine the future of radioactive tank waste at the Hanford nuclear site." [9]

The GAO reminds us in its report GAO-21-73 that the Department of Energy has a difficult task cleaning up the radioactive waste at Hanford. **But the DOE has created the Hanford radioactive mess, along with countless other radioactive messes across the U.S., all while compliant with its regulations, and without any serious regard for current or future generations. I see no sign that the DOE is serious about the existing radioactive contamination or is ceasing or slowing its creation of more radioactive waste. The DOE is throwing money at new ways to make more radioactively contaminated sites and more spent nuclear fuel, without knowing how it will confine existing or future nuclear waste.**

The Department of Energy must not be allowed to parade certain regulations in the Draft WIR Evaluation while not mentioning the far less restrictive DOE regulations that apply and the ability DOE has for changing its regulations at whim and for DOE to decide to waive any of its requirements. The Draft WIR Evaluation must explain in detail how easily DOE may change or waive any of its regulations, especially its regulations on radioactive waste.

CONSULTING WITH THE NRC IS ONLY FOR SHOW

The Draft WIR Evaluation (and the Federal Register announcement) state that "DOE is consulting with the Nuclear Regulatory Commission (NRC) concerning the Draft WIR Evaluation."

But the Draft WIR Evaluation does not admit that DOE does not have to comply with any suggestions from the NRC. It is nothing but a charade to say that DOE will consult with the NRC.

While the NRC does have a location for making its documents publicly available, those documents are often not entered for many years, and often are not numbered or titled in a manner to allow citizens to locate those documents out of thousands of documents. Does "consulting with the NRC" mean that any documentation of that consultation to DOE will actually be provided?

[9] Columbia Riverkeeper factsheet at https://www.columbiariverkeeper.org/news/2021/12/important-hanford-comment-period?eType=EmailBlastContent&eId=a2a14f30-2d70-45f5-a578-1a029ff37acb

The NRC, by the way, is tireless in its efforts to send more radioactive waste to Idaho, to a facility not licensed by the NRC to receive radioactive waste [US Ecology Idaho] and tireless in its efforts to allow ordinary municipal landfills to accept radioactive waste. It needs to also be understood that the **NRC's advice is generally made with the priority of the health of the nuclear industry** and not the health of the public or the environment.

The Department of Energy must not be allowed to pretend that by consulting with the NRC that its reclassification of HLW to LLW will be performed in a manner that is actually protective of workers or the public. The Draft WIR Evaluation must clarify that DOE need not heed any advice from the NRC or even document NRC's recommendations.

THERE IS NO DEFINITION FOR LOW-ACTIVITY WASTE

The Department of Energy, especially at Hanford, frequently uses the term "low-activity waste." There is no definition in DOE Manual 435.1-1 or in any federal law that defines what "low-activity waste" is.

A recent National Academy of Sciences report [10] **incorrectly states that the term "low-activity waste" has been defined by the Department of Energy in the current version of DOE Manual 435.1,** stating that low-activity waste means the waste that remains after as much of the radionuclides as technically and economically practicable have been removed from the tank waste, and that when immobilized in waste forms, may be disposed as low-level waste in a near-surface facility, as long as the waste meets criteria in the Waste Incidental to Reprocessing determination. Supplemental treatment refers to processing of the low-activity waste that is excess to that portion to be treated by vitrification in the Waste Treatment and Immobilization Plant at the Hanford site. **But the term "low-activity waste" is not used or defined anywhere, not even in DOE Manual 435.1-1, available online.**

Apparently, the Department of Energy likes the use of meaningless jargon that imply the radioactive waste isn't much of a problem – it's just "low-activity waste." I have witnessed Idaho Cleanup Project Citizens Advisory Board members be misled by this jargon all while the members did not have a clue as to the longevity or toxicity of the radioactive waste over time.

Therefore, I am providing some basic information on radioactivity, which the DOE should be providing if its intent was to be clear and transparent.

The number of disintegrations per unit time is the radioactivity. The units of radioactivity are curie or becquerel. [11] But to know the difficulty of shielding the radioactive material, or how harmful it is in the human body with inhaled or ingested, or to know how difficult the material is

[10] National Academies of Sciences, Engineering, and Medicine 2020. *Final Review of the Study on Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #4*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25710. Access to free PDF downloads is available currently.

[11] A becquerel is radioactive decay per second. There are 37 billion becquerels in 1.0 curie or 37,000,000,000 becquerels in 1.0 curie.

to confine in a disposal facility, and to know how long you must confine the material in a disposal facility, you must know the total disintegrations per unit time (or know the total mass) **of each radionuclide** that you have in the radioactive waste. And it matters how much total waste you have to dispose of. Finally, there is the issue that the nuclear industry selectively refuses to accept and learn from new information about higher health harm from inhaling and ingesting radionuclides.

Expanding on what you need to know about radioactive waste, you need to know the following:

- **Shielding.** You need to know what shielding will be needed to store, handle, and transport the material. The penetrating gamma rays from the waste must be shielded in order to limit the external radiation exposure during storage and handling. Cesium-137's decay progeny barium-137 has a penetrating gamma and it requires shielding whereas strontium-90 is a beta emitter and it easily shielded. Uranium and plutonium which are predominately alpha emitters also emit beta and gamma radiation, but are more easily shielded. However, the neutrons emitted from actinides, especially from curium and californium, pose an important shielding problem. Neutrons can be shielded by hydrogen atoms in water or paraffin, but are not shielded by metal or lead. Neutron dose is particularly harmful to gonads and may not be adequately monitored.
- **Harm From Inhalation or Ingestion.** Even radionuclides that do not have a penetrating gamma ray can be very harmful when released to the environment. Cesium-137, cobalt-60 and other radionuclides that have difficult to shield gamma rays are harmful when inhaled or ingested, as are easily shielded pure beta emitters such as strontium-90, iodine-129, and technetium-99. Uranium and the transuranics including plutonium, americium, neptunium, and curium can be highly retained in the human body and very harmful when inhaled or ingested, even in very low total disintegrations per unit time (or curies). A curie of plutonium-239, from airborne inhalation, is 20,000 times more harmful than a curie of cesium-137. So, this is important to remember: far lower curie amounts of the actinides (uranium and the transuranic radionuclides) are as harmful when inhaled (or ingested) compared to other radionuclides like cesium-137.
- **Mobility From a Repository.** Certain radionuclides are notoriously mobile through soil, such as technetium-99 (213,000-year half-life) and iodine-129 (17-million-year half-life). Other radionuclides are less mobile and tend to cling to soil. But the chemical form of the radionuclide and changing chemical environment can affect how mobile these radionuclides are. This includes plutonium, which can cling to soil and later become mobile.
- **Radioactive Half-life and How Long the Radionuclide Must Be Confined**. Some radionuclides have such a short half-life that they decay away within days or weeks. Seven to ten half-lives are generally assumed for the material to decay away. Iodine-131 with its 8-day half-life was still a problem as it contaminated the grass cows ate, and then was ingested by children, pregnant women and other people drank the milk. Cesium-137

and strontium-90 have a roughly 30-year half-life and remain a problem for 300 to 500 years. Repository performance for a few dozen years has proven difficult to predict. Some fission products are very long-lived such as technetium-99 (213,000-year half-life) and iodine-129 (17-million-year half-life). Actinides which are uranium and the transuranic radionuclides decay through a series of decay progeny before ultimately becoming a stable isotope of lead. While it is commonly stated that the radioactive half-life of plutonium-239 is 24,000 years, it decays to uranium-235 which has a 700-million-year half-life and it has more decay progeny to follow. The radioactive half-life of americium-241 is 432 years, but it decays to neptunium-237 which has a 2.1-million-year half-life and it has more decay progeny to follow. With uranium and plutonium, as the radioactive decay progeny build up, the waste actually gets more radioactive over time, peaking over tens of thousands of years. And the uranium and transuranic radionuclides and their progeny remain highly radioactive over more than hundreds of thousands of years. Yet, the DOE tends to refer to this as "low-activity waste."

- **Criticality Risk.** The criticality risk of plutonium, uranium and other transuranics remains for over 10,000 years, despite inadequate patchwork regulations that address only 10,000 years for some repositories and that don't adequately address the problem of criticality in storage or a repository. The so-called "low activity waste" can pose criticality issues, along with neutron dose, along with remaining radioactive over millennia.
- **The Total Quantity of Waste**. The total quantity of radioactive waste to be disposed of, to leach into the environment, matters. If the only perspective is that of concentration of waste per gram or per liter, without also bearing in mind the total quantity of waste, dilution is made to seem a compliant and reasonable solution to the radioactive waste. But the allowable concentrations of waste in a disposal facility are often based on biased and unreliable Performance Assessments, made without sound technical basis. The DOE can decide to approve any Performance Assessment, no matter how unreliable or even fraudulent the Performance Assessment is.
- **DOE and NRC's Radiation Protection isn't Protective.** The allowable concentrations of radionuclides in drinking water, for example, are based on more and more on the unscientifically and diluted effective whole-body doses, ignoring organ doses, and only contrived based on an incomplete understanding of the cancer fatality risk. Cancer incidence, heart disease, shortened life span, infertility and birth defects are not represented by either effective whole-body or organ doses used currently by the Department of Energy, the Environmental Protection Agency or the Nuclear Regulatory Commission. When the regulations limiting radiation exposure to the public to 100 millirem per year were created, it was assumed that cancer mortality risks were 0.0001 fatal cancers per rem and now even the DOE admits that single biological end point, that of cancer mortality, is at least 6 times higher. Yet, radiation protection standards didn't change.

