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DOE announces "New" Interpretation of its Radioactive High-Level Waste

On June 5, 2019, the U.S. Department of Energy, announced the **"new"** interpretation of its radioactive High-Level Waste that it has decided to grant itself.

After more than five decades of **mismanagement** of its many radioactive waste streams, the Department of Energy will decide when its High-Level Radioactive waste would be declared to be, almost as if by magic, Low-Level waste, on the basis of cost or any other criteria of its choosing. [1] [2] [3]

The reality is that allowing the DOE to reclassify its HLW to "non-HLW" will mean that vast amounts of the DOE's HLW becomes low-level waste (LLW). What this means is that the DOE has far fewer regulatory requirements about how it chooses to dispose of the LLW on its DOE sites.

The DOE can and will bury this reclassified "low-level waste" shallowly on DOE sites, arguing that the risk the human health and the environment is acceptable, based on its decision that the risk is acceptable because of the desire to save money based on biased and unrealistic "performance assessments."

The "performance assessments" estimate the rate at which radionuclides will leach out of the waste burial site into groundwater, soil and air. But there is no requirement that the performance assessments be accurate or actually protective of human health and the environment. There is no requirement for the DOE to heed bad news indicated from any risk or performance assessment. While conducting a performance assessment can be useful for comparing options for radioactive waste disposal, the state-of-the-art performance assessments can't predict waste migration performance over a few decades, let alone over the hundreds of thousands of years that the radioactive waste needs to be isolated.

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[1] U.S. Department of Energy, "Department of Energy Publishes Interpretation on High-level Radioactive Waste," June 5, 2019. https://www.energy.gov/articles/department-energy-publishes-interpretation-high-level-radioactive-waste

[2] U.S. Department of Energy, "DOE's New Interpretation of High Level Waste," and Fact Sheets at https://www.energy.gov/em/program-scope/high-level-radioactive-waste-hlw-interpretation

[3] Audrey McNamara, Reporter, *Daily Beast*, "Energy Department Plans to Reclassify High-Level Toxic Waste as Low-Level, Angering Environmental Advocates," June 5, 2019. https://www.thedailybeast.com/energy-department-plans-to-reclassify-high-level-toxic-waste-as-low-level-angering-environmental-advocates

The DOE's performance assessments tend to include various assumptions **that bias the resulting performance of the waste disposal site toward the appearance of low groundwater contamination** as the radionuclides are modeled as slowly trickling out from shallow burial sites. The DOE's performance assessments tend to underestimate precipitation and may leave out flooding considerations altogether.

Performance assessments are complex and the complexity fools many people into placing unwarranted confidence in the results. The reality is that the rate at which radionuclides leach out into groundwater is going to be variable and groundwater will be unsafe to drink, perhaps for many years on end. In the context of drinking radioactively contaminated water, it means illness, shortened life spans, and increased birth defects — things the DOE rarely mentions.

The reality of this "risk informed" exercise is analogous to "tobacco science" — a tortured, biased propaganda exercise — not a balanced analysis to understand the realities and uncertainties of the risk to human health and the environment posed by shallow burial of vast amounts of long-lived radionuclides at DOE sites over geologic time frames, over one million years.

In a statement by Geoff Fettus, a senior attorney at the Natural Resources Defense Council: [4]

> "The Trump administration is moving to fundamentally alter more than 50 years of national consensus on how the most toxic and radioactive waste in the world is managed and ultimately disposed of. No matter what they call it, this waste needs a permanent, well-protected disposal option to guard it for generations to come."

In a letter earlier this year from the Idaho Department of Environmental Quality to the U.S. Department of Energy regarding the DOE's interpretation of High-Level waste, [5] the Idaho DEQ stated numerous concerns.

"Idaho is concerned about DOE's proposal for several reasons. First, it appears that DOE has not yet complied with Section 3139 of the National Defense Authorization Act for Fiscal Year 2018 (H.R. 2810), which required DOE to prepare and submit a report to Congress, not later than February 1, 2018, on the 'Evaluation of Classification of Certain Defense Nuclear Waste.' This report is required to include multiple specific evaluations, as listed under subsection b, which directly impact several State of Idaho concerns below. In the absence of this information the State cannot fully evaluate the ramifications of this proposal. Moreover, it seems premature for DOE to move forward with this proposal when it has not met the Congressional directive."

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[4] Natural Resources Defense Council, "Energy Department Moves to Abandon Radioactive Waste," June 5, 2019. https://www.nrdc.org/media/2019/190605-3

[5] John H. Tippets, Director, Idaho Department of Environmental Quality, Letter to Anne White, Assistant Secretary, Office of Environmental Management, U.S. Department of Energy, Subject: State of Idaho Comments on U.S. Department of Energy Interpretation of High Level Radioactive Waste (83 FR 50909), January 9, 2019. See it on our website at http://www.environmental-defense-institute.org/publications/IDEQHLW.pdf

The IDEQ letter continues "Next, it should be noted this approach to reclassification of HLW under the authority of Order 435.1 has already been attempted and proven unsuccessful. See, *Natural Resources Defense Council v. Abraham*, 271 F.Supp.2d 1260 (D. Idaho 2003) *vacated on other grounds*, 388 F.3d.701 (2004). The Court in *Abraham* held that the definition of HLW was established by Congress and that DOE could not, via order, ignore the plain language of the Nuclear Waste Policy Act. Idaho, along with several other States, participated as *Amici* in that case due in part to the same concerns expressed below. Idaho encourages DOE to work with states and affected parties collaboratively to resolve these concerns."

"Similar to the past approach, the current proposal outlined in the Federal Register appears to imply unilateral authority on the part of the DOE to determine what wastes are to be considered as HLW and non-HLW, irrespective of the position held by the states which host the affected waste streams. As the Court in *Abraham* put it succinctly, 'These "alternative requirements" are not defined, and thus are subject to the whim of DOE.' 217 F.Supp.2d at 1265. The current proposal's reference to '*performance objectives of a disposal facility as demonstrated through a performance assessment conducted in accordance with applicable regulatory requirements*' is equally vague and leaves too much discretionary power to the DOE to leave waste in place. This does not align with Idaho's position with respect to the requirements for treatment and disposition of certain waste streams currently located at the Idaho National Laboratory (INL). More specifically, Idaho will point out that DOE cannot 'reclassify' wastes that are defined in the 1995 Settlement Agreement and were the subject of that Agreement. **This vagueness and the inherent risks it poses generate a significant, and unacceptable, level of uncertainty for the State." [emphasis added]**

"DOE has also not provided sufficient detailed information concerning the process by which each individual waste stream will be evaluated for categorization as HLW and non-HLW. The State of Idaho is concerned regarding the lack of objective criteria for making waste determinations and, again, is concerned that DOE will make such determinations unilaterally. Additional, documentation of technical requirements governing the conduct of performance assessments necessary to adequately characterize affected waste streams to ensure the protection of human health and the environment is also lacking at this time."

"Based on the items identified herein, the State of Idaho is unable to fully evaluate the proposal outlined in the Federal Register."

"Prior to a decision to move forward with the proposed interpretation of the existing HLW definition, the State formally requests that DOE provide the information described above, followed by collaborative dialogue to address all State of Idaho concerns."

To find out more about what's at stake, read articles on the EDI website and see High Level Waste comment submittals by Tami Thatcher and by Chuck Broscious on the Environmental Defense Institute website. [6] [7]

My Public Comment to the DNFSB Concerning the Four Transuranic Waste Drums that Exploded in April 2018 in Idaho

The June 20, 2019 Public Hearing on Safety Management of Waste Storage and Processing in the Defense Nuclear Facilities Complex, [8] held over a year after four waste drums exploded at the Idaho National Laboratory has given the Department of Energy (DOE) time to respond the event. Yet, the DOE has not adequately responded to the multiple deficiencies identified by the event. Importantly, I want to point out that, so far, not enough emphasis has been given to the blatant way that DOE was ignoring regulations and laws that allowed the four drums to explode in April 2018.

After the four drums exploded in April 2018, we learned that the issue wasn't *just* the understating of the likelihood and consequence of transuranic waste accidents with indefensible assumptions. Here in Idaho, last fall we learned from Department of Energy cleanup contractor Fluor Idaho's report [9] on the causes of the explosion of the four waste drums that the DOE had **not conducted the required nuclear safety analysis**, required by 10 CFR 830 nor had it conducted the required chemical compatibility analysis. This affected multiple facilities and multiple hazardous waste RCRA permits granted by the Idaho Department of Environmental Quality, not just the "sludge repackaging" facility where the four drums exploded.

The DOE has yet to address the gas buildup issues in its waste drums, not even when the Defense Nuclear Facilities Safety Board (DNFSB) pointed out remaining deficiencies last December after the event, [10] Defense Nuclear Facilities Safety Board Staff Report – Idaho Waste Drums with Elevated Methane Concentrations, December 10, 2018. The DOE has yet to adequately respond to the safety analysis deficiencies identified by the DNFSB prior to the four

[6] Environmental Defense Institute newsletter articles: If You Care About Human Health and the Environment, You Will Oppose Allowing DOE's HLW Reclassification, http://www.environmental-defense-institute.org/publications/News.19.Jan.pdf and Idaho Leaders and the Department of Energy Not Being Transparent About High-Level Waste Reclassification, Idaho Department of Environmental Quality Concerns About DOE's Proposed HLW Reclassification, and State of Washington Opposes DOE's Proposed HLW Reclassification, http://environmental-defense-institute.org/publications/News.19.Feb.pdf

[7] High-level Waste Reclassification comment submittals at http://www.environmental-defense-institute.org/index.html (http://www.environmental-defense-institute.org/publications/CommentDOEHLW.pdf and http://www.environmental-defense-institute.org/publications/EDIComHLW6.pdf)

[8] Defense Nuclear Facilities Safety Board public hearing and related documents at https://www.dnfsb.gov/public-hearings-meetings/public-hearing-safety-management-waste-storage-and-processing-defense

[9] Idaho Cleanup Project Core, "Formal Cause Analysis for the ARP V (WFM-1617) Drum Event at the RWMC," October 2018. https://fluor-idaho.com/Portals/0/Documents/04_%20Community/8283498_RPT-1659.pdf

[10] Defense Nuclear Facilities Safety Board Technical Report, Deficiencies in DOE Standards 5506-2007, Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities," DNFSB/TECH-43, February 2018.

drums exploding, see Deficiencies in DOE Standard 5506, Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities. [11]

The DNFSB has described some of the deficiencies that understate the transuranic waste accident severity – how the likelihood and/or the consequence of an accident involving transuranic waste is often understated in regard to DOE Standard 5506. But the DOE has long held a preference for using assumptions, even technically indefensible assumptions, that reduce the stated accident likelihood and/or consequences in order to avoid the expense or inconvenience of proper hazard mitigations. But, here again, regarding the four drums that exploded in Idaho, the DOE had not even conducted a safety analysis for the waste stream that exploded.

As we learned from the investigation of the single drum release at the Waste Isolation Pilot Plant (WIPP) accident in 2014, there were many essential DOE programs not functioning at WIPP. The extent that this is also true at the Idaho Cleanup Project where the four drums exploded is less widely known.

At the 2014 WIPP event and the April 2018 Idaho event, it was only due to good luck and not DOE safety programs that workers were not in the normally occupied facilities when the radiological release events occurred.

While the drum release at WIPP involved the addition of prohibited material being mixed in with a waste drum, the mixing of organic "kitty litter" with nitrate-laden waste despite being prohibited, the problem of waste characterization and preventing incompatible mixtures is more complicated in the April 2018 Idaho event.

After the four drums exploded in April 2018, the DOE gave many excuses for the explosion that pertained to the difficulty – even the inability – to understand what constituents were in the waste that had been exhumed from burial decades ago and from multiple waste generators. The DOE seemed gave the impression of not understanding its required role in adequately characterizing the waste so that it could be safety stored, processed and transported. **The DOE Idaho Operations Office had decided it was acceptable for a broad waste category that contained any of dozens of constituents, SD-176, to be treated without the required safety analysis and without even the simplistic chemical compatibility analysis required by state and federal RCRA laws.**

The problem of the DOE creating a category of waste that was a large collection of various chemicals and metals from multiple waste generators and various waste generating processes, a "catch-all" category including various hydrocarbons, halogens, and metals, and DOE's weaknesses in characterizing the contents of individual drums basically precluded proper understanding of fire and explosive hazards and the needed fire suppression systems and

[11] Defense Nuclear Facilities Safety Board, Letter to Secretary of Energy, March 12, 2019 with attached staff report "Idaho Waste Drums with Elevated Methane Concentrations," dated December 10, 2018 See dnfsb.org or https://ehss.energy.gov/deprep/2019/FB19M12A.PDF

emergency responses. This is true for waste repackaging and also for drum storage and transportation. The problem also is relevant to buried waste exhumation.

The chemical compatibility analysis required by state and federal hazardous waste laws is simplistic and assumes the material is at ambient temperature. This simplistic chemical compatibility analysis was not even conducted by the DOE. Secondary reactions after heating up the material would not necessarily have been predicted, not even by related chemical compatibility analysis for transuranic waste. The effect of radiolysis during decades of waste storage would not have been factored in and can allow chemical reactions at lower temperatures. Other changes of drum contents over time such as the buildup of uranium hydrides does not appear to have been considered. The inadequacy of chemical compatibility analysis is not only the failure to conduct a chemical compatibility analysis but also the technical deficiencies of currently accepted simplistic approaches. The problem may be exacerbated by the regulatory divisions between hazardous waste constituents regulated by the state and federal laws and the radiological constituents considered to be under DOE regulation.

In May, DOE submitted for state approval a hazardous waste permit modification for the Advanced Mixed Waste Treatment Project to prohibit the use of automatic fire suppression when exceeding specific quantities of unroasted uranium. In addition, a fire suppressant was proposed for pyrophoric uranium-laden wastes, without providing a chemical compatibility analysis for the fire suppressant for a waste stream of potentially dozens of chemical constituents that may include materials such as halogens and hydrocarbons. The permit modification was subsequently retracted for unstated reasons.

Importantly, the various definitions of pyrophoric material or absence of a definition, made the prohibiting of processing pyrophoric material at the Idaho Cleanup Project ineffective and had the result of creating potentially inadequate fire protection response to metal fires.

The DNFSB has not emphasized the serious and continuing problem of inadequate waste stream and waste drum content characterization and the detrimental effect of that on adequate safety analysis.

The explosion hazard whether described as overpressurization, explosion, or deflagration from gas buildup in drums, can cause the unplanned expulsion of toxic radiological waste drum contents. The DOE continues to put workers and the environment at excessive risk of harm. **The DOE continues to rely on technically inadequate assumptions and mitigations. And the DOE continues to ignore its own regulations and state and federal laws.**

How does one have adequate worker protection and emergency response to explosive hazards when denying the hazards exist? How can proper fire barriers be put in place when the hazards are not characterized? How can fire responders understand the limitations of their fire suppressants if they don't know what materials are involved? How can proper fire suppressants be provided for automatic or manual use if the materials involved are not known? Is DOE planning to conduct a chemical compatibility analysis after the fire starts?

The DOE still has not resolved the inadequate waste characterization issues, the chemical incompatibility issues, the fire, explosion, and excessive gas buildup issues for its TRU waste despite the April 2018 four drums that exploded and nearly had breached the facility.

Along with failure of the DOE to conduct needed safety analysis required by 10 CFR 830, it appears that DOE is still failing to implement an adequate Unreviewed Safety Question process for the Idaho Site and the DOE Complex.