"Low-activity waste" sounds like it would be less harmful or less of a concern than high-level waste, but unless you know the specific radionuclides you are dealing with, it doesn't tell you much about the health harm of its environmental release or the difficulty of keeping the material from migrating from a disposal (burial) site.

The point of this discussion is to point out how vague the term "low-activity waste" is. The use of the undefined term "low-activity waste" appears to be part of a propaganda ploy by the Department of Energy. When the Department of Energy means that removal of the cesium-137 will reduce the need for shielding, they should simply say that the high-level waste had some of the cesium-137 removed, rather than resort to vague and undefined terms like "low-activity waste."

The Draft WIR Evaluation needs to provide meaningful information to supplement the undefined and at times misleading use of the term "low-activity waste."

DOE'S DRAFT WIR EVALUATION IS NOT BASED ON SCIENCE

The recent endorsement of DOE's HLW interpretation by the Biden Administration while touted as being based on science, is not based on science. [12] [13] It is rooted in DOE's vague and inaccurate depictions of certain wastes as "low-activity waste," the lack of a repository for high-level waste and the desire to wiggle out of federal laws pertaining to stricter disposal requirements for HLW in a geologic repository.

It is not scientific to mislead the public with regard to the actual requirements in DOE Manual 435.1-1.

It is not scientific to emphasize the large curie amounts of cesium-137 in high-level waste and the need for shielding the gamma rays from cesium-137's decay progeny barium-137m but not emphasize how far lower curie amounts of plutonium, americium, curium and uranium and others pose radiological hazards for millennia.

The DOE's so-called "science" has tended to emphasize unbalanced discussion of short-lived higher curie hazards from certain radionuclides while ignoring the greater repository hazards over far lower curie amounts over the long term for the actinides (uranium, plutonium, americium, neptunium, curium and others) and for fission products iodine-129 and technetium-99 that are highly mobile in the environment and difficult to detect.

The Department of Energy has tended to assume unrealistically slow migration of radionuclides, without a technically sound basis, from waste disposal sites in its performance

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[12] *Federal Register*, A Notice by the Energy Department on 12/21/2021, "Assessment of Department of Energy's Interpretation of the Definition of High-Level Radioactive Waste at https://www.federalregister.gov/documents/2021/12/21/2021-27555/assessment-of-department-of-energys-interpretation-of-the-definition-of-high-level-radioactive-waste This Federal Register Notice (FRN) and other documents relevant to DOE's HLWI are available on the Department's website at: *https://www.energy.gov/em/program-scope/high-level-radioactive-waste-hlw-interpretation*

[13] Keith Ridler, AP, *The Idaho Falls Post Register*, "US affirms new interpretation for high-level nuclear waste," December 29, 2021.

assessments. By assuming higher retention of plutonium and other actinides to soil, for example, disposal performance assessments appear to adequately slow the migration of these radionuclides to groundwater. The slowed trickle-out of contaminants underestimates the releases the continue for waste that is radioactive over more than hundreds of thousands of years, over millennia. Flooding is assumed to never occur. And the average doses may be far exceeded from time to time, for many years, but this devastating impact on human life is ignored. And for waste sites including those involving U.S. Environmental Protection Agency CERCLA [14] disposal, the performance criteria for the disposal site are arbitrarily truncated to 1000 or 10,000 years, despite increasing levels of radioactivity migrating from the site after 10,000 years.

The Department of Energy and the Nuclear Regulatory Commission continue to dismiss organ doses in favor of effective whole-body dose, continue to rely on effective whole-body doses keyed to cancer mortality while ignoring cancer incidence, increased heart disease, harm to the immune system, shortened life span, infertility and increased birth defects.

The Department of Energy has refused to say what its plans really are, for high-level waste at the Hanford site as well as at the Idaho National Laboratory. The INL has liquid sodium-bearing high-level waste and powdery, soluble calcine high-level waste that is unsafely stored in flooding vulnerable and seismically vulnerable bin sets.

The DOE's Draft WIR Evaluation must follow DOE's disclosure of the full ramifications of its HLW interpretation [15] effects in terms of how this may affect radioactive waste at DOE sites and at radioactive waste disposal facilities.

DOE SEEKS TO SAVE MONEY ON CLEANUP ALL WHILE THROWING VAST SUMS OF MONEY TO CREATE MORE NUCLEAR WASTE, WITHOUT HAVING A PROGRAM TO PROVIDE LONG-TERM STORAGE OR DISPOSAL OF EXISTING OR FUTURE RADIOACTIVE WASTE

The Department of Energy seeks cost saving on Hanford cleanup, all while giving away enormous levels of funding for technologies to make more nuclear waste that the DOE has no program to provide for long-term storage or disposal of. The U.S. Department of Energy is providing funding for small nuclear reactors including NuScale, the Versatile Test Reactor, the military's mobile microreactor (Project Pele), the MARVEL reactor, and many others.

The Department of Energy has no spent fuel or high-level waste disposal facility and has no program from a spent nuclear fuel or HLW disposal facility — and yet advocates with millions

[14] U.S. Environmental Protection Agency's Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

[15] *Federal Register*, A Notice by the Energy Department on 12/21/2021, "Assessment of Department of Energy's Interpretation of the Definition of High-Level Radioactive Waste at https://www.federalregister.gov/documents/2021/12/21/2021-27555/assessment-of-department-of-energys-interpretation-of-the-definition-of-high-level-radioactive-waste This Federal Register Notice (FRN) and other documents relevant to DOE's HLWI are available on the Department's website at: *https://www.energy.gov/em/program-scope/high-level-radioactive-waste-hlw-interpretation*

of dollars for the development of more nuclear reactors, more spent nuclear fuel — all with no long-term disposal plan to keep radioactive waste confined.

The Department of Energy's track record on high-level waste disposal is relevant for the public to understand, in order to understand DOE's dismal record on creating technically sound Performance Assessments for radioactive waste disposal.

Regarding the Department of Energy's proposed spent nuclear fuel and high-level waste repository at Yucca Mountain, the Department of Energy's modeling of the trickle out of radionuclides from the disposal of spent nuclear fuel at Yucca Mountain made it problematic to achieve 15 mrem/yr to an individual living 18 km downgradient of Yucca Mountain. But as water seeps into the porous volcanic "tuff" of the mountain and the waste containers inevitability corrode, the radionuclides trickle out, moving with groundwater. The degree of "sorption" of radionuclides to the soil along the way has been modeled based on contrived laboratory tests and often over zealously is modeled to sorb to the soil rather than reach the person drinking water 18 km from the disposal site.

The water infiltration model was thought by one prominent geologist, Lynn W. Gelhar, to underpredict the groundwater flow and the estimated annual radiological dose, as he explained in Chapter 14 of the book *Uncertainty Underground*. [16]

But something would happen to drastically lower the Department of Energy's trickle out radiation doses between 2007 and 2008 when the DOE submitted its license application for Yucca Mountain to the NRC. I had trouble understanding how the predicted doses dropped to less than 1 mrem/yr for post-10,000-year time frame. Both the earlier and later submittals had assumed perfect titanium drip shield performance, despite the implausibility of ever installing them in the repository. I finally found the answer in a letter on the State of Nevada's website for Yucca Mountain. [17]

An independent review of DOE's calculations had been contracted by the DOE but withheld from the State of Nevada. The review's conclusion was that the Department of Energy's modeling of water infiltration to the disposed of waste **did not provide a credible representation of water infiltration at Yucca Mountain**. In other words, because the periodic spikes in water infiltration had raised the estimated radiation dose, the water infiltration spikes were simply removed from the modeling in order to drive the estimated radiation exposures down. The contamination trickle-out problem that had previously estimated 95th percentile

[16] Edited by Allison M. Macfarlane and Rodney C. Ewing, *Uncertainty Underground – Yucca Mountain and the Nation's High-Level Nuclear Waste*, The MIT Press, 2006. ISBN 0-262-13462-4. Chapter 14 by Lynn W. Gelhar, *Containment Transport in the Saturated Zone at Yucca Mountain*. He concludes that the DOE calculations "could easily be three orders of magnitude larger than the DOE predicts (see figure 14.3). Figure 14.3 shows radiation dose versus time with the dose peaking after 10,000 years from closure. The DOE prediction was from 2001, DOE/RW-0539. Gelhar also points out the looseness of the EPA's standard "that probabilistic results be interpreted by applying the numerical standards to a "reasonable expectation" prescribed to be the mean is troubling." Figure 14.3 shows DOE's model yielded 95th percentile doses above 1000 mrem/yr after 100,000 years.

[17] Senate Hearing 109-523, Yucca Mountain Repository Project, May 16, 2006. https://www.govinfo.gov/content/pkg/CHRG-109shrg29473/html/CHRG-109shrg29473.htm

radiation doses above 1000 mrem/yr (yes, one thousand mrem/yr) and would struggle to meet the 100 mrem/yr median requirement by EPA regulations now had contrived the modeling to slash the estimated radiation dose to a person living 15 km (or 11 miles) downgradient to less than 1 mrem/yr.

The Department of Energy's problem of meeting the regulatory standards for Yucca Mountain was easily solved by the use of technically unsupportable assumptions, which naturally the Nuclear Regulatory Commission (NRC) had no problem with. The NRC would tell the media and the Government Accountability Office that there were no technical reasons to object to the repository at Yucca Mountain and that the Yucca Mountain repository would be "safe."