The DNFSB's staff report, Idaho Waste Drums with Elevated Methane Concentrations, [12] points out that even months after the drums exploded, the DOE Idaho Operations Office (DOE-ID) still lacks effective controls to prevent or mitigate deflagrations in drums of repackaged waste. It does not appear that DOE-ID or Fluor Idaho, LLC have responded to the DNFSB report on the drum gas buildup problems remaining to be solved. The DNFSB stated that **"DOE-ID lacks effective controls to prevent or mitigate deflagrations in drums of repackaged waste." The report details why the Department of Energy's response to understanding how to prevent future transuranic waste drum explosions remains inadequate, and why the new mitigations put in place are inadequate.** The DNFSB found that Fluor Idaho's limited mitigations, which included the use of thermal monitoring during and immediately following repackaging and a 24 hour hold time after sorting the waste prior to repackaging, do not provide adequate hazard protection.

The DOE has not put in place technically defensible strategies even now, for drum repackaging. The DOE has not put in place technical defensible strategies for waste storage or handling either.

These excessive gas build up issues and chemical incompatibility issues are not limited to the sludge repackaging facility, the ARP V, where the four drums exploded – the issues pertain to all locations where such ill-defined "catch-all" categories of waste streams, such as the SD-176 waste stream, reside, including the AMWTP.

The waste involved in the April 2018 event was also being treated without identifying any specific waste acceptance criteria. The state of New Mexico should be concerned that waste was being prepared for shipment to New Mexico's WIPP facility [Waste Isolation Pilot Plant] without approved characterization activities to support an approved WIPP Waste Acceptance Criteria.

The DOE's willful decision to violate its own regulations and state regulations, which led to the four drums that exploded in 2018, came close to causing many lives being lost or vastly shortened. DOE chose to not conduct required chemical compatibility analysis and chose not to conduct required nuclear safety analysis – all to avoid the cost and inconvenience of conducting adequate studies, and the cost and schedule delays of putting proper mitigations in place.

[12] Defense Nuclear Facilities Safety Board, Letter to Secretary of Energy, March 12, 2019 with attached staff report "Idaho Waste Drums with Elevated Methane Concentrations," dated December 10, 2018 See dnfsb.org or https://ehss.energy.gov/deprep/2019/FB19M12A.PDF

The DOE is addressing its accidental environmental releases from the four drums that exploded or other accidental or intentional releases by denying or simply not disclosing the releases. This includes the Idaho National Laboratory's long-standing practice of flushing radioactively-laden resin beads to an open-air pond. [13] Refusing to estimate its releases is another way of underestimating annual radiological airborne releases under state and federal air permitting requirements. The release of long-lived radionuclides to the environment is continuing unabated.

Finally, the DNFSB has acknowledges that it has a role in addressing worker safety. The DOE is addressing worker radiological intakes by aggressively, at times indefensibly, underestimating the intakes, which may deny workers access to state Worker's Compensation and federal Energy Employee Illness Compensation. Chemical intakes are notoriously ignored or inaccurate. Workers are denied access to their radiological dose information unless they conduct Freedom of Information Act (FOIA) requests, branding themselves as trouble-makers. The lack of independent scrutiny of worker dose assessments is a continuing problem, where DOE contractors have a conflict of interest and who want to avoid penalties for worker exposures. [14] [15]

Finally, this meeting which was postponed and then a date reset on short notice, is held in Washington DC rather than Idaho. It is being held the same day as one of the few Idaho Cleanup Project Citizens Advisory Board meetings. I am grateful for the opportunity to provide public comment in writing; however, the impression had been given that phone-in public comments would be accepted. I am not optimistic that enough public scrutiny of the DOE's actions will be provided by the meeting. And I am wondering how many more accidents involving transuranic waste will happen before anything changes.

Concerning the Waste Drums that Blew Up, the Department of Energy Blows Off the DNFSB's Concerns

Of the four transuranic waste drums that blew their lids many feet in the air, expelling waste from the drums last April 2018, the Department of Energy Idaho Operations Office has stated in writing that **"There was no explosion during the April 11, 2018 event at the Accelerated Retrieval Project V facility**, nor was hydrogen a contributing factor. The event was caused by

[13] Environmental Defense Institute newsletter article: "Radiological Release to ATR Complex Evap Pond," http://www.environmental-defense-institute.org/publications/News.17.August.pdf (This footnote, added for clarity, was not included in original comment submittal to DNFSB)

[14] Environmental Defense Institute newsletter articles include: "Oxidative stress causes a wide range of health problems," and "Energy Employee Illness Compensation radiation cohort expanded, now includes 1963 to 1974" http://www.environmental-defense-institute.org/publications/News.17.Aprilt.pdf (This footnote, added for clarity, was not included in original comment submittal to DNFSB)

[15] Environmental Defense Institute newsletter article: "Ralph Stanton's "Nuclear Nightmare" – A "Must Read" for Radiation Workers and Their Families" http://www.environmental-defense-institute.org/publications/News.19.June.pdf and "Our Nuclear Nightmare" at http://www.environmental-defense-institute.org/publications/OURNUCLEARNIGHTMARE.pdf (This footnote, added for clarity, was not included in original comment submittal to DNFSB)

the heating of unoxidized uranium that led to the hydrolysis reaction of beryllium carbide that resulted in rapid methane gas generation of sufficient pressure to overcome the drum lids." [16]

The declaration that the four drums were simply "overpressurized" is contrary to the Department's own safety analysis guidance in DOE-STD-5506-2007. [17]

In response to the Defense Nuclear Facilities Safety Board written concerns over the gas buildup issue in waste drums documented in a DNFSB tech staff report, *Idaho Waste Drums with Elevated Methane Concentrations*, [18] the Department of Energy issued a letter [19] which basically blows off the DNFSB's concerns. The Department of Energy basically said that it had *already* strengthened its processes and controls regarding transuranic waste including requiring chemical compatibility evaluations — ***like the chemical compatibility evaluations required by hazardous waste laws that Fluor Idaho had not conducted on the waste stream involved with the four drums that exploded***. The Department of Energy did commit to identify how many drums have not had their head space gas levels sampled and identify what facility controls **are already in place** for drums found to contain flammable or near-flammable conditions, to mitigate deflagration hazards.

The DNFSB tech staff report specifically found that the DOE Idaho Operations Office and Fluor Idaho had not put in place controls to prevent the packaging of drums with elevated methane concentrations, that the DOE's safety basis included unsupported assumptions about the ability of filter vents to keep a drum below lower flammability limits (LFLs), and that other controls, already in effect before the April 2018 event, also may be ineffective in preventing or mitigating methane deflagrations in product drums.

Regarding the concern that there are unidentified waste drums with elevated methane concentrations, the Department of Energy stated that **the Idaho Cleanup Project has approximately 10,884 contact handled transuranic (CH-TRU) drums awaiting flammable gas measurement**. The drum types and general locations in Idaho are as follows:

- Accelerated Retrieval Project (ARP): 5,314-55 gal. drums
- Sludge Repackage Project (SRP): 226-55 gal. drums
- Product Drums: 5,231-100 gal. drums

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[16] Idaho Cleanup Project Citizens Advisory Board, ICP CAB, answers to questions submitted April 25, 2019 and answers provided June 20, 2019 at https://www.energy.gov/em/icpcab/idaho-cleanup-project-citizens-advisory-board-icp-cab

[17] DOE Standard, "Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities," DOE-STD-5506-2007, April 2007. https://www.dnfsb.gov/sites/default/files/meeting/DOE%20STD%205506-2007%20Safety%20Basis%20for%20TRU%20Facility.pdf

[18] Defense Nuclear Facilities Safety Board, Letter to Secretary of Energy, March 12, 2019 with attached staff report "Idaho Waste Drums with Elevated Methane Concentrations," dated December 10, 2018 See dnfsb.org or https://ehss.energy.gov/deprep/2019/FB19M12A.PDF

[19] Department of Energy letter, Jeff C. Griffin, Ph.D., Associate Principal Deputy Assistant Secretary for Field Operations to The Honorable Bruce Hamilton, Chairman, Defense Nuclear Facilities Safety Board, May 7, 2019, https://www.dnfsb.gov/sites/default/files/meeting/May%207%202019%20DOE%20Response%20to%20Board%20Idaho%20Letter.pdf

- Legacy Waste Drums: 113-55 gal. drums

Newly packaged drums are stored for undefined periods before drum headspace flammable gas measurements are made because the gas measurements are not made until preparing to ship the drums to WIPP. And even if drum headspace gas measurements indicate elevated gas levels, the hazard of breaching the drum [20] and releasing the waste may still not be adequately mitigated in order to protect workers and prevent a release to the environment.