The State of Nevada, however, had noted that in addition to the contrived modeling of the trickle out from Yucca Mountain, that other essential aspects of the license application for Yucca Mountain were technically unsupported and lacked design details or even the identification of applicable codes and standards. The Department of Energy has no technical basis to support the claims in its 2008 Yucca Mountain License Application about corrosion resistance of the metal waste packaging and drip shield and had not corrected the situation even after strong urging from the U.S. Nuclear Waste Technical Review Board. [18] [19]

The Draft WIR Evaluation must provide a long-term plan for all radioactive waste that the Department of Energy now is responsible for and for the radioactive waste that will continue to be created.

DOE'S PERFORMANCE ASSESSMENTS WILL NOT PROTECT THE ENVIRONMENT OR THE PUBLIC

DOE's Performance Assessments will not protect the environment or the public. When the DOE reclassifies its HLW to LLW, DOE can dispose of LLW on its DOE sites. There are no dose standards, no compliance periods and no standards for the technical adequacy of its Performance Assessments. Even when the disposal is conducted under the Environmental Protection Agency's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the compliance period is only 10,000 years although the radioactive waste remains an increasing hazard over 10,000 years.

The Department of Energy and the Nuclear Regulatory Commission have a history of accepting technically unsound Performance Assessments, as discussed above for Yucca Mountain.

[18] State of Nevada to Chairman of the Nuclear Waste Technical Review Board, October 8, 2008. http://www.state.nv.us/nucwaste/news2008/pdf/nv08108nwtrb.pdf

[19] See the State of Nevada website, including the "Key Technical Issues" webpage at http://www.state.nv.us/nucwaste/technic.htm

A recent National Academy of Sciences report [20] actually muddies the water more than it provides clarity and it does not come close to providing useful and candid information — it advises trying to loosen drinking water standards as the way to solve radiation waste disposal issues.

The Draft WIR Evaluation must address the gaps in regulations for radioactive waste that will remain at the Hanford site due, especially for waste reclassified to be low-level waste. Such waste that was from reprocessing that becomes low-level waste has very few requirements for disposal performance on a DOE site and often inadequate Performance Assessments are conducted, both on and off of DOE sites for radioactive waste disposal.

DOE HAS NO HLW (OR SPENT FUEL) DISPOSAL PROGRAM

The Department of Energy approach to waste management is like a song, "Tomorrow, tomorrow, there's always tomorrow…" This is the Department of Energy's approach to spent nuclear fuel and high-level waste management and disposal. And it generally hinges on the DOE manager's retirement being only a day away, so that it's always someone else's problem.

The Draft WIR Evaluation must acknowledge that the DOE has already exceeded its allotted limit of spent nuclear fuel and HLW in Yucca Mountain. The Draft WIR Evaluation must explain how after decades of promising to open a repository but failing to, that the DOE, with no repository program since 2010, is going to obtain a repository.

The fact is that the Department of Energy **has no spent nuclear fuel disposal program or high-level waste disposal program** for its DOE-owned spent fuel or the spent nuclear fuel from commercial nuclear power plants or high-level waste. Consolidated interim storage is not a substitute for a permanent solution.

The fact is that the Nuclear Waste Fund that collected fees from electricity generated by nuclear power plants has been discontinued and the $30 billion or so that it collected is not even enough money to package commercial spent nuclear fuel in disposal containers, let alone to license and construct a repository.

The many trillions of dollars that this will cost the U.S. taxpayer to continue to seek a repository is not being opening and honestly presented, by the Department of Energy or by propaganda sessions conducted at taxpayer expense by the Idaho National Laboratory.

The Department of Energy habitually ignores state and federal laws. For example, the amount of spent nuclear fuel and HLW allocated to the DOE for the failed Yucca Mountain repository effort is limited and the DOE already has exceeded its lawful allotment. The Nuclear Waste Policy Act remains the law; it limits the quantity of spent nuclear fuel from commercial nuclear power plants to 63,000 metric tons heavy metal (MTHM), 2,333 MTHM for DOE SNF

[20] National Academies of Sciences, Engineering, and Medicine 2020. *Final Review of the Study on Supplemental Treatment Approaches of Low-Activity Waste at the Hanford Nuclear Reservation: Review #4*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25710. Access to free PDF downloads is available currently.

and 4,667 MTHM for HLW. The quantity of commercial SNF, DOE SNF, and DOE-managed HWL are each greater than DOE's allotment for the first repository. [21] But DOE hasn't obtained its first repository, which by law, would be at Yucca Mountain.

The Department of Energy promised to begin disposal of spent nuclear fuel by 1998. Then came other promised dates that have come and gone. The U.S. Nuclear Regulatory Commission believed those empty promises from the Department of Energy, expecting to disposal by 1998, then 2008, and then by the first quarter of this century. [22] [23] The Department of Energy's rapidly evolving waste emplacement concepts continued to evolve as every assumption about how the repository would contain the waste didn't hold up. No utility has packaged its spent nuclear fuel into DOE's recommended "transport, aging and disposal" TAD canister. The Yucca Mountain repository concept also relies on never designed titanium drip shields that no one honestly believes are feasible to install decades after the waste is emplaced.

The Department of Energy has no spent nuclear fuel repository program and hasn't since 2010. It must address the fact that the Department of Energy **has no credible cost estimate for the costs of disposal of now-existing spent nuclear fue**l plus the fuel from already operating reactors. Few people know that there is already more than double the amount of spent nuclear fuel (and high-level waste) than Yucca Mountain was set to legally hold. And few people know that if nuclear energy were to make a dent in climate, we would need a new Yucca Mountain every year.

While the Department of Energy's estimated releases from the proposed Yucca Mountain repository are unbelievably low, this is an artifact of reducing the water infiltration rates through the corroding waste containers. Using more realistic water infiltration rates and their variability over time results in far higher releases.

The heat load of the spent nuclear fuel placed in the repository poses a risk to the structure of the repository and the DOE never actually decided whether to use a "hot" repository or a "cool" repository design. The amount of waste and how it is spaced in the repository obviously affect the ability to cool thermally hot spent nuclear fuel.

The criticality issues for Yucca Mountain have grown substantially as the enrichment level used in commercial nuclear power plants has increased. It has also grown because YM originally was not envisioned to dispose of the Department of Energy's highly enriched fuels. And another change has been the included possibility of disposal of surplus plutonium at Yucca Mountain. The Department of Energy concedes that criticalities are possible in the repository, yet it does not address the harm to the repository or the additional spacing requirements.

Doubling the capacity of Yucca Mountain, the slated 70,000 metric tons of spent nuclear fuel and high-level waste, may seem easy, when only the fraudulent radionuclide trickle-out radiation

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[21] U.S. Nuclear Waste Technical Review Board (NWTRB), Management and Disposal of U.S. Department of Energy Spent Nuclear Fuel. Arlington, December 2017. See p. 15.

[22] Nuclear Regulatory Commission, 10 CFR 51, Waste Confidence-Continued Storage of Spent Nuclear Fuel, Federal Register, Vol. 78, No. 178, September 13, 2013.

[23] Blue Ribbon Commission of America's Nuclear Future. 2012. (It uses 2010 estimates for spent fuel quantities) www.brc.gov

doses are reviewed but in reality, is far more problematic. The slated capacity of Yucca Mountain already required skirting around seismic faults and required 40 miles of underground tunnels.

U.S. Nuclear Regulatory Commission Chairman Kristine Svinicky recently characterized the nation's growing inventory of spent nuclear fuel as having a volume that would fit in a football field. That the head of the agency that would grant a license to the Department of Energy's proposed Yucca Mountain repository would omit the realities of the difficulties of safely containing the spent nuclear fuel is very telling of the mindset of the NRC. The NRC wants to grow nuclear energy no matter the cost to rate-payers, taxpayers, or to humanity. All the NRC has to do is sign off that they believe the DOE's safety case for repository provides a "reasonable expectation" of meeting stipulated requirements.

An online briefing "What Congress Needs to Know About Pending Nuclear Waste Legislation" was held November 13, 2020 by the Environmental and Energy Study Institute, with guest speakers Robert Alvarez, Institute for Policy Studies; Don Hancock, Southwest Research and Information Center; and Diane D'Arrigo, Nuclear Information and Resource Service to explain hazards associated with spent nuclear fuel and history pertaining to the Nuclear Waste Policy Act. [24]

The State of Nevada was attentive to the DOE's rapidly changing disposal concepts and the many times that technically indefensible studies were used to form the basis for how long it would take the waste containers to corrode and how long it would take radionuclides from the waste to migrate to groundwater.

The DOE continues to rely on environmental impact statements (EISs) that are grossly inadequate as well as inconsistent in every essential aspect related to the spread of radiological material and the harm. **Is that why DOE issued the Environmental Assessment on the Draft WIR Evaluation to a limited small group of people, not the public, and allowed a 14-day review period?**

The DOE often makes technical unsound assumptions to support irresponsible management of radioactive waste. The Yucca Mountain safety evaluations assumed 0.9999 efficiency for HEPA filters and that there would be no releases from spent fuel stored outdoors and without HEPA filtering. The Yucca Mountain safety evaluations have used fraudulent and unscientific water infiltration modeling to lower predicted doses from the migration of radionuclides from the disposed of waste. The Yucca Mountain EIS assumes the design of spent fuel canisters, the "TADs," that have not been used for commercial spent nuclear fuel storage

When the Department of Energy twice proposed a disposal container for the commercial nuclear power plant owners to use, they ignored it. The electrical utilities would choose cheaper canister designs not intended for disposal because they planned on it becoming the Department of Energy's problem. And this means that the problem would be solved at the expense of the

[24] Environmental and Energy Study Institute (EESI) briefing at https://www.eesi.org/briefings/view/111320nuclear#RSVP and see "Yucca Mountain in Brief at https://www.eesi.org/files/Letter_to_Congress-Yucca_Mountain_in_Brief.pdf

U.S. taxpayer. And the U.S. Nuclear Regulatory Commission did everything in its power to limit the utilities' costs.