The Department of Energy stated in writing for an Idaho Cleanup Project Citizens Advisory Board meeting question that **there are 155 drums that have been previously tested for flammable gas measurement and exceeded Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria.** These drums will need additional work to meet the WIPP Waste Acceptance Criteria. [21] "These containers are stored in a number of locations such as the [Advanced Mixed Waste Treatment Project's] WMF-636, Transuranic Storage Area – Retrieval Enclosure, or a Type II Storage Module (e.g., WMF-629, 630, 631, 632, or 633). They are tracked in the Waste Tracking System and are inspected per the RCRA permit requirements."

The reasons for the elevated levels of flammable gases have not been understood. Neither has the behavior of the gas concentrations, which have fluctuated rather than steadily declined over time. Based on the data, including the dates of gas measurements provided in the DNFSB staff report, it appears to me that a hot summer could influence the production of higher levels of methane and/or hydrogen gas buildup in the drums. Part of the problem, as I see it, is the poor understanding of the constituents in the waste — which chemicals and radionuclides and in what concentrations. What goes for "acceptable knowledge" for the transuranic waste may entirely leave out a constituent, its properties, or that it is a significant quantity.

The Hazardous Waste Numbers (HWN) assigned to the waste stored or treated at various facilities in Idaho are listed in a summary of Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) Part A Permit Applications for the Idaho National Laboratory and the Advanced Mixed Waste Treatment Project (AMWTP). [22]

As an example, the HWNs for the AMWTP Waste Storage Facility (including WMF-628) are shown below. The HWN for reactive materials is D003, but when the reactive constituent is a radionuclide regulated under the Atomic Energy Act, such as uranium, it is not assigned an HWN. There are no HWN D003 "reactive" materials included in RWMC or AMWTP facilities

[20] Rod E. Arbon et al., Idaho Cleanup Project Core, Prepared for DOE EM, "Technical Analysis of Drum Lid Ejections – ARP V," RPT-1662, December 2018. https://www.dnfsb.gov/sites/default/files/meeting/RPT-1662%20ARP%20V%20Technical%20Analysis.pdf

[21] Idaho Cleanup Project Citizens Advisory Board, ICP CAB, answers to questions submitted April 25, 2019 and answers provided June 20, 2019 at https://www.energy.gov/em/icpcab/idaho-cleanup-project-citizens-advisory-board-icp-cab

[22] Idaho Cleanup Project, "Summary of the Part A for FWMA/RCRA Units at the Idaho National Laboratory," Revision February 19, 2019. https://idahocleanupproject.com/Content/documents/Community/01A-FINAL%20Part%20A%20Summary-Rev_2-19-19.pdf

listed in Fluor Idaho's Part A Permit document. So, while EPA regulations state that certain radionuclides are regulated under the Atomic Energy Act, nonetheless, chemical compatibility evaluations for transuranic waste operations at the Idaho Cleanup Project need to and have included consideration of the radionuclides present, including plutonium and uranium. The problem is that no one bothered to pay attention to the extent that the amount and form of the uranium, in the case of the four drums that exploded, differed from what had been assumed in previous similar chemical compatibility evaluations. [23] [24] As the DNFSB has pointed out, lessons from past fires and explosions were not learned. [25] [26] And the importance of the assumption in chemical compatibility analyses, as typically conducted, that the materials remain at ambient temperatures, was not recognized.

ENVIRONMENTAL PROTECTION AGENCY HAZARDOUS WASTE NUMBER(s):

D-LISTED	F-LISTED	K-LISTED	P-LISTED	U-LISTED		
D001-D002 D004-D011 D018-D043	F001-F007 F009 F039	Not Applicable	P005 P012 P015 P022 P024 P027-P028 P030-P031 P056 P073 P075 P077 P098-P099 P104-P106 P113 P116 P119-P120	U002-U004 U007 U009 U012 U014 U019-U020 U032 U037 U043-U044 U048 U052 U069-U070 U072 U078-U081 U083-U084 U102-U103	U105 U108 U116 U118 U120 U122-U123 U127-U128 U131 U133-135 U138 U140 U144-U145 U147 U151 U154 U159	U162 U165U169- U171 U182 U188 U190-U191 U196 U201 U204 U207-U211 U215 U217-U220 U225-U228 U239 U328

To decipher what these codes mean, we take a look at Environmental Protection Agency documents that define the hazardous waste codes and their corresponding wastes. [27] A partial list of HWNs typically relevant to the RWMC is provided in Table 1.

[23] John R. Dick, and Brent N. Burton, INEEL, Bechtel BWXT Idaho, LLC, Prepared for DOE EM, "Evaluation of Chemical Compatibilities of the OU 7-10 Glovebox Excavator Method Project," INEEL/EXT-01-01587, June 2002. https://ar.icp.doe.gov/images/pdf/200304/2003041100126KAH.pdf

[24] John R. Dick et al., Idaho Cleanup Project, CH2M-WG Idaho, LLC, "Chemical Compatibility and Inventory Evaluation for the Accelerated Retrieval Project and the Accelerated Retrieval Project II," EDF-5307, August 9, 2006. https://ar.icp.doe.gov/images/pdf/200608/2006081600834TUA.pdf

[25] Kevin Daniels et al., Idaho Cleanup Project, CH2M-WG Idaho, LLC, "Independent Investigation Report of the November 2005 Drum Fire at the Idaho National Laboratory Site," RPT-190, March 2006. https://ar.icp.doe.gov/images/pdf/200605/2006051600209TUA.pdf

[26] Idaho Cleanup Project Core, "Formal Cause Analysis for the ARP V (WFM-1617) Drum Event at the RWMC," October 2018. https://fluor-idaho.com/Portals/0/Documents/04_%20Community/8283498_RPT-1659.pdf

[27] U.S. Environmental Protection Agency, Hazardous Waste Characteristics, October 2009 at https://www.epa.gov/sites/production/files/2016-01/documents/hw-char.pdf for D-Listing and Hazardous Waste

Table 1. Hazardous waste numbers (HWNs) and their corresponding wastes, a partial list.

HWN	Description	HWN	Description
D-List			
D001	Ignitability	D025	p-Cresol
D002	Corrosivity	D026	Cresol
D003	Reactivity	D027	1,4-Dichlorobenzene
D004	Arsenic	D028	1,2-Dichloroethane
D005	Barium	D029	1,1-Dichloroethylene
D006	Cadmium	D030	2,4-Dinitrotoluene
D007	Chromium	D031	Heptachlor (and its epoxide)
D008	Lead	D032	Hexachlorobenzene
D009	Mercury	D033	Hexachlorobutadiene
D010	Selenium	D034	Hexachloroethane
D011	Silver	D035	Methyl ethyl ketone
D012	Endrin	D036	Nitrobenzene
D018	Benzene	D037	Pentachlorophenol
D019	Carbon tetrachloride	D038	Pyridine
D020	Chlordane	D039	Tetrachloroethylene
D021	Chlorobenzene	D040	Trichloroethylene
D022	Chloroform	D041	2,4,5-Trichlorophenol
D023	o-Cresol	D042	2,4,6-Trichlorophenol
D024	m-Cresol	D043	Vinyl chloride
F-List			
F001	The following spent halogenated solvents: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons.	F020 – F023 and F026 – F028	Dioxin bearing wastes … tri-, tetra-, or pentachlorophenol Tetra-, penta-, or hexachlorobenzenes…
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-	F024 and F025	Wastes from production of certain chlorinated aliphatic hydrocarbons

Listings, September 2012 at https://www.epa.gov/sites/production/files/2016-01/documents/hw_listref_sep2012.pdf for P- and U-Listing.