The U.S. Nuclear Regulatory Commission claims to have accepted the highly speculative safety case for DOE's proposed Yucca Mountain, yet no construction license was ever issued.

Current law prohibits consolidated interim storage about 10,000 metric tons (MT). Despite this, the U.S. NRC is planning to license two far larger consolidated interim storage facilities for spent nuclear fuel. One facility is in New Mexico and the other in Texas.

Many electrical utilities are seeking to move their spent nuclear fuel away from places the U.S. NRC never should have allowed the spent fuel to be "indefinitely" stored: ocean coastlines and lake shores, among them. These consolidated interim storage sites are planning to accept spent nuclear fuel in non-disposable containers. The proposed consolidated interim storage facilities will have no capability for repackaging a damaged canister, nor repackaging for disposal if a repository were found. And importantly, the Nuclear Waste Policy Act sought to prevent consolidated storage that would have the effect of lessoning the effort to attain a permanent solution for the permanent isolation of the radioactive waste, which remains radio-toxic for millennia.

To help the SONGS utility understand their options for moving their spent fuel farther from the California coastline, they have hired a consultant, North Wind. A tangled web of possibilities was presented at a public meeting for the San Onofre spent fuel but currently there is no place to move their spent nuclear fuel to. [25]

The utility is also concerned that the full costs of transportation and storage may not be fully reimbursable from the Judgment Fund from the litigation with the Department of Energy's partial breach of contract in failure to start disposing of the spent nuclear fuel from commercial nuclear power plants. Also, it was pointed out that utility customers may not be fully shielded from liability for accidents involving storage of spent nuclear fuel at private storage facilities. Utilities want the Department of Energy to take ownership of the spent nuclear fuel. But the Department of Energy has no place to put it. The Nuclear Waste Policy Act of 1982 and amended in 1987 sought specifically to avoid letting up the pressure on the Department of Energy to obtain permanent, safe disposal of spent nuclear fuel. The DOE was restricted from obtaining interim spent fuel storage unless it had obtained a license for a facility for permanent disposal.

Both the U.S. NRC and the Department of Energy are touting consolidated interim storage as though it were equivalent to obtaining a permanent solution for isolating the radioactive waste. They know that repackaging will be needed, acknowledged to be needed every one hundred years or so. Yet both proposed consolidated storage facilities the NRC is planning to approve this year do not have any canister repackaging or isolation capability.

So why would the U.S. NRC be ready and willing to license two consolidated interim storage facilities that by design will not include any capability to repackage damaged canisters? The

[25] San Onofre Nuclear Generating Station (SONGS), 11/20/20, North Wind slide presentation https://www.songscommunity.com/_gallery/get_file/?file_id=5faf01792cfac225d3c64352&ir=1&file_ext=.pdf

answer that the U.S. NRC has given is that the situation is similar to the spent fuel facility it licensed in Utah but which was never built. The U.S. NRC said that the Private Fuel Storage facility in Utah did not need any repackaging capability because if a canister of spent nuclear fuel was damaged, it would be sent back to the licensee that generated the waste.

This is important to understand, as the Department of Energy is actively promoting nuclear energy and failing to mention its continuing failure to find a permanent solution to safety isolate the spent nuclear fuel (and high-level waste) and failing to discuss the problems of short-sighted consolidated interim storage that the U.S. NRC is ready to approve. The challenges of spent nuclear fuel disposal are greater now than they were assumed to be 40 years ago. In fact, the technology to safely isolate these radioactive wastes from our air, soil and water has not been found and this is whispered by the U.S. Nuclear Waste Technical Review Board.

The ridiculousness of the NRC's argument that the consolidated storage facilities have no need for repackaging capability because they would just require the waste to be returned to the utility that generated it shows the extent of nonsensical lying the agency is prone to. A damaged canister cannot be legally shipped. And spent nuclear fuel being sent to a consolidated storage site may have shut down its reactors and decommissioned all its facilities. The NRC's argument that the compromised canister would simply be shipped back to the utility that generated the spent nuclear fuel is utterly absurd. But this is the quality of thought that the NRC has put into much of its licensing and its "waste confidence" rule and its subsequent environmental impact statement for continued storage of spent nuclear fuel. The NRC gave up on trying to keep track of the latest promised date that a repository would be available and now assumes that a repository will become available "when needed." The NRC also assumes that the facilities to repackage the spent nuclear fuel, every 100 years or so, will also become available "when needed." And it simply isn't the NRC's problem what the cost is, or who pays for it, as long as it is not one of its licensees, the electrical utilities who operated nuclear reactors.

The technology to repackage the spent nuclear fuel canisters used prevalently by commercial nuclear power plants does not exist. It is recognized that these operations will pose many worker risks and radiological release risks as well as billions of dollars in cost. The disposal canister designs do not exist. And the capability to terminate the radiological release from a damaged canister does not exist. This is problem for the U.S. NRC who assumes no liability for the releases. And actually, the U.S. NRC undermines the radiological monitoring where spent nuclear fuel is stored so that citizens won't know that actual release levels either.

The Draft WIR Evaluation must state that the Department of Energy has no designed disposal canister for its spent nuclear fuel, for disposal at the repository that the DOE has long promised but, in fact, does not exist, and was never licensed or constructed.

The Department of Energy is rushing to create more spent nuclear fuel, both DOE-owned SNF and new kinds of commercial spent nuclear fuel, while ignoring the problems we already face from decades of spent nuclear fuel accumulation. Each new variety of spent fuel cladding type, enrichment type, burnup and design require new storage and disposal analyses and designs, and more indefinite storage facilities, which fall to the U.S. taxpayer to fund.

The Draft WIR Evaluation must explain how the Department of Energy's lack of planning and its very inadequate existing environmental impact statements affect the future poisoning of current and future generations.

AN CAUTIONARY EXAMPLE OF A DOE PERFORMANCE ASSESSMENT

The Idaho National Laboratory's Radioactive Waste Management Complex (RWMC) began accepting radioactive waste in 1952 and the Department of Energy continued disposing of radioactive waste there, even after waste exhumations were conducted. Of the 97-acre burial ground, waste was buried in pits and trenches in 35 acres. Of the 35 acres of buried waste, only 5.69 acres are designated to be sifted through to exhume only "targeted" waste and return non-targeted waste for reburial. The "targeted" waste was the most chemically laden waste that was already exceeding federal drinking water standards in the aquifer because of the buried waste. An estimated initial radionuclide inventory is provided in Table 1. [26]

The most mobile contaminants, such as technetium-99, iodine-129, and chlorine-36 are from INL wastes and remain poised to contaminate the aquifer because "targeted waste" includes only a portion of Rocky Flats waste and not INL wastes.

These contaminants will exceed federal drinking water standards even though their curie inventory seems small. Other rather low curie amounts of radionuclides like uranium, plutonium and americium will cause seriously unhealthy drinking water for hundreds of thousands of years.

The Department of Energy's Performance Assessment for disposal of radioactive waste that has continued even as CERCLA so-called "cleanup" has been conducted to exhume a fraction of the buried waste does not comply with 10 CFR 61, Subpart C for land disposal. It didn't have to. And it doesn't. It does not limit doses, does not consider organ doses or remain protective without long-term maintenance, for millennia. The Nuclear Regulatory Commission had no authority over the radioactive waste disposal on a DOE site. Environmental Protection Agency, when a CERCLA site, focused on 1000 years of performance and didn't concern itself at all with performance after 10,000 years despite the peak radioactivity occurring after 10,000 years.

[26] Tami Thatcher, "Important Long-Lived Contaminants at INL's RWMC Not Remediated," at http://www.environmental-defense-institute.org/publications/RWMCunrem.pdf

Table 1. Radionuclide and chemical contaminants at RWMC for 1000 year and 10,000-year groundwater ingestion peak risk estimates and groundwater concentrations, unremediated.

Radionuclide (half-life)	Inventory	Source[a]	Peak Risk	Calendar Year	Peak Aquifer Concentration (Percent of MCL)	Maximum Contaminant Level
Am-241 (432 yr)	243,000 Ci	RFP	3E-3[b]	3010	6.8E-8 (< 1 percent)	15 pCi/L
C-14 (5,730 yr)	731 Ci	INL	1E-5	2133	186 **9.3 percent**	2000 pCi/L
Cl-36 (301,000 yr)	1.66 Ci	INL	2E-6	2395	21.2 3 percent	700 pCi/L
I-129 (17,000,000 yr)	0.188 Ci	INL	4E-5	2111	13.1 **1310 percent**	1 pCi/L
Tc-99 (213,000 yr)	42.3 Ci	INL	3E-4	2111	2710 **301 percent**	900 pCi/L
Np-237 (2,144,000 yr)	0.141 Ci	INL	1E-4	12000	86.8 **579 percent**	15 pCi/L[c]
U-238 (4,470,000,000 yr)	148 Ci	RFP[f]	9E-5	12000	47.1 **472 percent**	1.01E1 pCi/L[d]
Total Uranium [c]			NA	12000	1.44E-1mg/L **480 percent**	3.00E-2 mg/L[e]
Carbon Tetrachloride	7.9E8 g	RFP	5E-4	2133	3.07E-1 mg/L **6140 percent**	5.0E-3 mg/L
1,4-Dioxane	1.87E6 g 4.24E4 g	RFP INL	2E-5	2111	1.69E-01 mg/L **5633 percent**	3E-3 mg/L
Methylene chloride	1.41E7 g	RFP	5E6	2245	5.85E-2 mg/L **1170 percent**	5E-3 mg/L
Nitrate	4.06E8 g 4.97E7 g	RFP INL	(Hazard index 1)	2094	66.7 mg/L **667 percent**	10 mg/L
Tetrachloroethylene	9.87E7 g	RFP	7E-7	2145	6.64E-2 mg/L **1328 percent**	5.0E-3 mg/L
Trichloroethylene	8.92E7 g	RFP	9E-4	2130	3.8E-2 mg/L **760 percent**	5.0E-3 mg/L

Sources: DOE/ID-11241 sections 4 and 7.

a. Rocky Flats Plant (RFP); Idaho National Laboratory (INL)

b. The peak risk for Americium-241 is due to external exposure, soil ingestion, inhalation and crop ingestion. The risk for the other contaminants is primarily groundwater pathways.

c. The limit is 15 pCi/L for total alpha (40 CFR 141).

d. The limit is 3.0E-2 mg/L (30 microgram/L) for total uranium. To compare concentrations of uranium isotopes, 3E-2 mg/L is converted to the equivalent activity for each isotope.

e. Total uranium is presented for comparison to the maximum contaminant limit.

f. Table 4-4 of the RI/BRA shows that most of the U-238 waste is from Rocky Flats. Of this, 24.9 curies of U-238 was placed on pad A which is not currently planned to be removed.