HWN	Description	HWN	Description
	trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1-2-trichloroethane; … [mixtures]		
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexance, and methanol; … [mixtures]	F032, F034, F035	Wastes from wood preserving… …chlorophenolic formulations, …creosote…… inorganic preservatives containing arsenic or chromium…
F004	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures	F037 – F038	Petroleum refinery wastewater treatment sludges …
F005	The following spent non-halogenated solvents: Toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; … [mixtures]	F039	Multisource leachate
F006 – F012, and F019	Wastes from electroplating and other metal finishing operations, …cyanides… sludges from the chemical conversion coating of aluminum		
K Waste	**(Usually not listed in transuranic waste)**		
P Waste	**(partial list)**		
P005	Allyl alcohol	P075	Nicotine, & salts
P012	Arsenic oxide	P077	p-Nitroaniline
P015	Beryllium powder	P098	Potassium cyanide
P022	Carbon disulfide	P099	Potassium silver cyanide
P024	Benzenamine, 4-chloro-	P104	Silver cyanide

HWN	Description	HWN	Description
P027	3-Chloropropionitrile	P105	Sodium azide
P028	Benzene, (chloromethyl)-	P106	Sodium cyanide
P030	Cyanides (soluble cyanide salts), not otherwise specified	P113	Thallium oxide
P031	Cyanogen	P116	Thiosemicarbazide
P056	Fluorine	P119	Vanadic acid, ammonium salt
P073	Nickel carbonyl	P120	Vanadium oxide or pentoxide
U-List	**(partial list)**		
U002	Acetone 2-Propanone (I)	U135	Hydrogen sulfide
U003	Acetonitrile	U138	Methane, iodo- Methyl idodide
U004	Acetophenone Ethanone- 1-phenyl-	U140	Isobutyl alcohol (I,T) 1-Propanol, 2-methyl- (I,T)
U007	Acrylamide 2-Propenamide	U144	Acetic acid, lead(2+) salt Lead acetate
U009	Acrylonitrile 2-Propenenitrile	U145	Lead phosphate Phosphoric acid, lead(2+) salt
U012	Aniline	U146	Lead, bis(acetate-O)tetrahydroxytri- Lead subacetate
U014	Auramine	U147	2,5-Furandione Maleic anhydride
U019	Benzene (I,T)	U151	Mercury
U020	Benzenesulfonic acid chloride (C,R) Benzenesulfonyl chloride (C,R)	U154	Methanol (I) Methyl alcohol (I)
U032	Calcium chromate Chromic acid, calcium salt	U159	2-Butanone (I,T) Methyl ethyl ketone (MEK) (I,T)
U037	Chlorobenzene Benzene, chloro-	U162	Methyl methacrylate (I,T) 2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U043	Ethene, chloro- Vinyl chloride	U165	Naphthalene
U044	Chloroform	U169	Benzene, nitro-

HWN	Description	HWN	Description
	Methane, trichloro-		Nitrobenzene (I,T)
U048	o-Chlorophenol Phenol, 2-chloro-	U170	p-Nitrophenol Phenol, 4-nitro-
U052	Cresol (Crysylic acid) Phenol, methyl-	U171	2-Nitropropane (I,T) Propane, 2-nitro- (I,T)
U069	Dibutyl phthalate 1,2-Benzenedicarboxylic acid, dibutyle ester, Dibutyl phthalate	U182	Paraldehyde 1,3,5-Troxane, 2,4,6-trimethyl-
U070	Benzene, 1,2-dichloro- o-Dichlorobenzene	U188	Phenol
U072	Benzene, 1,4-dichloro- p-Dichlorobenzene	U190	1,3-Isobenzofurandione Phthalic anhydride
U078	1,1-Dichloroethylene Ethene, 1,1-dichloro-	U191	2-Picoline Pyridine, 2-methyl-
U079	1,2-Dichloroethylene Ethene, 1,2-dichloro-, (E)-	U196	Pyridine
U080	Methane, dichloro- Methylene chloride	U201	1,3-Benzenediol Resorcinol
U081	2,4-Dichlorophenol Phenol, 2,4-dichloro-	U204	Selenious acid Selenium dioxide
U083	Propane, 1,2-dichloro- Propylene dichloride	U207	Benzene, 1,2,4,5-tetrachloro- 1,2,4,5-tetrachlorobenzene
U084	1,3-Dichlorophenol 1-Propene, 1,3-dichloro-	U208	Ethane, 1,1,1,2-tetrachloro- 1,1,1,2-Tetrachloroethane
U102	1,2-Benzenedicarboxylic acid, dimethyl ester Dimethyl phthalate	U209	Ethane, 1,1,2,2-tetrachloro- 1,1,2,2-Tetrachloroethane
U103	Dimethyl sulfate Sulfuric acid, dimethyl ester	U210	Ethene, tetrachloro- Tetrachloroethylene
U105	Benzene, 1-methyl-2,4-dinitro- 2,4-Dinitrotoluene	U211	Carbon tetrachloride Methane, tetrachloro-
U108	1,4-Diethyleneoxide	U215	Carbonic acid, dithallium(1+) salt

HWN	Description	HWN	Description
	1,4-Dioxane		Thallium(I) carbonate
U116	Ethylenethiourea 2-Imidazolidinethione	U217	Nitric acid, thallium(1+) salt Thallium(I) nitrate
U118	Ethyl methacrylate 2-Propenoic acid, 2-methyl-,ethyl ester	U218	Ethanethioamide Thioacetamide
U120	Fluranthene	U219	Thiourea
U122	Formaldehyde	U220	Benzene, methyl- Toluene
U123	Formic acid (C,T)	U225	Bromoform Methan, tribromo-
U127	Benzene, hexachloro- Hexachlorobenzene	U226	Ethane, 1,1,1-trichloro- Methyl chloroform 1,1,1-Trichloroethane
U128	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-	U227	Ethane, 1,1,2-trichloro 1,1,2-Trichloroethane
U131	Ethane, hexachloro- Hexachlorobutadiene	U228	Ethene, trichloro- Trichloroethylene
U133	Hydrazine (R,T)	U239	Benzene, dimethyl- (I,T) Xylene (I)
U134	Hydrofluoric acid (C,T) Hydrogen fluoride (C,T)	U328	Benzenamine, 2-methyl- o-Toluidine

Table notes: This is a partial listing derived from U.S. Environmental Protection Agency, Hazardous Waste Characteristics, October 2009 at https://www.epa.gov/sites/production/files/2016-01/documents/hw-char.pdf for D-Listing and Hazardous Waste Listings, September 2012 at https://www.epa.gov/sites/production/files/2016-01/documents/hw_listref_sep2012.pdf for P- and U-Listing.

Idaho Cleanup Project Citizens Advisory Board Meeting on June 20, 2019, IWTU Status

The June 20, 2019 Idaho Cleanup Project Citizens Advisory Board was held in Fort Hall, Idaho. [28] The meeting was lightly attended and had a light schedule. As usual, the latest news for the Integrated Waste Treatment Unit (IWTU) was that testing was ongoing, had uncovered some problems, and there was no schedule for when the facility would begin treating liquid radioactive

[28] Idaho Cleanup Project Citizens Advisory Board, June 2019 meeting in Fort Hall, https://www.energy.gov/em/icpcab/downloads/icp-cab-meeting-materials-june-2019

waste that it was slated to have completed treating in 2012. The liquid sodium bearing waste stored in decades-old tanks at the Idaho National Laboratory is High-Level Waste that the Department of Energy has long wanted to reclassify as transuranic Low-Level Waste.