Downgradient of INL, the migrating buried waste will reach 100 mrem/yr unless the soil cap performance is perfect for millennia. But that is based on contrived modeling of soil "sorbing" factors that slow the migration of the waste into the aquifer and contrived mixing that maximizes dilution. [27] [28] "Fast paths" that can move relatively concentrated contamination through lava tubes in the aquifer downgradient are ignored. [29] And more long-lived radioactive waste is being buried at the INL. [30]

The DOE's report summarizing the "forever contamination" at RWMC was never disclosed to the public prior to EDI's freedom of information act request. [31] A figure from the DOE's report showing the rising radiation doses largely from migration of contaminants to the aquifer is shown in the figure below depicting the 100 mrem/yr case without credit for the soil cap slowing migration of contaminants to the aquifer.

In the short term, less than 1000 years, the ingestion dose from drinking water near RWMC due to migration of radionuclides buried at RWMC to the aquifer is primary due to carbon-14, chlorine-36, iodine-129, and technetium-99. In the longer term, americium-241 is the predominant contributor to dose as well as various uranium and plutonium isotopes. The figure does not show the chemical contamination at RWMC which has already exceeds federal maximum contaminate level (MCL) drinking water standards.

[27] Idaho National Laboratory, "Explanation of Significant Differences Between Models Used to Assess Groundwater Impacts for the Disposal of Greater-Than-Class C Low-Level Radioactive Waste and Greater-Than-Class-C-Like Waste Environmental Impact Statement (DOE/EIS-0375D) and the Environmental Assessment for the INL Remote-Handled Low-Level Waste Disposal Project (INL/EXT-10-19168)," INL/EXT-11-23102, August 2011. http://www.inl.gov/technicalpublications/documents/5144355.pdf and a report prepared for the US Department of Energy, DOE Idaho Operations Office, "Preliminary Review of Models, Assumptions, and Key Data Used in Performance Assessments and Composite Analysis at the Idaho National Laboratory," INL/EXT-09-16417, July 2009. See p. 11, Tables 3 and 4 for sorption coefficients.

[28] See that the publicly available administrative record for RWMC cleanup does not contain the assessment of radionuclide migration and radioactive doses after 10,000 years. The pre-10,000-year contaminant migration is artificially suppressed for the first 10,000 years and then rapidly escalates and stays elevated for hundreds of thousands of years. See the Administrative Record at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documents for documents associated with this cleanup action, including "Record of Decision" documents and EPA mandated Five-year Reviews at http://ar.inel.gov or http://ar.icp.doe.gov

[29] Johnson TM et al., Geology, "Groundwater "fast paths" in the Snake River Plain aquifer: Radiogenic isotope ratios as natural groundwater tracers," v. 28; no. 10; p. 871-874, October 2000.

[30] US Department of Energy, "Environmental Assessment for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site," Final, DOE/EA-1793, December 2011. http://energy.gov/sites/prod/files/EA-1793-FEA-2011.pdf

[31] U.S. Department of Energy, 2008. Composite Analysis for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11244. Idaho National Laboratory, Idaho Falls, ID and U.S. Department of Energy, 2007. Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site. DOE/NE-ID-11243. Idaho National Laboratory, Idaho Falls, ID. Available at INL's DOE-ID Public Reading room electronic collection. See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

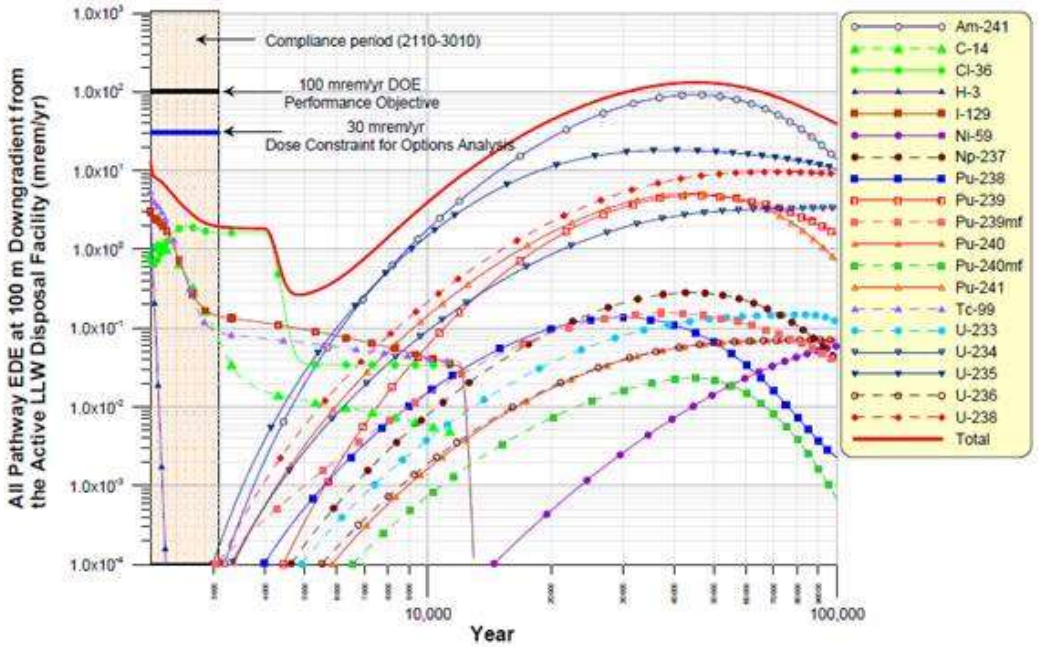

Figure 4-2. All-pathways effective dose equivalent 100 m downgradient from the Radioactive Waste Management Complex boundary from year 2110 to year 100,000 with cover infiltration rate equal to 1 cm/year.

The figure above shows the rising contamination levels after 10,000 years, with the leading Snake River Plain Aquifer contaminant being from americium-241. Please note the U.S. Environmental Protection Agency allows the Department of Energy to ignore and not display to the public the obscene radioactive contamination levels after 10,000 years at DOE cleanup sites.

Regarding the Snake River Plain Aquifer, the estimated migration of radioactive waste from the RWMC will still be dominated by americium-241, followed by other long-lived radionuclides or radionuclides such as plutonium and uranium that decay through a long series of radioactive progeny. Americium-241, with its radioactive half-life of 430 years decays into neptunium-237 which has a radioactive half-life of 2.1 million years. The Np-237 then decays through a long series of radioactive progeny. Americium-241 is the decay product of plutonium-241. Americium-241 decay ingrowth causes it to build up during the first 70 years from the time the plutonium-241 was created in a nuclear reactor. Plutonium-239 is the sought-after nuclear weapons material, but plutonium-240 and plutonium-241 are also created in a reactor along with the plutonium-239 and not easily separated out. Separation of the americium-241 from weapons material was conducted at the Rocky Flats plant and contamination levels of the Am-241 in the waste from Rocky Flats was highly variable and not well known.

The Department of Energy's disposal site at the RWMC will have a deep soil cap installed, but this situation would not meet U.S. Nuclear Regulatory Commission requirements [32] for stability of the disposal site after closure because both DOE and the EPA have acknowledged that the soil cap at the INL will require maintenance over millennia to maintain the integrity of the soil cap.

The Draft WIR Evaluation must explain how flexible and unreliable its Performance Assessments for radioactive waste disposal are. The Performance Assessment at the Idaho National Laboratory was withheld from the public and its chosen criteria were ad hoc because there were no adequate and protective criteria for disposal system performance.

RADIATION PROTECTON STANDARDS BASED PRIMARILY ON CANCER MORTALITY ARE INADEQUATE

The public as well as radiation workers need to keep in mind that, despite what they may have been taught:

- The cancer risk is not reduced when radiation doses are received in small increments, as the nuclear industry has long assumed. [33]

- Despite the repeated refrain that the harm from doses below 10 rem cannot be discerned, multiple and diverse studies from human epidemiology continue to find elevated cancer risks below 10 rem and from low-dose-rate exposure. [34]

- The adverse health effects of ionizing radiation are not limited to the increased risk of cancer and leukemia. Ionizing radiation is also a contributor to a wide range of chronic illnesses including heart disease and brain or neurological diseases.

The public and radiation workers take cues from their management that they should not be concerned about the tiny and easily shielded beta and alpha particles. DOE-funded fact sheets often spend more verbiage discussing natural sources of radiation than admitting the vast amounts of radioactive waste created by the DOE. The tone and the meta-message from the DOE, the nuclear industry, is that if you are educated about the risks, then you'll understand that

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[32] 10 CFR 61.44 – Stability of the disposal site after closure. https://www.law.cornell.edu/cfr/text/10/61.44 See § 61.44 Stability of the disposal site after closure. The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required.

[33] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015 This cohort study included 308,297 workers in the nuclear industry.

[34] US EPA 2015 http://www.regulations.gov/#!documentDetail;D=NRC-2015-0057-0436 . For important low-dose radiation epidemiology see also John W. Gofman M.D., Ph.D. book and online summary of low dose human epidemiology in "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis," Committee for Nuclear Responsibility, Inc., 1990, http://www.ratical.org/radiation/CNR/RIC/chp21.txt And see EDI's April 2016 newsletter for Ian Goddard's summary and listing of important human epidemiology concerning low dose radiation exposure.

the risks are low. Yet, these agencies continue to deny the continuing accumulation of compelling and diverse human epidemiological evidence that the harm of ingesting radionuclides is greater than they've been claiming.

The biological harm that ionizing radiation may cause to DNA is mentioned sometimes but it is emphasized that usually the DNA simply are repaired by the body. And the training to radiation workers will mention that fruit flies exposed to radiation passed genetic mutations to their offspring but workers are told that this phenomenon has never been seen in humans even though, sadly, the human evidence of genetic effects has continued to accumulate. Birth defects and children more susceptible to cancer are the result.

Gulf War veterans who inhaled depleted uranium have children with birth defects at much higher-than-normal rate. The same kinds of birth defects also became prevalent in the countries where citizens were exposed to DU. There are accounts to suggest that the actual number of birth defects resulting from the World War II atomic bombs dropped on Japan and by weapons testing over the Marshall Islands have been underreported. The Department of Energy early on made the decision not to track birth defects resulting from its workers or exposed populations. But people living near Hanford and near Oak Ridge know of increased birth defects in those communities.

In radworker training, there may be discussion of the fact that international radiation worker protection recommends only 2 rem per year, not 5 rem per year. There is no mention of recent human epidemiology showing the harm of radiation is higher than previously thought and at low doses, below 400 mrem annually to adult workers, increased cancer risk occurs.

Although not always delineated as "effective" whole-body radiation doses, the dose estimates in millirem (mrem) that are provided in Department of Energy environmental surveillance programs, such as in the annual reports for the Idaho National Laboratory, are given only in "effective" whole-body dose.

It is vital for the public to understand the distortion of "Effective Whole-Body Doses" in millirem, which are the typical focus of disposal facility performance. The Department of Energy did not consider organ doses in the Performance Assessment of long-lived radioactive waste remaining buried at the Idaho National Laboratory and it did not have stated radiation protection limits for the radioactive waste disposal.

The non-physical concept of "effective" whole body doses does not provide meaningful doses for estimating fatal cancer risk because the organ absorbed doses are unstated. In addition, the basis for assigning importance of various organs or tissues to the contribution to cancer mortality is based primarily on the external gamma dose received by survivors of the 1946 atomic bombing of Japan and it tells nothing about the cancer risks when radionuclides are inhaled or ingested and incorporated into the body. Cesium-137 mimics potassium, strontium-90 mimics calcium, plutonium-239 mimics iron, etc.

Even with accounting for the clearance of the radionuclide from the body and accounting for the tendency for the radionuclide to accumulate in certain organs such as the thyroid or in bone tissue — the harm from internal radiation is greater than from external radiation and is not

accounted for by the nuclear industry's International Committee on Radiological Protection (ICRP) models because of their reliance on reviewing the radiation harm from external radiation.

Don't blame the ICRP. They are just nuclear weapons industry-funded folks who don't actually understand human biology. Anyone not sticking to the nuclear industry agenda would be booted out, sooner or later. The ICRP has no responsibilities what-so-ever.

An "effective" dose in rem builds into the rem estimate various multipliers that lower the rem value based on nuclear promotor's opinions of the cancer mortality effect of radiation to various parts of your body. And this is in addition to the multipliers regarding the type of radiation, the *equivalent* dose, that increase the dose from alpha radiation and neutron exposure over that of gamma exposure.

The Department of Energy tries to tell people they really don't need a healthy thyroid because people don't often die of thyroid cancer. Never mind how important a healthy thyroid is to the developing fetus/embryo in utero.

The "effective" rem dose is lowered before the ICRP's low-balled cancer mortality rate is even applied. I say this because in 1990, John W. Gofman's review of the atomic bomb effects on Japanese survivors predicted 0.0026 fatal cancers per rem, [35] which is over 4 times higher than the current Department of Energy fatal cancers per rem value of 0.0006. But even Gofman's prediction would underestimate the cancer risk from internal radiation, such as the iodine-129, strontium-90, cesium-137, americium-241, plutonium-239, and others, which make up most of the radiation dose from INL radiological releases.

Effective whole-body dose in rem (or millirem which is one thousandth of a rem) starts off with an estimate of absorbed dose but then keeps reducing and further reducing the estimated dose on the basis on ICRP opinion of the likelihood of that organ to cause cancer mortality based on external exposure. Then ICRP sums the reduced organ doses, again weights the organs to reduce their importance and thus the black box spits out an "effective" whole body dose.

This method for estimating the effective whole-body dose had actually originally been called **the doubly-weighted organ doses model** or construct, according to a 2017 article by Fisher and Fahey on *Appropriate Use of Effective Dose in Radiation Protection and Risk Assessment*. [36] For additional information about how misleading the "effective dose" is, read *Burdens of Proof* by Tim Connor, Energy Research Foundation, 1997 regarding the multiple failures to attribute Hanford radiological releases to the thyroid cancers in the region.

As far back as 1977, the U.S. Environmental Protection Agency recognized that continued exposure over substantial portions of a lifetime near 100 mrem per year should be avoided, read

[35] John W. Gofman, M.D., Ph.D., Committee for Nuclear Responsibility, Inc., "Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis," 1990. See more in the August 2021 Environmental Defense Institute newsletter.

[36] Darrell R. Fisher and Frederic H. Fahey, *Health Phys*., "Appropriate Use of Effective Dose in Radiation Protection and Risk Assessment," August 2017, PMID: 28658055 and https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5878049/

more in the TENORM report. [37] In 1977, it was assumed by the ICRP that the risk of fatal cancers was 0.0001 per rem (or 1.0E-5 per millisievert in SI units). Various radiation regulations were based on this assumption. It was recognized by 1994 that the fatal cancer risk was higher, at 0.0005 per rem. Even the ICRP currently recognizes that the fatal cancer risk from ionizing radiation is now at least 0.0006 per rem.

The 100 millirem (mrem) per year all pathways radiation dose limit is greatly emphasized by the Department of Energy as the dose they consider allowable. Air permits may be regulated by the U.S. Environmental Protection Agency or by the states, but in either case, the EPA and the state, such as the State of Idaho, will often emphasize that the state cannot regulate Department of Energy radiological emissions. In Idaho, the State of Idaho Department of Environmental Quality will issue an air permit to the Department of Energy based entirely on the DOE's stated radiological release guesses or estimates, the Department of Energy contractors monitoring or lack thereof, and the State will agree to rapid records destruction of radiation monitoring of open-air radioactive waste evaporation ponds that is fully intended to cover up any radiological releases in excess of agreed to quantities.

In the Department of Energy's environmental monitoring reports, it is greatly emphasized that the DOE's derived concentration standards (DCGs) are safe as they imply a dose of 100 mrem per year. By now, you may be starting to understand why 100 mrem per year would actually guarantee a health catastrophe to the health of people, especially children.

Before the late 1990s, radiation risks to females were generally treated as roughly equal to the radiation risks to males. But by the late 1990s, studies of the survivors of the atomic bombing of Japan in 1945 by the International Commission on Radiation Protection (ICRP) had higher radiation risk harm to women than men, for the same dose. And the studies showed higher cancer risk to children, especially female children, than to adults for the same dose. The National Research Council BEIR VII report issued in 2006 found even higher risks to women and children. See Institute for Energy and Environmental Research (IEER.org) report, *Science for the Vulnerable*, for additional insight. [38] (Read more in the August 2020 Environmental Defense Newsletter at Environmental-Defense-Institute.org)

The Department of Energy's derived concentration standard (DCG) from gross alpha radioactivity in air for a 100 mrem per year dose are getting closer to the DCG for gross alpha radioactivity in air and are actually being exceeded from time to time in southeast Idaho. The most restrictive DCG is for americium-241 at 20 E-15 microcuries per milliliter (E-15 uCi/mL). With gross alpha radioactivity air usually below 4 E-15 uCi/mL, it is notable that values such as

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[37] National Research Council, Committee on Evaluation of EPA Guidelines for Exposure to Naturally Occurring Radioactive Materials. Evaluation of Guidelines to Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials. Washington DC, National Academies Press, 1999. See page 108. https://www.nap.edu/catalog/6360/evaluation-of-guidelines-for-exposures-to-technologically-enhanced-naturally-occurring-radioactive-materials and chapters at https://www.nap.edu/catalog/6360/evaluation-of-guidelines-for-exposures-to-technologically-enhanced-naturally-occurring-radioactive-materials#toc

[38] Arjun Makhijani, Ph.D., Brice Smith, Ph.D., Michael C. Thorne, Ph.D., Institute for Energy and Environmental Research, *Science for the Vulnerable Setting Radiation and Multiple Exposure Environmental Health Standards to Protect Those Most at Risk*, October 19, 2006.