The IWTU had completed a test run and the results were still being evaluated. It seemed that the Denitration Mineralization Reformer (DMR) had performed satisfactorily, but there were obvious problems with Process Gas Filter performance. Additional testing at the Colorado Hazen Research facility are planned. More design changes are expected.

After the IWTU has conducted a Contractor Readiness Assessment, at some time in the future in preparation for radioactive waste operations, testing of off-gas emissions will be conducted with Idaho Department of Environmental Quality oversight to establish final air permit conditions when the radioactive tank waste is processed.

In response to questions about the potential IWTU air emissions [29] when the sodium-bearing waste is processed, the Department of Energy stated that Carbon Monoxide and Carbon Dioxide will be continuously monitored.

Regarding the IWTU potential radiological air emissions, the requirements specified in 40 Code of Federal Regulations (CFR) 61, Subpart H requires limiting the estimated releases to not exceed an effective dose of 10 millirem per year. Particulate filter monitoring will be tested monthly for gamma emitters (cesium137, Barium-137m), total strontium-90, and actinides (americium-241, plutonium-238, plutonium-239/240). An activated charcoal filter will also be analyzed for iodine-129, but only quarterly. The radionuclide inventory of the sodium-bearing waste includes a large amount of long-lived transuranic radionuclides as well as iodine-129.[30]

The particulate filters will be analyzed once per week for the first four weeks of operation and then monthly for the remainder of the expected several years of processing of waste using the IWTU.

Idaho Cleanup Project Citizens Advisory Board Meeting on June 20, 2019, Transuranic and Mixed Waste Status

The June 20, 2019 Idaho Cleanup Project Citizens Advisory Board was held in Fort Hall, Idaho [31] gave a status on transuranic and mixed low-level radioactive waste at the Radioactive Waste Management Complex and the Advanced Mixed Waste Treatment Project.

Of decades of waste buried at the Radioactive Waste Management Complex Subsurface Disposal Area, or burial ground, a few years of Rocky Flats waste disposal was exhumed prior to

[29] Idaho Cleanup Project Citizens Advisory Board, April 2019, "Recently Asked Questions" Answers posted June 20, 2019. https://www.energy.gov/em/icpcab/recently-asked-questions

[30] C. M. Barnes et al., "Feed Composition for the Sodium-Bearing Waste Treatment Process," INEEL/EXT-2000-01378, Rev. 8, September 2003. https://inldigitallibrary.inl.gov/sites/STI/STI/3156999.pdf#search=INEEL%2FEXT%2D2000%2D01378

[31] Idaho Cleanup Project Citizens Advisory Board, June 2019 meeting in Fort Hall, https://www.energy.gov/em/icpcab/downloads/icp-cab-meeting-materials-june-2019

the 1980s as shipments continued from Rocky Flats. The exhumed drums and transuranic waste drums from Rocky Flats that continued to arrive in Idaho were stored above ground at what is now the Advanced Mixed Waste Treatment Project. These legacy drums exhumed from the burial ground include the waste that had been repackaged at the Accelerated Retrieval Project (ARP) V when four drums exploded last April 2018.

Most of the buried waste remains buried and is planned to remain buried. Of the 97-acre burial ground, waste was buried in 35 acres. Of the 35 acres of buried waste, only 5.69 acres are designated to be sifted through to exhume "targeted" waste. 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. The "targeted" waste includes: [32]

- 741 Sludge: Fairly homogenous solid of salt precipitate containing plutonium and americium oxides, and organic constituents
- 742 Sludge: Fairly homogenous solid of salt precipitate containing plutonium and americium oxides, metal oxides, and organic constituents
- 743 Sludge: Paste or grease-like solidified organic liquid containing hazardous solvents and calcium silicate
- Graphite Waste: Broken graphite mold chunks and poly bottles of fine particles (e.g., graphite scarfings) containing residual plutonium

The targeted waste includes discarded filters and pre-filters, high-efficiency particulate air (HEPA) filters contaminated with transuranic and uranium radionuclides. It includes uranium roaster oxides, "with some uranium metal possible." The Idaho Department of Environmental Quality knew this, yet didn't worry about whether the treatment facilities and processes were designed to safely treat the unroasted uranium. And the Idaho DEQ, complicit with the Department of Energy, does not discuss that the majority of buried transuranic waste is staying buried, nor that all of the non-transuranic radioactive waste and most of the chemical waste is staying buried.

Of nine Accelerated Retrieval Project (ARP) exhumations, the first eight have been completed. Only ARP IX remains to be completed. Of the targeted waste, 88 percent of the targeted waste has been exhumed. But unfortunately, over 90 percent of the buried transuranic waste, is remaining buried. For simplicity and due to the significance of the americium-241 to the estimated migration of radionuclides from the burial ground, let's discuss the amount of americium-241 that is not being exhumed from the burial ground. In fact, over 90 percent of the americium-241 is remaining buried, of 230,000 curies of americium-241, after completing buried waste exhumation, an estimated 215,000 curies will remain buried according to composite analysis calculations. [33] [34] [35] The buried americium-241 is not the only

[32] Presentation to the Citizens Advisory Board, by Mark K. Clough, Idaho Department of Environmental Quality, "State Oversight of the Buried Targeted Waste CERCLA Exhumation Project," January 14, 2015.

[33] See the July 2017 EDI newsletter for a timeline for the burial ground at the Radioactive Waste Management Complex and other cleanup information at http://www.environmental-defense-institute.org/publications/News.17.July.pdf

radionuclide that contributes to contaminant migration, but it was the dominant contributor according to the buried waste performance assessment.

Of the transuranic waste, there remain 5,849 cubic meters in Idaho and of the burial ground exhumed waste, there remain 3,079 cubic meters of waste exhumed and 800 cubic meters remaining to be exhumed. One 55-gal drum holds 0.208 cubic meters. So, the number of 55-gallon drums are 28,120 transuranic waste drums from above-ground storage and 14,802 drums of exhumed transuranic waste and 3846 drums to be exhumed. [36]

The issues are (1) Difficult waste streams and (2) Waste certification challenges. Few details were provided at the ICP Citizens Advisory Board meeting. For remote-handled waste, apparently there is a need to establish "an alternative transport and disposal package." Again, there were few details about the problems.

The exhumation of buried waste at the Radioactive Waste Management Complex is being conducted at the Accelerated Retrieval Project IX, as organic vapor extraction continues. There are an estimated 800 cubic meters of targeted waste in 0.69 acres of targeted waste to exhume.[37] Challenges include degraded drums as well as concrete and steel remnants of previous Accelerated Retrieval Project structures. The 30 feet deep Subsurface Disposal Area soil cap design is expected to be designed by this September.

There was a presentation of the AMWTP treatment of large items, like glove boxes, from Mound in Ohio. They have treated this waste stream contaminated with plutonium-238 and other transuranic radionuclides for about a year, beginning in April 2018. The last Mound box was

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[34] 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. (Newly released because of Environmental Defense Institute's Freedom of Information Act request.) See https://www.inl.gov/about-inl/general-information/doe-public-reading-room/

[35] See the CERCLA administrative record at www.ar.icp.doe.gov (previously at ar.inel.gov) and see also Parsons, Alva M., James M. McCarthy, M. Kay Adler Flitton, Renee Y. Bowser, and Dale A. Cresap, Annual Performance Assessment and Composite Analysis Review for the Active Low-Level Waste Disposal Facility at the RWMC FY 2013, RPT-1267, 2014, Idaho Cleanup Project. And see Prepared for Department of Energy Idaho Operations Office, Phase 1 Interim Remedial Action Report for Operable Unit 7-13/14 Targeted Waste Retrievals, DOE/ID-11396, Revision 3, October 2014 https://ar.inl.gov/images/pdf/201411/20141103009 60BRU.pdf

[36] See Department of Energy presentations on transuranic waste and buried waste to the Idaho Cleanup Project Citizens Advisory Board on February 21, 2019, on June 20, 2019, and also to the Idaho Leadership in Nuclear Energy Commission meeting on May 16, 2019.