7.2 E-15 uCi/mL occur (see Blackfoot monitoring in 2012). The increasing gross alpha radioactivity in air values are within a factor of three or four of the DCG.

There are large fluctuations in the concentrations of gross beta radioactivity in air in southeast Idaho and these fluctuations appear to be due to the INL's airborne radiological releases, despite statements to the contrary by the Department of Energy's environmental surveillance contractor. In 1998, the gross beta radioactivity in air concentrations ranged from 8 to 38 E-15 uCi/mL. In contrast, in 2002, gross beta concentrations ranged from 8 to 129.4 E-15 uCi/mL. The Department of Energy's environmental surveillance contractor continues to assert that no detected radioactivity could be attributed to the INL, stating: "In general, gross alpha and gross beta activities show levels and seasonal variations not attributable to INEEL releases. Seven of the weekly gross beta results showed statistical differences between boundary and distant locations. In all cases the differences were attributed to natural variation or to inversion conditions." And as typical of every INL annual environmental surveillance report no matter what they detect in their monitoring, they state: "In summary, the results of the monitoring programs for 2002 presented in this report indicate that radioactivity from current INEEL operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding the INEEL."

The escalating levels of radioactivity in southeast Idaho are addressed by DOE's environmental surveillance program by torturing until submission any "outliers" and using radioactive blanks in order to achieve large negative values to reduce the annual averages.

With intermittent releases puffed out by INL nuclear facilities and evaporation ponds, why would anyone be surprised that the values fluctuated? But the DOE's environmental surveillance program is continually surprised by fluctuating values and it actively seeks to discard the "aberrant" samples showing high concentrations of radioactivity.

The Department of Energy embraces only the effective whole-body dose while ignoring the far higher organ doses, such as the absorbed dose to the thyroid from of iodine-131, iodine-129, americium-241 and other radionuclides.

The internal radiation cancer harm is not based on solid epidemiological evidence and there are experts from Karl Z. Morgan to Chris Busby to Jack Valentin that understand that the accepted models may understate the cancer harm by a factor of 10, 100 or more. The nuclear industry continues to ignore the epidemiological evidence that implies tighter restrictions are needed. **Jack Valentin, former chair of the International Commission on Radiological Protection (ICRP) has admitted, before resigning from the ICRP, that the ICRP's radiation model underpredicts the harm of internal radiation by over a factor 100.**

The DOE' Draft WIR Evaluation must explain why DOE continues to base its regulations and decisions on the ICRP recommendations and why it considers the very inadequate ICRP models to be acceptable for the protection of human health.

DOE WRONG TO USE ICRP'S TREATMENT OF HERITABLE DISEASE

While the International Commission of Radiological Protection (ICRP) continues to say that "Radiation induced heritable disease has not been demonstrated in human populations," Chis Busby writes that evidence of genetic effects *has* been found in humans and at very low radiation doses. [39] [40]

Robin Whyte wrote in the *British Medical Journal* in 1992 about the effect in neonatal (1 month) mortality and stillbirths in the United States and also in the United Kingdom. The rise in strontium-90 from nuclear weapons testing from 1950 to 1964 has been closely correlated, geographically, with excess fetal and infant deaths. The doses from strontium-90 due to atmospheric nuclear weapons testing were less than 50 millirem (or 0.5 millisievert), according the Chris Busby. Radioactive fallout from atmospheric nuclear weapons testing would not only include strontium-90, it would include iodine-131, tritium, cesium-137, and other radionuclides, including plutonium. [41] The extent of the nuclear weapons testing immorality continues to astound me and I applaud the work being done to reduce the risk of human extinction from nuclear weapons. [42]

The ICRP maintains that human evidence of genetic effects due to radiation does not exist. The ICRP then uses the study of external radiation on mice to estimate the heritable risks for humans. One study was conducted using internal radionuclides on mice and the study noted that "detailed research on internal radiation exposure has hardly ever been reported in the past." [43] **This limited study of microcephaly in mice found that far lower doses of <u>internal radiation</u> caused the same effect as higher doses of <u>external radiation</u>.**

It has been known now for a few decades that radiation exposure to the developing embryo and fetus "can cause growth retardation; embryonic, neonatal, or fetal death; congenital malformations; and functional impairment such as mental retardation." [44]

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[39] Chris Busby, *The Ecologist*, "It's not just cancer! Radiation, genomic instability and heritable genetic damage," March 17, 2016. https://theecologist.org/2016/mar/17/its-not-just-cancer-radiation-genomic-instability-and-heritable-genetic-damage

[40] Chris Busby, Scientific Secretary, European Committee on Radiation Risk, Presentation, *Radioactive discharges from the proposed Forsmark nuclear waste disposal project in Sweden and European Law*, September 8, 2017. Online pdf 646_Nacka_TR_M1333-11_Aktbil_646_Christopher_Busby_presentation_170908

[41] R. K. Whyte, *British Medical Journal*, "First day neonatal mortality since 1935: re-examination of the Cross hypothesis," Volume 304, February 8, 1992. https://www.bmj.com/content/bmj/304/6823/343.full.pdf

[42] Jackie Abramian, ForbesWomen, "After Her Nuclear Disaster Dress Rehearsal, Cynthia Lazaroff Has A Wake-Up Call For Our World As We Sleepwalk Into Nuclear Extinction," September 21, 2021. https://www.forbes.com/sites/jackieabramian/2021/09/21/after-her-own-nuclear-disaster-dress-rehearsal-cynthia-lazaroff-has-a-wake-up-call-as-our-world-sleepwalks-into-nuclear-extinction/?sh=6a22151d62e2 Lazaroff has founded NuclearWakeupCall.Earth due to her concern over nuclear weapons. "There are nearly 13,500 nuclear warheads in current arsenals of nine nuclear-armed states. That the U.S. has more nuclear warheads than hospitals should be a wake-up call," says Lazaroff.

[43] Yukihisa Miyachi, J-STAGE, "Microcephaly Due to Low-dose Intrauterine Radiation Exposure Caused by 33P Beta Administration to Pregnant Mice," 2019 Volume 68 Issue 3 Pages 105-113. https://www.jstage.jst.go.jp/article/radioisotopes/68/3/68_680303/_article/-char/en

[44] Eric J. Hall, *Radiobiology for the Radiologist*, 5th ed., 2000, p. 190.

In 2007, the International Commission of Radiological Protection (ICRP) lowered its estimate of the risk of genetic harm of congenital malformations by 6-fold, from 1.3E-4/rem to 0.2E-4/rem. Based on the belief that the study of the Japanese bomb survivors did not detect genetic effects, **the ICRP genetic effect estimate for humans is based on studies of external radiation of mice.**

The ICRP estimate of risk of congenital malformations is a fraction of its predicted cancer risk for cancer mortality (or latent cancer fatality). The ICRP latent cancer fatality risk was 5.0E-4 LCF/rem (1991 estimate), close to the cancer mortality rate used in the Department of Energy's Versatile Test Reactor EIS of 6.0E-4 LCF/rem. [45]

While the studies of genetic injury to the Japan bombing survivors declared that they found no evidence of genetic damage, other researchers have found those studies to have been highly flawed. A report published in 2016 by Schmitz-Feuerhake, Busby and Pfugbeil summarizes numerous human epidemiology studies of congenital malformations due to radiation exposure. [46]

The 2016 report disputes the ICRP genetic risk estimate and finds that diverse human epidemiological evidence supports a far higher genetic risk for congenital malformations. **Nearly all types of hereditary defects were found at doses as low as 100 mrem.** The pregnancies are less viable at higher doses and so the rate of birth defects appears to stay steady or falls off at doses above 1000 mrem or 1 rem. The 2016 report found the excess relative risk for congenital malformations of 0.5 per 100 mrem at 100 mrem falling to 0.1 per 100 mrem at 1000 mrem.

The 2016 report's result for excess relative risk of congenital malformations of 5.0/rem is 250,000-fold higher than the ICRP estimate of 0.2E-4/rem which ICRP appears to assume has a linear dose response. (See the August 2021 Environmental Defense Institute newsletter.)

The bottom line is that the nuclear industry and especially the Department of Energy is grossly underestimating the fatal cancer risk of their radiological releases, and ignoring serious adverse health effects such as cancer incidence, heart disease, reduced immune system function, fertility problems, decreased life span, as well as increased rates of infant death and birth defects And they are also grossly underestimating the risk of genetic effects of ionizing radiation exposure prior to conception that are passed on to their children and grandchildren, by relying on ICRP's industry-biased recommendations.

The Draft WIR Evaluation must explain why primarily cancer fatality is the focus of its radiation protections standards and why many of the know health problems from radionuclide exposure, ingestion and inhalation have been ignored.

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[45] U.S. Department of Energy's Versatile Test Reactor Draft Environmental Impact Statement (VTR EIS) (DOE/EIS-0542) (Announced December 21, 2020). A copy of the Draft VTR EIS can be downloaded at https://www.energy.gov/nepa or https://www.energy.gov/ne/nuclear-reactor-technologies/versatile-test-reactor. (See discussion in VTR EIS Appendix C, page C-4).

[46] Inge Schmitz-Feurerhake, Christopher Busby, and Sebastian Pflugbeil, *Environmental Health and Toxicology, Genetic radiation risks: a neglected topic in the low dose debate*, January 20, 2016. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4870760/ The 2016 report found the "excess relative risk for congenital malformations of 0.5 per mSv at 1 mSv falling to 0.1 per mSv at 10 mSv exposure and thereafter remaining roughly constant."

DOE'S DOSE LIMITS ARE NOT PROTECTIVE OF RADIATION WORKERS OR THE PUBLIC

DOE's dose limits are not protective of radiation workers (5,000 millirem per year) or the public (100 millirem per year).

Epidemiology of thousands of radiation workers found elevated cancer risk occurring at an average 200 mrem/yr. [47] An INL-specific study found radiation and nonradiation workers at the site had higher risk of certain cancers. [48] The US Nuclear Regulatory Commission and the Department of Energy maintain that their 5 rem/yr worker exposure limit is protective despite compelling scientific evidence to the contrary. [49]

At the Department of Energy's Hanford high-level waste tanks, decades of harmful and largely inadequately monitored chemical vapor releases have harmed many workers. [50]

The NRC cancelled funding of what would have been the first meaningful epidemiology study of health near US nuclear facilities. They claimed it would cost too much (at $8 million) and take too long. [51]

The US NRC prefers reliance on the 1980s epidemiology study that mixed children and adults and populations near and far from nuclear plants and predictably found no harm. [52] The NRC

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[47] Richardson, David B., et al., "Risk of cancer from occupational exposure to ionizing radiation: retrospective cohort study of workers in France, the United Kingdom, and the United States (INWORKS), BMJ, v. 351 (October 15, 2015), at http://www.bmj.com/content/351/bmj.h5359 Richardson et al 2015] (And please note that studies of high leukemia risk in radiation workers and of ongoing studies to assess health effects of high and low-linear energy transfer internal radiation must also be studied in addition to this one on external radiation.)

[48] "An Epidemiology Study of Mortality and Radiation-Related Risk of Cancer Among Workers at the Idaho National Engineering and Environmental Laboratory, a U.S. Department of Energy Facility, January 2005. http://www.cdc.gov/niosh/docs/2005-131/pdfs/2005-131.pdf and http://www.cdc.gov/niosh/oerp/ineel.htm and Savannah River Site Mortality Study, 2007. http: /www.cdc.gov/niosh/oerp/savannah-mortality/

[49] "Health Risks from Exposure to Low Levels of Ionizing Radiation BEIR VII – Phase 2, The National Academies Press, 2006, http://www.nap.edu/catalog.php?record_id=11340 The BEIR VII report reaffirmed the conclusion of the prior report that every exposure to radiation produces a corresponding increase in cancer risk. The BEIR VII report found increased sensitivity to radiation in children and women. Cancer risk incidence figures for solid tumors for women are about double those for men. And the same radiation in the first year of life for boys produces three to four times the cancer risk as exposure between the ages of 20 and 50. Female infants have almost double the risk as male infants.

[50] Hanford Tank Vapor Assessment Report, SRNL-RP-2014-00791, October 30, 2014 at http://srnl.doe.gov/documents/Hanford_TVAT_Report_2014-10-30-FINAL.pdf

[51] NRC (Nuclear Regulatory Commission) 2010. NRC Asks National Academy of Sciences to Study Cancer Risk in Populations Living near Nuclear Power Facilities. NRC News No. 10-060, 7 April 2010. Washington, DC: NRC. The framework for the study was reported in "Analysis of Cancer Risks in Populations Near Nuclear Facilities; Phase I (2012). See cancer risk study at nap.edu.

[52] NCI (National Cancer Institute) 1990. Cancer in Populations Living near Nuclear Facilities. 017-042-00276-1. Washington, DC: Superintendent of Documents, U.S. Government Printing Office.

actively ignores the irrefutable studies from Germany that found increased cancer and leukemia rates of children living near each of the plants. [53] [54] [55]

The U.S. NRC knows that if people knew the harm of living near nuclear power plants, just from routine radiological emissions, it would be the end of nuclear energy.

The Draft WIR Evaluation must explain why the DOE continues to claim that 5,000 millirem per year doses to the radiation workers and 100 millirem per year to the public is protective.

DOE'S DRAFT WIR EVALUATION IMPLIES DOE WILL COMPLY WITH DEPARTMENT OF ENERGY REGULATIONS BUT IGNORES DOE'S LACK OF COMPLIANCE

From the DOE's nuclear weapons testing at the Nevada Testing Station, in the Pacific islands, and elsewhere, the DOE told people they were safe and then covered up epidemiology that showed people had increased rates of leukemia and cancer from the fallout. The DOE claimed its releases from the INL were too low to cause harm, but when asked to state what it had released to the Idaho skies, the DOE didn't know. Then when the DOE issued a report of estimated releases through its history to 1989, reviews by the Center for Disease Control found the releases had been significantly underestimated. It is also documented that many environmental monitoring records were subsequently destroyed, which would have indicated more contamination that the DOE wanted others to know about. The DOE has lost or destroyed worker radiation dose records throughout its history when the records would show elevated doses. The DOE uses secrecy, document destruction, omission of key information during public presentations, and adherence to providing false information about its plans, and breaks its commitments. The DOE would not have conducted any cleanup at all if other federal agencies had not been able to say that hazardous chemical laws needed to apply to DOE sites, allowing CERCLA cleanup investigations. The DOE has systematically lied about the pervasive long-lived radionuclides at sites likes the INL, omitting what it well knew, that uranium, plutonium and americium were included in soil and perched water. It omitted this information so well that the DOE and the U.S. Geological Survey have often, without justification, omitted the reporting of extensive radiological contamination at the INL, later found by CERCLA investigations.

DOE lied about its radiological releases decades ago from nuclear weapons testing, reactor testing, and reactor accidents and other operations and it continues to misinform the public about its past and about current contamination.

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[53] Kaatsch P, Kaletsch U, Meinert R, Michaelis J.. 1998. An extended study of childhood malignancies in the vicinity of German nuclear power plants. Cancer Causes Control 9(5):529–533.

[54] The study is known by its German acronym KiKK (Kinderkrebs in der Umgebung von Kernkraftwerken): Kaatsch P, Spix C, Schmiedel S, Schulze-Rath R, Mergenthaler A, Blettner M 2008b. Vorhaben StSch 4334: Epidemiologische Studie zu Kinderkrebs in der Umgebung von Kernkraftwerken (KiKK-Studie), Teil 2 (Fall-Kontroll-Studie mit Befragung). Salzgitter: Bundesamt für Strahlenschutz.

[55] Kaatsch P, Spix C, Schulze-Rath R, Schmiedel S, Blettner M., 2008. Leukemia in young children living in the vicinity of German nuclear power plants. Int J Cancer 122(4):721–726.

The Department of Energy has a long history of telling workers they are protected from radiological hazards — but workers got illnesses. Nationwide, billions of dollars of illness compensation have been paid out under the Energy Employee Illness Compensation Program Act (EEICOPA) even with two-thirds of INL claims denied.

The Department of Energy has a long history of saying its radiological releases were too small to affect the public — but studies found that the public had higher infant mortality and certain cancers and leukemia.

The Department of Energy has rightfully earned and continues to earn the public's distrust. The Department of Energy must not be allowed to unilaterally reclassify HLW waste because the DOE cannot be trusted to comply with its own regulations should its regulations or DOE Orders be deemed inconvenient or costly.

The Idaho National Laboratory along with other Department of Energy operations at Hanford and Rocky Flats have a long tradition of falsification of lung count results. The last situation requiring lung counts, reported that lung counts were not required, despite lung counts being required. Workers are not informed that their lung count results can be manipulated in order to obtain lowered intake results. I have personally seen irrefutable evidence of fraudulent lung count report manipulations by the Idaho National Laboratory.

The Draft WIR Evaluation must explain why the public or the courts should expect the Department of Energy to be compliant or protective of human health and the environment given the DOE's track record.

THE DRAFT WIR EVALUATION FAILS TO ACKNOWLEDGE THAT THE DOE HAS A RECORD OF NOT DISCLOSING SAFETY PROBLEMS PUBLICLY OR ACCURATELY

The Department of Energy routinely makes its unusual occurrence reports and other safety information impossible or difficult for the public to obtain. If reported, the public can expect months of delay before information is available publicly. The Draft WIR Evaluation must explain why DOE makes its documents difficult or impossible to obtain.

The DOE has also conducted numerous public comment opportunities, only to refuse to publish those public comments such as the consent-based interim spent nuclear fuel storage meetings conducted a few years ago. [56] [57]

The pervasive lack of candid, complete information coupled the Department of Energy's utter lack of regard for human health and the environment make it necessary for higher federal laws and the oversight of independent agencies to oversee radioactive material management and

[56] Before ending the consent-based siting effort, information found about the Department of Energy's consent-based siting at www.energy.gov/consentbasedsiting and its Integrated Waste Management and Consent-based Siting booklet at http://energy.gov/ne/downloads/integrated-waste-management-and-consent-based-siting-booklet

[57] Environmental Defense Institute's comment submittal on the Consent-based Approach for Siting Storage for the nation's Nuclear Waste, July 31, 2016. http://www.environmental-defense-institute.org/publications/EDIXConsentFinal.pdf

disposal. That is another compelling reason that the DOE's Draft WIR Evaluation must be rejected.

The author, Tami Thatcher, has a degree in Mechanical Engineering from the University of Idaho and worked as an Advisory Engineer for the Idaho National Laboratory, specializing in nuclear reactor risk assessment and nuclear facility safety analyses and also maintained radiation worker certification. She has been studying and writing about issues related to the Idaho National Laboratory's extensive radiological contamination of southeast Idaho since 2007, including issues relating to environmental monitoring, aquifer contamination, CERCLA cleanup, nuclear facility safety, radiation worker protection, and radiation health issues.