[37] Nathan Brown, *The Idaho Falls Post Register*, "Fluor says just .69 acres of waste left at desert complex," April 23, 2019. As most news articles, this one gives the false impression that all the radioactive waste is being exhumed. The "targeted" waste is focused on the most chemically laden waste and more than 90 percent of the transuranic waste buried at the Subsurface Disposal Area will remain buried. This article says that "several feet of gravel and soil will cap the 130 acres" where just about 5 acres of waste have been exhumed. The reality is that the cap will have to cover to 25 ft high Pad A and will have to be about 30 ft thick in areas. The Department of Energy has been deliberately vague in stating that the soil and gravel cap with be half the height of existing buildings at the Radioactive Waste Management Complex. Many of these structures are about 60 feet high, see DOE/ID-11396, Rev. 3, 2014, Table 4.

completed April 18, 2019. The Mound boxes, glove boxes, included a box with 789 million disintegrations per minute (DPM) of loose alpha; 1.5 billion DPM fixed. Waste was transported to the Idaho site years ago, and was transported from the Transuranic Storage Retrieval Enclosure at the Advanced Mixed Waste Treatment Project to the Accelerated Retrieval Project VII facility during the last year. After being reduced in size, the Mound box contents were transported to the AMWTP's boxlines and then crushed in the supercompactor prior to shipment to the Waste Isolation Pilot Plant for disposal.

The AMWTP had been expected to complete waste treatment in July. [38] But given the recent problems that the AMWTP seems to be having in sorting out what the appropriate fire suppression measures should be, and the retracted State hazardous waste permit modification for treating waste more heavily laden with unroasted uranium, it appears that AMWTP waste treatment completion may be delayed. [39] [40]

Elevated Levels of Plutonium and Americium Detected in the Second Quarter of 2018, Several Potential INL Sources

According to the air filter analysis conducted by a Department of Energy contractor for environmental monitoring on the IdahoESER.com website, "Alpha-emitting radionuclides ^{238}Pu, $^{239/240}$Pu, and ^{241}Am were detected in the Van Buren Gate filter composite at elevated levels compared to historical measurements by the ESER program." [41] "This was also one of the infrequent times americium and plutonium isotopes have been detected together in an ESER Program filter composite. Thorough examination of quality assurance and control data, including analytical results from blanks and performance evaluation samples, does not suggest inadvertent contamination of the filter in the field or laboratory. Although the measurements were elevated, they are well below public health standards (i.e., DCSs) and therefore do not represent a public health concern."

[38] Nathan Brown, *The Idaho Falls Post Register*, "Involuntary layoffs expected at AMWTP later this year," May 17, 2019.

[39] Fluor Idaho letter, May 29, 2019, "Notification of a Class 2 Permit Modification and Request for Temporary Authorization for the Advanced Mixed Waste Treatment Project Hazardous Waste Management Act/Resource Conservation and Recovery Act Permit Located on the Idaho National Laboratory, EPA ID No. ID43890008952. https://inldigitallibrary.inl.gov/PRR/168663.pdf#search=AMWTP%20%22Class%202%22%20RCRA

[40] Fluor Idaho letter, June 13, 2019 "Notification of Retraction of a Class 2 Permit Modification with a Request for Temporary Authorization for the Advanced Mixed Waste Treatment Project Hazardous Waste Management Act/Resource Conservation and Recovery Act Permit Located on the Idaho National Laboratory, EPA ID No. ID43890008952. "The primary purpose of this retraction is to allow the Permittee [Fluor Idaho and the Department of Energy] to include additional information regarding the technical basis, justification, and level of detail for the proposed changes being made at the AMWTP prior to resubmittal of the revised Class 2 PMR/RTA."

[41] INL Environmental Surveillance, Education and Research Program, Managed by Veolia Nuclear Solutions – Federal Services, www.idahoeser.com, Second Quarter 2018 INL Quarterly Site Environmental Report, VNS-ID-ESER-SURV-058, http://www.idahoeser.com/Quarterlies/2018Q2/air.html

The 2018 Second Quarter report, further states: "A possible source of the radionuclides measured in the Van Buren Gate sample is the Radioactive Waste Management Complex (RWMC). Plutonium isotopes and ^{241}Am are often detected in low-volume air filters collected around the Subsurface Disposal Area, as well as in soil contaminated from past flooding (in 1962 and 1969) of pits and trenches containing transuranic waste originating from the Rocky Flats Plant. The Van Buren Gate is also situated in the predominant downwind direction from the RWMC. This and other possible sources will be investigated further."

Curiously, the four drums exploded at the RWMC in the second quarter of 2018. Also, the Mound Box Project with plutonium-238 and transuranic radionuclide contamination was moving the waste between facilities.

DOE Slow Walks Calcine to Nowhere

The CAB meeting had a presentation on High-Level waste called calcine stored at the Idaho National Laboratory, with a disturbing shift in policy taking form. Despite the discussion of the Idaho Settlement Agreement milestone to have the "calcine ready for disposal outside the State of Idaho by December 31, 2035," and the NEPA Record of Decision in 2008 that selected Hot Isostatic Press as the treatment option for the calcine, and the RCRA Part B permit for the Hot Isostatic Press treatment process submitted to the State of Idaho in 2012, it appears that we are back to square one. [42]

And it appears to me, that DOE is very close to proposing leave the calcine in place. The DOE at the EM meetings is emphasizing that there is no repository and none on the horizon. So, why spend money readying waste for a repository that does not exist? This is deeply troubling, as is the hinting that "In Situ Entombment" is perfectly acceptable despite some stakeholder concerns.

In its contrived "independent" study of calcine disposition alternatives, the scoring of various disposal options was chosen as follows:

Safety (10%)

Regulatory Compliance (10%)

Technical Feasibility (27.5%)

Operability and Maintainability (15%)

Cost and Schedule (27.5%)

Stakeholder Acceptance (10%)

[42] Idaho Cleanup Project Citizens Advisory Board, June 2019 meeting in Fort Hall, https://www.energy.gov/em/icpcab/downloads/icp-cab-meeting-materials-june-2019 , Independent Analysis of Alternatives for Disposition of the Idaho Calcined High-Level Waste Inventory at https://www.energy.gov/sites/prod/files/2019/06/f64/Volume%201%20Calcine%20AoA%20Final%2004-19-16%20w_signatures.pdf

The calcine as currently stored in bin sets is in a flood plain and is seismically vulnerable. The calcine is highly soluble and poses a risk to the aquifer as well as to an above-ground release.

For more information about the high-level waste calcine at the Idaho National Laboratory, see our Environmental Defense Institute June 2018, June 2017 and July 2017 newsletters and calcine comments including 2016 comments. [43]

In Table 2, the radionuclide inventory of the stored calcine is compared to the buried radioactive waste that is not being exhumed and to the new replacement for RWMC.

Table 2. Calcine bin set total radionuclide inventory comparison to the waste that will remain buried at RWMC and to the replacement for RWMC.

Radionuclide (half life)	Calcine Inventory (curies)	Buried (existing) RWMC Inventory (curies)	Buried (future) Replacement RH-LLW Inventory (curies)
Carbon-14 (5730 year)	0.038	731	432
Chlorine-36 (301,000 year)	0	1.66	260
Iodine-129 (17,000,000 year)	**1.6**	0.188	0.133
Technetium-99 (213,000 year)	**4600**	42.3	16.7
Neptunium-237 (2,144,000 year)	**470**	0.141	0.003
Uranium-232 (68.9 year)	1.6	10.6	0.00036
Uranium-233 (159,000 year) Product bred from U-235 and thorium, also decay of Np-237	0.057	2.12	0.0001
7Uranium-234 (245,500 year) Pu-238 decay product	**130**	63.9	0.0012
Uranium-235 (703,800,000 year)	**3.2**	4.92	0.005
Uranium-236 (23,400,000 year) Pu-240 decay product	**11**	1.45	0.0001
Uranium-237 (0.0185 year to Np-237)	**1.5**	-	-
Uranium-238 (4,470,000,000 year)	3.1	148	16.2
Thorium-228 (1.92 year to radium-224) Natural thorium decay and Pu-240 decay product	1.6	10.5	-
Americium-241	12,000	215,000	0.38

[43] Calcined Solids Storage Comment Submittal (Docket No. 10W-1604), by Chuck Broscious and Tami Thatcher, July 11, 2016. http://www.environmental-defense-institute.org/publications/EDICalcineComments.pdf

(423 y decays to Np-237)			
Plutonium-238 (87.7 year)	**110,000**	2080	-
Plutonum-239 (24,000 year)	**48,000**	64,100	-

* Calcine inventory from DOE/EIS-0287; RWMC buried waste inventory from DOE/NE-ID-11243/11244 (figures cited may not be the latest estimates); replacement remote-handled facility INL-EXT-11-23102.
**Bold highlighting of calcine inventory indicates a similar or larger inventory than the buried RWMC waste. The RWMC buried waste is estimated by the DOE to yield 100 mrem/yr doses in drinking water for millennia unless a perfect soil cap limits the estimated doses to be 30 mrem/yr. Importantly, the inevitable spikes in contamination due to flooding have not been accounted for despite RWMC flooding in 1963 and 1969. The dose estimates are not conservative. The assumed dilution factors are not consistent with past INL aquifer contamination migration. Calcine migration Kd coefficients may be different than used for RWMC and may worsen the effect of calcine in the soil.

Table 3 provides some additional perspective on the large inventory of radioactive material in the calcine bin sets. It would require 1,975,000,000 billion liters of water (or over 800 Snake River Plain aquifers) to dilute the strontium-90/y-90 in calcine storage to federal drinking water standards. It would require 7,300,000 billion liters of water (or over 3 Snake River Plain aquifers) to dilute the Pu-238 stored in the calcine to federal drinking water standards. It should also be pointed out that these figures are presented as though only a single contaminant were present. In reality, the health detriment of the combination of all contaminants in the drinking water must be considered. This is a point often overlooked by the Idaho Department of Environmental Quality as IDEQ surveys the contamination in the aquifer, dismissing any result below federal drinking water standards which have, for tritium and hexavalent chromium been found to not be protective of human health, especially when consumed over a lifetime. [44]

Table 3. Perspective on the quantity of radionuclides in the stored calcine.

Radionuclide (half life)	Inventory (curie)	Maximum Contaminant Level	Dilution volume (Liter) [b]	Number of Aquifers to Dilute
Sr-90/Y-90 (Sr-90 29.1 year)	15,800,000	8 pCi/L	1.975E+18 1,975,000,000 billion	809
Cs-137/Ba-137m (30.2 year)	17,300,000	160 pCi/L	1.081E+17 108,000,000 billion	44
C-14 (5,730 yr)	0.038	2000 pCi/L	1.90E+7 0.019 billion	<<1
Cl-36 (301,000 yr)	0	700 pCi/L	0	0
I-129 (17,000,000 yr)	1.6	1 pCi/L	1.6E+12 1600 billion	<<1
Tc-99 (2213,000 yr)	4600	900 pCi/L	5.11E+12 5110 billion	0.002

[44] See www.environmental-defense-institute.org for discussion of more stringent tritium and hexavalent chromium regulations and public health goals that the current EPA federal drinking water standards.

Np-237 (2,144,000 yr)	470	15 pCi/L[a]	3.13E+13 31,300 billion	0.0128
U-234 (245,500 yr)	130	15 pCi/L[a]	8.67E+12 8,670 billion	0.00355
Am-241 (432 yr to Np-237)	12,000	15 pCi/L[a]	8.0E+14 800,000 billion	0.378
Plutonium-238 (87.7 year)	110,000	15 pCi/L[a]	7.3E+15 7,300,000 billion	3
Plutonum-239 (24,000 year)	48,000	15 pCi/L[a]	3.2E15 3,200,000 billion	1.3

a. The unit of 1 picoCurie/liter is 1.E-12 curie/liter. The limit is 15 pCi/L for total alpha (40 CFR 141). For uranium, total natural uranium limit of 30 microgram/liter for all combined uranium isotopes.
b. Aquifer volume of 2.44E+15 liters is assumed.
c. The dilution volume ignores soil adsorption and migration delay timing; it is provided to give some perspective on the amount of waste involved. It ignores that fact that the entire aquifer is not going to be involved with dilution, although waste in the aquifer can fan out and involve a considerable portion of the aquifer downstream.

The graph of the migration of the buried waste at RWMC that will remain at RWMC buried in soil is shown below in Figure 1. The contamination migration is not realistically modeled by the DOE nor is it conservatively modeled. Flooding and fast paths of contaminant migration are ignored. [45] The ingestion doses will undoubtedly exceed the 30 to 100 mrem/yr radiation doses shown, intermittently at least. The CERCLA cleanup ignored doses after 10,000 years. Check out how, even after 100,000 years, the long lived radioactive waste, including americium-241, various plutonium and uranium isotopes, iodine-129, neptunium-237 and technetium-99, remains an ingestion hazard, even with the modeling assumptions biased toward retention in the burial grounds.

[45] 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.

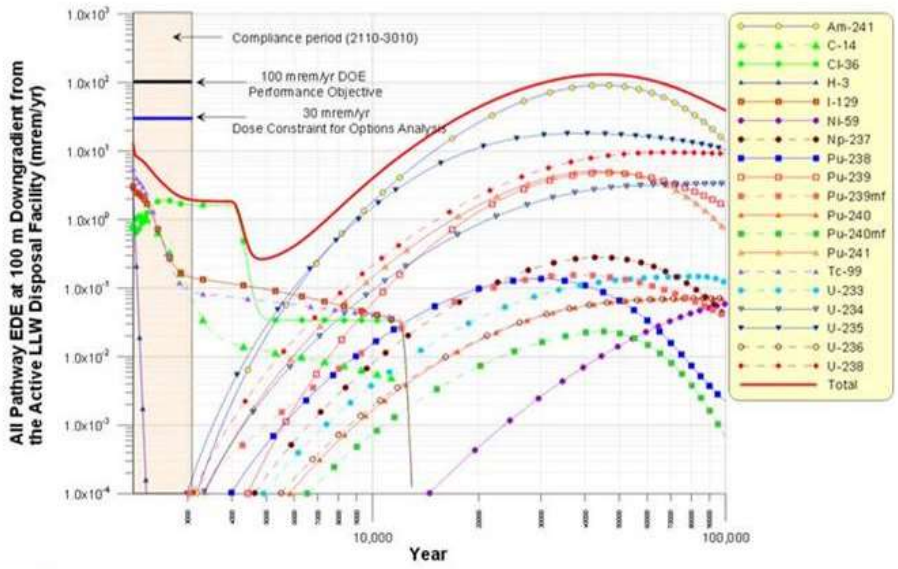

Figure 4-2. All-pathways effective dose equivalent 100 m downgradient from the Radioactive Waste Management Complex boundary from year 2110 to year 100,000 with cover infiltration rate equal to 1 cm/year.

Figure 1. All-pathways radiation dose for the Radioactive Waste Management Complex from DOE/NE-ID-11243 and DOE/NE-ID-11244. Americium-241, uranium-235, uranium-238, and plutonium-239 are top contributors to ingestion dose after 10,000 years. Beware, however, that contamination migration by the DOE appears to be modeled with a bias toward delaying the release timing to be after 10,000 years. The EPA ignores post-10,000 contamination in its INL CERLCA cleanup.

Articles by Tami Thatcher for July 2019.